An Annotated Bibliography of the Cytogenetics of the Chironomidae (Diptera)

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(with corrections)

JON MARTIN

Department of Genetics, University of Melbourne
Parkville, Victoria, 3052, Australia

Abstract

This Bibliography of 1312 entries is a comprehensive listing of the references, including abstracts and theses, pertaining to the cytogenetics of Chironomidae up to the end of 1990. A brief note of the contents is given except in the case of a few references that were unobtainable. A list of the species to which reference is made is appended to each entry, amended where necessary to the present usage.

Introduction

This Bibliography provides a comprehensive coverage of the literature relating to the cytogenetics of Chironomidae up to the end of 1990, including not just published papers but also abstracts and theses where such references could be obtained. The major cytological contents of the articles are summarised and attention drawn to related studies, particularly where such work has led to different conclusions or where later work has distinguished between alternative explanations. Where they can be identified, the species used are listed and indexed according to the nature of the investigation. Since there has been a considerable revision of generic and specific limits within the Chironomidae in recent years, the latter often directly as a result of cytogenetic studies, it has been important to correct specific names in line with current usage wherever possible. The original and present names are given with the article, but only the present name is indexed.

Chironomidae have been used extensively for cytogenetic studies, although the majority of the work has utilised the polytene chromosomes of the salivary glands, particularly in the Chironomini. This emphasis tended to be due to a belief that the other tribes and subfamilies did not have polytenes of such good quality. However, a number of studies have now shown that this is not necessarily true and such studies have revealed some features not present in the Chironomini.

Polytene chromosomes were first identified in the salivary glands of *Chironomus plumosus* by E.G.Balbiani in 1881. They were subsequently used extensively for studies on the structure of such chromosomes. These studies provoked a controversy that was not finally resolved until the 1940's. Studies with chironomids then took second place to those using Drosophila, because of the much better Mendelian genetics of that organism, for use in studies such as gene mapping and determining the relationships between genes and polytene bands. However there has been a continuing interest in the large puffs of chironomid polytenes, particularly the Balbiani rings, which have contributed much to our knowledge of gene action in higher eucaryotes. In recent years these cytological studies have extended to extensive molecular analysis of the genes involved, the dividing line between cytogenetics and molecular genetics becoming very blurred.

There has also been an ongoing interest in the chromosomal rearrangements, mostly inversions, which may be recognized in the polytene chromosomes. Interspecific rearrangements have been used to follow the cytoevolution of genera, in particular the genus *Chironomus*. Since so many species differ by chromosomal rearrangements there has been speculation on the possible role of chromosomal rearrangements in speciation. Intraspecific inversions have often only been recorded with regard to frequency and geographic distribution, but some studies have investigated their role in the adaptation of populations to their habitat. Often these studies have revealed that species recognized on morphological grounds are complexes of two or more species. The species may differ by fixed inversions or there may be apparent polymorphism but with a significant deficiency of heterozygotes, indicative of subdivision of the population. Recognition of cytologically distinct species necessitates a

reassessment of which species in a complex were actually used in earlier studies. Such a reassessment has been attempted in this work.

Heteromorphic sex chromosomes have so far been reported only for two species of Orthocladiinae.

However in other groups there have been sporadic reports of inversions showing complete or partial sex linkage. Detailed analysis of such inversions in the genus *Chironomus* has revealed the existence of a dominant male determining gene that varies in chromosomal location both within and between species.

The mitotic and meiotic chromosomes of the Chironomidae are small and, therefore, have not been extensively studied. Those studies that have been carried out have revealed, amongst other things, the occurrence of somatic pairing in mitosis, the chromosome elimination system of the Orthocladiinae, and non-homologous pairing of inverted regions in heterozygotes at pachytene.

Acknowledgments

I am grateful to Dr Rory J. Post, Department of Biological Sciences, University of Salford, for editorial advice during the preparation of this work, which was originally intended as one chapter of a comprehensive bibliography of dipteran cytogenetics. Also to Dr Odwin Hoffrichter, Institut für Biologie I, Freiburg Universität, for providing me with copies of many otherwise unobtainable European references. The Natural History Museum provided a small grant to assist with the costs of obtaining reference material.

Bibliography

Acton, A.B. 1955a. Selective value of chromosome inversions in *Chironomus*. *Proceedings of the Royal Physical Society*, Edinburgh **26**: 10-14.
Studied natural populations of *Chironomus tentans* in Scotland in order to determine whether selection was operating on the inversion polymorphisms. A significant excess of cases where 3La and 3R occurred together was found in two populations and in laboratory crosses where the larvae were reared under poor conditions. Near Glasgow, where 3La is replaced by 3L, there appears to be an excess of 3R with 3L.

Specialised subjects: Inversions - adaptive significance, - non-random associations
Species: *Chironomus tentans*

Acton, A.B. 1955b. Larval groups in the subgenus *Chironomus* Meigen. *Archiv für Hydrobiologie* **50**: 64-75.
Confusion has arisen in the literature concerning the possibility that a single species of *Chironomus* can arise from two distinct types of larvae. It is suggested that this arises from incorrect identification of the adults and that the problem can be resolved by using the polytene chromosomes. This is illustrated by the polytene chromosomes of *Chironomus thummi* [=*C. riparius*] and *C. dorsalis* [=*C. luridus*], which are quite distinct although the adults of these two species are sometimes confused.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus dorsalis* [=*C. luridus*], *C. thummi* [=*C. riparius*]

Acton, A.B. 1956a. Crossing over within the inverted regions in *Chironomus*. *American Naturalist* **90**: 63-65.
Investigated individuals heterozygous for inversions to determine whether crossing over occurred within the inverted regions. The observation of bridges and fragments at anaphase I of meiosis in the testes of prepupae, plus the finding of an aberrant chromosome in a salivary gland cell, indicated that such crossing over did occur.

Specialised subjects: Inversions - male meiosis
Species: *Chironomus dorsalis* [=*C. luridus*]

Acton, A.B. 1956b. Chromosomal polymorphism in *Chironomus*. *Proceedings of the Royal Society*, B **145**: 347-350.
Reviews the extent of chromosomal polymorphism in *Chironomus*.

Specialised subjects: Inversions - polymorphy
Species: *Chironomus dorsalis* [=*C. luridus*], *C. pallidivittatus, C. tentans,*

Acton, A.B. 1957a. Chromosome inversions in natural populations of *Chironomus tentans*. *Journal of Genetics* **55**: 61-94.
Studied seven populations from the British Isles, including one sampled over a year to test for seasonal variations in frequency. Inversions were generally those reported from Europe, some showing male-linked inheritance. Records four species hybrids and one larva with a duplication and deficiency amongst 1036 studied in one population. Concludes that inversions are maintained by selection.

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus tentans*
Acton, A.B. 1957b. Chromosome inversions in natural populations of *Chironomus dorsalis*. *Journal of Genetics* **55**: 261-275.
Studied a number of populations of *C. dorsalis* [=*C. luridus*] in England and Scotland, finding considerable differences between certain localities. Found that some chromosome rearrangements occur more often in one sex than in the other, indicating sex linkage. Reports occurrence of bridges and fragments at meiosis of inversion heterozygotes. An individual heterozygous for a reciprocal translocation was found.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus dorsalis* [=*C. luridus*]

Acton, A.B. 1957c. Sex chromosome inversions in *Chironomus*. *American Naturalist* **91**: 57-59.
Discusses cases in which heterozygotes for particular inversions are found only in males, or more frequently in males.

Specialised subjects: Sex chromosomes, Inversions - polymorphy
Species: *Chironomus annularius, C. cingulatus, C. dorsalis* [=*C. luridus*], *C. plumosus, C. tentans*
Acton, A.B. 1958a. The gene contents of overlapping inversions. *American Naturalist* **92**: 57-58.
Cites data from *Chironomus tentans* to support Wallace's (1953) argument that only two of the three members of an overlapping triad will be common at any locality. The Toronto population is, however, an exception.

Specialised subjects: General Dipteran Cytogenetics, Inversions - triads
Species: *Chironomus tentans*
Acton, A.B. 1958b. A cytological comparison of Nearctic and Palaearctic representatives of *Chironomus tentans* (Diptera). *Proceedings of the Linnean Society of London* **169**: 129-131.
Describes the cytological differences between European and Canadian populations. Hybridisation can occur between individuals from the two areas and fertility does not appear to be reduced. The implications of these findings for the specific status of populations in the two areas are discussed.

Specialised subjects: Incipient species, Hybrids
Species: *Chironomus tentans*
Acton, A.B. 1959. A study of the differences between widely separated populations of *Chironomus* (=*Tendipes*) *tentans* (Diptera). *Proceedings of the Royal Society of London* **151B**: 277-296.
C. tentans occurs in both Europe and Canada but populations differ in the inversions present. Diagrammatic maps of the chromosomes are presented. Chromosomes 2 and 3 are different on the two sides of the Atlantic. While four inversions occur on both sides, the other inversions occur only in Canada or only in Europe. The findings suggest there is little migration between Canada and Europe.

Specialised subjects: Incipient species; Inversions - geographical distribution
Species: *Chironomus tentans*
Acton, A.B. 1962. Incipient taxonomic divergence in *Chironomus* (Diptera)? *Evolution* **16**: 330-337.
Additional samples of *Chironomus tentans* from North America, including Alaska, were analysed to further investigate differences between North American and European populations. The Alaskan population proved to have the same basic pattern as found in Europe but showed some floating inversions typical of Canadian populations as well as one typical of Europe and two endemic inversions. This suggests that the barrier to migration between populations may have been the ice cap of one of the North American glacial periods.

Specialised subjects: Incipient species; Inversions - geographical distribution
Species: *Chironomus tentans*
Acton, A.B. 1965. *Chironomus tentans* (Diptera): the giant chromosomes and taxonomic divergence. *Proceedings of the XIIth International Congress of Entomology*, *London*, *1964*: 245. (Abstract)
Essentially repeats the information in Acton (1962).

Specialised subjects: Incipient species; Inversions - geographical distribution
Species: *Chironomus tentans*
Acton, A.B. 1966. The gigant chromosoms (*sic*) as evidence of allopatric speciation. *Gewässer und Abwässer* **41/42**: 21 (Abstract)
Refers back to Acton (1965).

Specialised subjects: Incipient species
Species: *Chironomus tentans*
Acton, A.B. 1969. On the significance of rare inversions. *American Naturalist* **103**: 543-546.
In response to a paper by Van Valen & Levins (1968) making predictions on the origin of

inversion polymorphisms, data is presented to show that in *Chironomus* rare inversions are much more likely to be short (less than 5% of the length of the chromosome). These inversions are, therefore, less likely to become established than longer inversions, indicating that temporary linkage disequilibrium is not a significant factor in the establishment of inversions. It is suggested that such inversions may disrupt previously existing coadapted complexes and therefore be selected against.

Specialised subjects: General Dipteran Cytogenetics: Inversions - length distribution
Species: *Chironomus dorsalis* [=*C. luridus*], *C. pallidivittatus*, *C. piger*, *C. tentans, C. thummi* [=*C. riparius*]

Acton, A.B. & Scudder, G.G.E. 1971. The zoogeography and races of *Chironomus* (=*Tendipes*) *tentans* Fab. *Third International Symposium of Chironomid Research, Moscow, 1968. Limnologica* **8**: 83-92. (English and Russian summaries)
C. tentans has a holarctic distribution but is not uniform throughout its range. It can be divided into four chromosomal races on the basis of the basic pattern of the chromosome banding and the complement of polymorphic inversions, as described in this paper, in Acton (1957a, 1958, 1959, 1962) and in Beermann (1955). The races are called the "European", "Alaskan", "West Canadian" and "East Canadian". It is postulated that they arose by allopatric selection following the invasion of North America.

Specialised subjects: Incipient species, Inversions - geographical distribution
Species: *Chironomus tentans*

Agapova, O.A. & Kiknadze, I.I. 1985*a*. Organisation and expression of genes coding tissue specific secretory proteins of the salivary gland of Chironomidae, pp. 96-100, 204, 218. *In* Salganik, R.I. (ed.) *Organisation and expression of genes of tissue-specific functions in Diptera*. 237pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
Provides background information on the development and structure of the Balbiani rings of *Chironomus thummi* [=*C. riparius*]. Separate photographs on p. 204 and pp. 218. (Partim)

Specialised subjects: Puffs - Balbiani rings, tissue specificity
Species: *Chironomus thummi* [=*C. riparius*]

Agapova, O.A. & Kiknadze, I.I. 1985*b*. Organisation of the secretory process in salivary gland cells of chironomids, pp.126-131, 229-232. *In* Salganik, R.I. (ed.) *Organisation and expression of genes of tissue-specific functions in Diptera*. 237pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
This article discusses the part played by puffs in secretion and includes a drawing showing the polytene chromosomes arranged against the nuclear membrane of the cell. (Partim)

Specialised subjects: Puffs - Balbiani rings, secretory activity
Species: *Chironomus thummi* [=*C. riparius*]

Albuquerque, R.M. & Serra, J.A. 1951. Caracteres da heterocromatina an cromosomas gigantes de Dipteros. *Memó□rias e Estudos Museu zoológico de Universidade de Coimbra* **209**: 1-9. (English summary)
Heterochromatic regions, especially at the centromere, of the larval salivary gland chromosomes are described and depicted in a member of the *Chironomus thummi* group compared with *Drosophila melanogaster*.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus thummi* gp.

Alfert, M. 1954. Composition and structure of giant chromosomes. *International Review of Cytology* **3**: 131-175.
Reviews studies on the morphology and structure of polytene chromosomes in the light of the three main theories for their structure. Concludes that the polytene theory appears to be the best supported by the available evidence. Also notes the absence of a chromocentre and the variable degree of end-to-end association, attributed to heterochromatin, in *Chironomus*. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* [=*Cryptochironomus*] *defectus, C. plumosus*, *C. thummi* [=*C. riparius*], *C. tentans*

Aller, P. 1982. Effect of incubation and translation inhibitors on the transcriptional activity in salivary glands of *Chironomus thummi*. *Cell Differentiation* **11**: 203-209.
Salivary glands were incubated in synthetic media, with and without the addition of protein inhibitors. The synthetic media reduced the activity of uridine uptake and its incorporation into RNA. The effect was reduced to some extent following brief treatment with protein inhibitors. The only visible cytological effect was some regression of the Balbiani rings in the synthetic media. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus thummi* [=*C. riparius*]
Aller, P. & Reifas, J.S. 1983. Changes in the nucleolar structure and activity following short *in vivo* treatments with cyclohexamide and emitine in polytene cells of *Chironomus thummi*. *Cytobios* **37**: 27-36.
Treatment of larvae with cyclohexamide or emitine resulted in decreased activity of the nucleolar pre-ribosomal transcription. Cyclohexamide produced a change in nucleolar structure and in the pattern of uridine incorporation. Such changes were less marked in the case of emitine. Illustrated by photographs.

Specialised subjects: Nucleolus; Chromosomal morphology
Species: *Chironomus thummi* [=*C. riparius*]
Allfrey, V.G., Pogo, B.G.T., Littau, V.C., Gershey, E.L. & Mirsky, A.E. 1968. Histone acetylation in insect chromosomes. *Science* **159**: 314-316.
It is demonstrated that the normal fixatives preferentially remove highly acetylated "arginine-rich" histones from polytene chromosomes, thus probably accounting for the reported absence of histone acetylation in *Drosophila melanogaster*. However sufficient remains for it to be demonstrated by autoradiography, that acetylation of histones takes place along the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] when RNA synthesis is active.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]
Allison, L., Arndt-Jovin, D.J., Gratzner, H., Ternynck, T. & Robert-Nicoud, M. 1985. Mapping of the pattern of DNA replication in polytene chromosomes from *Chironomus thummi* using monoclonal anti-bromodeoxyuridine antibodies. *Cytometry* **6**: 584-590.
Describe a technique using monoclonal antibodies to BrdU for studying the pattern of DNA replication in the polytene chromosomes. The technique is claimed to be superior to the auto-radiographic technique usually used as it allows resolution at the level of one chromosomal band. The patterns are described and illustrated by photographs.

Specialised subjects: Techniques; Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]
Almeida, J.C. de, & Edström, J.-E. 1983. Inhibition of Balbiani ring transcription following differential arrest of Balbiani ring-coded translation. *Chromosoma* **88**: 343-348.
Treatment with cyclohexamide, with or without emetine, lead to puff regression and inhibition of translation of the large Balbiani rings, BR1 and BR2. It is suggested that this effect is due to control emanating from the translational process. Low cyclohexamine plus emetine lead to increased levels of RNA in nucleoli. A photograph indicating the effect of treatment on the salivary glands shows the polytene chromosomes within the nuclei. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*
Alverdes, F. 1912a. Die Entwicklung des Kernfadens in der Speicheldrüse der *Chironomus*-Larve. *Zoologischer Anzeiger* **39**: 1-6.
Describes the structure and development of the chromosomes and, particularly, of the nucleolus in the nuclei of salivary gland cells.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus plumosus*
Alverdes, F. 1912b. Die Kerne in den Speicheldrüsen der *Chironomus*-Larve. *Archiv für Zellforschung* **9**: 168-204.
Reviews the earlier work on the structure of the salivary gland chromosomes of *Chironomus*, which had lead to two theories on the nature of the crossbands. Attempts to decide the question by studying the development of the chromosomes in the salivary gland cells, mainly of *Chironomus plumosus*, and concludes that the differences are due to changes in appearance as the larvae grow. The changes are illustrated by many line drawings. He notes the absence of mitosis in these cells and figures binucleate cells, presumably due to fusion of cells, but ascribed to amitosis. He also notes the chromatic nature of the nucleolus.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus plumosus*, *C. thummi* [=*C. riparius*], *Orthocladius* species
Alverdes, F. 1913. Nochmals über die Kerne in den Speicheldrüsen der *Chironomus*-Larve. *Zoologischer Anzeiger* **42**: 565-574.
Used a variety of staining techniques in an attempt to clarify the nature of various structures in the nucleus of the cells in the larval salivary gland in an unspecified species of *Chironomus*, probably *C. plumosus*. Amongst the structures investigated are

the nucleolus, the Balbiani rings and the "achromatin". (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus, Puffs - structure
Species: *Chironomus* species [?=*C. plumosus*]

Ambrose, E.J. & Gopal-Ayengar, A.R. 1952. Molecular organization in giant chromosomes. *Nature* **169**: 652-653.
Experimental swelling of polytene chromosomes in distilled water, along with dichroism following vital staining with neutral red, indicates the presence of long chain molecules lying parallel to the length of the chromosome thread. Combined with the evidence of D'Angelo (1946), that the fresh chromosomes can be stretched reversibly up to 5 times the original length of the nucleus, the results indicate the presence of an orderly folding of molecules within the chromosome.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species
Ambrose, E.J. & Gopal-Ayengar, A.R. 1953. Molecular orientation and chromosome breakage. *Symposium on Chromosome Breakage, 1952. Heredity* **6**(*Supplement*): 277-292.
Comparisons between the behaviour of fresh salivary gland chromosomes and oriented nucleo-protein fibres, in various salt concentrations in electric fields and in reagents which affect hydrogen bonds, suggest that the main lateral forces of cohesion within the chromosome are of an electro-static character controlled mainly by the dimensions of the electrical double layer. The longitudinal cohesive forces appear to be largely due to hydrogen bonds. It is suggested that the chromosomes consist of threads produced by the adhesion of anisotropic particles by means of hydrogen bonds. Studies of dichroism suggest that the salivary chromosomes contain macromolecules which are folded to a high degree in an organised manner. It is further suggested that radiomimetic drugs affect chromosomes by blocking certain functions of the nucleo-protein.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species
Ambrose, E.J., Cuckow, F.W. & Gopal-Ayengar, A.R. 1955. The molecular organization and fine structure of chromosomes. *Fine structure of cells. Eighth Congress of Cell Biology, Leiden, 1954*: 191-194.
Electron microscope studies of *Chironomus* larvae of different ages showed the presence of microfibrils, of diameter 100-200Å, running along their length in the interband regions. The number, but not the dimensions, of the fibrils increased with increasing size of the larvae. This was interpreted to indicate that the chromosomes increase in size by duplication of the number of the fibrils.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species
Amrein, K.E. 1986. *Charakterisierung eines Gens von* Chironomus tentans *aus dem 20-OH-Ecdyson regulierten Puff I-18c*. Doktors der Wissenschaften,
Eidgenössischen Technischen Hochschule, Zürich, Switzerland. (English summary)
Characterises a clone from the region of the I-18c puff. This puff is regulated by ecdysone and the effect is illustrated in a plate of photographs. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*
Andersson, K., Björkroth, B. & Daneholt, B. 1980. The *in situ* structure of the active 75S RNA genes in Balbiani rings of *Chironomus tentans*. *Experimental Cell Research* **130**: 313-326.
The nature of the ribonucleoprotein fibres, as well as that of the chromosome filament, of the Balbiani rings were studied by electron microscopy. Since the chromosomal axis was only 5 nm in these transcriptionally active genes, compared to estimates of 25 nm in other parts of the chromosome, this infers that the filament is uncoiled during transcription, a conclusion supported by the rapid reformation of a 25 nm fibre at the completion of transcription.

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus tentans*
Andersson, K., Björkroth, B. & Daneholt, B. 1982. Rapid reformation of the thick chromatin fibre after completion of RNA synthesis at the Balbiani ring genes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 5.
Abstract of the studies published in Andersson *et al*. (1982).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*
Andersson, K., Mähr, R., Björkroth, B. & Daneholt, B. 1982. Rapid formation of the thick chromosome fibre upon completion of RNA synthesis at the Balbiani ring genes in *Chironomus tentans*. *Chromosoma* **87**: 33-48.

The nucleoside analogue DRB was used to facilitate investigation of changes in the appearance of Balbiani rings and the chromatin fibres during transcriptional activity. The results are illustrated by photographs and electron micrographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Ankel, W.E. 1938. Neue Wege bei der Erforschung des Chromosoms. *Natur und Volk* **68**: 419-427.
Reviews recent work on chromosomes. Notes that the chromosomes in the salivary glands of chironomids are 100-200 times larger than those of other body cells. The banded nature can be seen in stained and unstained preparations. In the genus *Chironomus* there are four polytene chromosomes and the sequence of bands allows chromosome maps to be prepared. Although the species figured are not identified, the photographs suggest that some, if not all, of the material was *Chironomus thummi* [=*C. riparius*].

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*], *C.* species

Anonymous. 1972. Max-Planck-Institut für Biologie, Tübingen. *In*, Die Max-Planck-Gesellschaft zur Föderung der Wissenschaften e. V. Tätigkeits- bericht für die Zeit vom 1.1.1970 bis 31.12.1971. *Experientia* **59**: 551-555.
Reports the studies under way to examine the genetic function of giant chromosomes and repetitive sequences in the DNA. (Partim)

Specialised subjects: Polytene chromosomes - structure; gene activity
Species: *Chironomus nuditarsis*, *C. pallidivittatus*, *C. plumosus*, *C. tentans*, *Prodiamesa olivacea*

Anonymous. 1989. [Tribute to the contribution of Wolfgang Beermann to developmental studies of puffs in *Chironomus* polytene chromosomes.] *Chromosoma* **97(5)**: A1 & A10.
Cover picture of this volume shows chromosome 4 of *Chironomus tentans* after metachromatic staining. The explanation of the photograph pays tribute to Wolfgang Beermann.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Arndt-Jovin, D.J., Robert-Nicoud, M., Zarling, D.A., Greider, C., Weimer, E. & Jovin, T.M. 1983. Left-handed Z-DNA in bands of acid fixed polytene chromosomes. *Proceedings of the National Academy of Sciences* **80**: 4344-4388.
Antibodies to DNA in the Z-configuration bound predominantly to the band regions, particularly at telomeric regions. It is suggested that Z-DNA could be involved in higher order structural organization of chromosomes. Illustrated by many photographs. Hill and others subsequently have suggested this high level of binding is an artefact of acid fixation (Beckmann 1986) (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Ashburner, M. 1970. Function and structure of polytene chromosomes during insect development. *Advances in Insect Physiology* **7**: 1-95.
Reviews the occurrence of polytene chromosomes in different organisms and different tissues of the same organism, and the structure of the chromosomes at various stages of development. Much of the emphasis is on the biochemistry and physiology of puffs, including studies on a number of chironomid species. These studies cover Balbiani rings, hypertrophy due to microsporidian infection, association of the chromosomes with outpockets of the nuclear membrane, differential polyteny of the smallest chromosome of *Anatopynia* [=*Psectrotanypus*] *varius*, and heterochromatin proliferation in *Chironomus melanotus*. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes; Puffs - structure
Species: *Acricotopus lucidus* [=*A. lucens*], *Anatopynia* [=*Psectrotanypus*] *varius, Chironomus dorsalis* [=*C. yoshimatsui*,], *C. melanotus*, *C. pallidivittatus, C. tentans*, *C. thummi* [=*C. riparius*], *C.* species, *Metriocnemus hygropetricus*, *Smittia parthenogenetica*, *Trichocladius* [=*Halocladius*] *vitripennis*

Atchley, W.R. & Davis, B.L. 1979. Chromosomal variability in the Antarctic insect, *Belgica antarctica* (Diptera: Chironomidae). *Annals of the Entomological Society of America* **72**: 246-252.
Describes and illustrates the three polytene chromosomes and gives the limits of five inversions, one of which is sex-linked. Inversion frequencies from 18 localities in the vicinity of Anvers Island, in the Antarctic, are compared. There appeared to be no correlation between inversion frequency and pH, electrical

conductivity, percent organic material, or degree of ecological complexity.

Specialised subjects: Inversions - adaptive significance
Species: *Belgica antarctica*
Atchley, W.R. & Martin, J. 1971. A morphometric analysis of differential sexual dimorphism in larvae of *Chironomus* (Diptera). *The Canadian Entomologist* **103**: 319-327.
The extent of morphological sexual dimorphism in the fourth instar larvae of four species of *Chironomus* parallels the degree of inversion polymorphism, such that the sexes are more discrete in the more polymorphic species. In a fifth species, *C. staegeri*, the sexes showed 40% overlap although the species is highly polymorphic.

Specialised subjects: Inversions - polymorphy
Species: *Chironomus cloacalis*, *C. frommeri*, *C. nepeanensis*, *C. staegeri*, *C. tepperi*
Badaev, N.S., Borisov, Yu.M., Zelenin, A.V. & Iordanskii, A.B. 1973. Diversity of structural heterochromatin in *Chironomus thummi*. *Doklady Akademiia Nauk S.S.S.R.*, **213**: 949-951. (Translated in *Doklady Biological Sciences* **213**: 472-474)
Polytene chromosomes of *C. thummi* [=*C. riparius*] were stained with three different fluorescent stains in order to determine the existence of different types of heterochromatin. At least three types of heterochromatin could be distinguished on the basis of their fluorescence and pairing characteristics. The reason for the different fluorescence characteristics of the three types could not be determined but it was suggested that it may be due to differences in nucleotide composition or sequence, replicability, packing density or the structure of the DNA-protein complex.

Specialised subjects: Heterochromatin
Species: *Chironomus thummi* [=*C. riparius*]
Bäumlein, H. 1977. *Einsatz spezifischer RNA-Fraktionen zur Genom- charakterisierung von* Chironomus thummi *durch Nukleinsäure-hybridisierung*. Ph.D. Thesis, University of Jena, D.D.R.
Reference not seen, but assumed to be essentially same content as Bäumlein & Wobus (1976).

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus thummi* [=*C. riparius*]
Bäumlein, H., Serfling, E. & Wobus, U. 1981. Selective enrichment of Balbiani ring DNA by equilibrium density centrifugation in actinomycin D-CsCl gradients. *Biologisches Zentralblatt* **100**: 285-294. (English and German summary)
Balbiani ring DNA from *Chironomus thummi* [=*C. riparius*] was separated from bulk DNA in actinomycin D-CsCl gradients and *in situ* hybridised to the polytene chromosomes to confirm that separation had been achieved. (Partim)

Specialised subjects: Puffs - Balbiani rings
Species: *Chironomus thummi* [=*C. riparius*]
Bäumlein, H. & Wobus, U. 1976. Chromosomal localization of ribosomal 5S RNA genes in *Chironomus thummi* by in situ hybridization of iodinated 5S RNA. *Chromosoma* **57**: 199-204.
Iodinated 5S RNA hybridised to only a region identified as B3c-e of chromosome II in salivary gland chromosomes of *C. thummi* [=*C. riparius*]. This corresponds to arm C in the system of Keyl (1962) and therefore differs from the sites identified in *C. tentans* (Wieslander, Lambert & Egyhazi 1975) and an Australian species (Martin, Webb & Lee, unpubl.) which are both on arm B. Although there is continuous synthesis of 5S RNA in salivary gland cells there were no clear cut morphological signs of puffing or auto-radiographically detectable incorporation of ^{3}H-uridine in region B3c-e. In one larva the labelling of this region was clearly heterozygous. Illustrated by a photograph of the region of chromosome II and by autoradiographs.

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]
Bäumlein, H., Wobus, U., Gerbi, S.A. & Kafatos, F.C. 1982. The basic repeat unit of a *Chironomus* Balbiani ring gene. *Nucleic Acids Research* **10**: 3893-3904.
In situ hybridisation of a clone, putatively from Balbiani ring BRb, to polytene chromosomes of *Chironomus thummi* [=*C. riparius*], demonstrated that it hybridized only to the site of BRb. Illustrated by photograph. (Partim)

Specialised subjects: Puffs - Balbiani rings
Species: *Chironomus thummi* [=*C. riparius*]
Bäumlein, H., Wobus, U. & Panitz, R. 1982. Molecular analysis of a recombinant lambda phage containing Balbiani ring-DNA. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 6.
A clone of *Chironomus thummi* [=*C. riparius*] genomic DNA, called λChBRc1, was found to hybridise to BRc when used as a probe for *in situ* hybridisation. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]
Balbiani, E.G. 1881. Sur la structur du noyau des cellules salivaires chez les larves de *Chironomus*. *Zoologischer Anzeiger* **4**: 637-666.
Describes the existence, in the salivary gland cells of *Chironomus plumosus*, of a pale cylindrical body convoluted like an intestine, consisting of dark transverse striae regularly alternating with bands of an intermediate clear substance. The cord he considered to be enclosed in a membranous envelope, forming a tube. These are now recognised to be polytene chromosomes. He interpreted the bands as chromatin discs in a matrix or plastin. He noted that the bands were more resistant to deformation. The presence of two nucleoli, which are sometimes fused, and the structures now called Balbiani rings were also noted.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus plumosus*
Barettino, D., Morcillo, G. & Diez, J.-L. 1982. Induction of heat-shock Balbiani rings after RNA synthesis inhibition in polytene chromosomes of *Chironomus thummi*. *Chromosoma* **87**: 507-517.
Most heat-inducible puffs of *C. thummi* [=*C. riparius*] were blocked by RNA synthesis inhibitors, although the heat shock Balbiani ring, T-BR-III, is still induced. The major heat-inducible puff, III-A3b, appeared resistant to DRB treatment. Illustrated by photographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]
Barettino, D., Morcillo, G. & Diez, J.-L. 1988. Induction of the heat shock response by carbon dioxide in *Chironomus thummi*. *Cell Differentiation* **23**: 27-36.
Describe the effects of a set of stress treatments on gene expression in the salivary gland chromosomes. Only in recovery from carbon dioxide was a response similar to heat shock observed. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]
Barettino, D., Morcillo, G., Díez, J.-L., Carretero, M.T. & Carmona, M.J. 1988. Correlation between the activity of a 5,6,-dichloro-1-beta-D-ribo-furanosylbenzimidazole-insensitive puff and the synthesis of major heat shock polypeptide, hsp70, in *Chironomus thummi*. *Biochemistry and Cell Biology* **66**: 1177-1185.
The induction of puff III-A3b,, a major heat-shock puff, was insensitive to the transcription inhibitor DRB, unlike the other heat-shock puffs. A polypeptide apparently similar to hsp70 was synthesised under these conditions, suggesting it is encoded by III-A3b. Puff III-A3b is also less sensitive to low-salt conditions, suggesting it is independent of RNA polymerase II. However it was sensitive to alpha-amanitin, another RNA polymerase II inhibitor, and the enzyme was detected on this and the other heat shock puffs by immunofluorescence with anti-RNA polymerase II antibodies. Illustrated by autoradiographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]
Barigozzi, C. 1937a. Le sostence minerali nei cromosomi delle ghiandole salvari dei ditteri, in relazione alla probabile distribuzione dei geni. *Bollettino Societa italiana di Biologia sperimentale* **12**: 208-209. (Abstract)
Briefly notes some of the mineral contents of the salivary gland chromosomes and how they were determined.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]
Barigozzi, C. 1937b. Primo contributo alla conoscenza di alcussi componenti dei cromosomi (Sostanze minerali e proteine nei cromosomi delle ghiandole salivari di *Chironomus*). *Zeitschrift für Zellforschung und mikroskopische Anatomie* **26**: 462-472. (German summary)
Studied the inorganic substances of salivary gland chromosomes by microincineration and tyrosine containing proteins using Millon's reagent. Microincineration showed that inorganic residues were not present in all parts of the chromosome but the bands showed high ash content. Phosphate salts were interpreted as the residue of nucleic acids, the non-phosphate salts as part of unidentified proteins. Tyrosine or tyrosine-like substances were demonstrated in the chromatic and achromatic parts of the chromosome. Concludes that the chromosomes are comprised of a) bands of nucleic acid, b) proteins which may be shown to be either rich or poor in mineral salts in specific parts, depending on the treatment.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]
Barigozzi, C. 1939. Esperienze di microdissezione sui cromosmi delle ghiandole

salivari di *Chironomus* sp. *V Internationaler Zellforschung- kongress in Zürich, 1938. Archiv für experimentelle Zellforschung besonders Gewebezüchtung* **22**: 190-195.
When the polytene chromosomes of *Chironomus thummi* [=*C. riparius*] were manipulated in amphibian Ringer the chromosomes were refractile and gelatinous and adhered to the needles. They returned to their normal size and appearance after being stretched to double their length, while the diameter decreased when stretched. Under repeated stretchings they first transformed into bundles of parallel longitudinal filaments and then "dissolve" completely. These chromosomes are compared with those of some other animals and plants.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]
Barigozzi, C. 1952. La struttura microscopica del nucleo durante il riposo. *Experientia* **8**: 133-136. (English summary)
Reviews different techniques of studying the resting nucleus and the reliability of the structures seen. Concludes that isolated chromatic threads (chromosomes) are probably closest to the living structures and can provide new information on the spiralisation cycle and on the length of the threads during the stage of gene activity. Deals only partly with polytene chromosomes, the rest concerning mitotic cells in amphibia.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]
Basrur, V.R. 1957a. *Cytotaxonomic studies in blackflies and midges*. Ph.D. thesis, University of Toronto, Toronto, Ontario, Canada.
Studies inversion polymorphism in *Glyptotendipes barbipes*. Published in Basrur (1957*b*). (Partim).

Specialised subjects: Inversions - geographical distribution
Species: *Glyptotendipes barbipes*
Basrur, V.R. 1957b. Inversion polymorphism in the midge *Glyptotendipes barbipes* (Staeger). *Chromosoma* **8**: 597-608.
Describes and figures the inversions found in a Canadian population of *G. barbipes* and compares them to those previously described from Germany. Meiosis in inversion heterozygotes was found to be normal. Two inversions, IS and IIL, appeared to show an excess of heterozygotes suggested, in the case of IS, to be due to lethals since no IS-1/IS-1 larvae were found. This inversion was later shown by Martin & Porter (1973) to be sex-linked, and that there was no need to invoke lethals.

Specialised subjects: Inversions - geographical distribution, adaptive significance
Species: *Glyptotendipes barbipes*
Baudisch, W. 1960. Specifisches Vorkommen von Carotinoiden und Oxyprolin in den Speicheldrüsen von *Acricotopus lucidus*. *Die Naturwissenschaften* **47**: 498-499.
Notes that structural modification of the polytene chromosomes in the three lobes of the salivary glands accompanies slight changes in the secretion of the lobes. The main and accessory lobes produce oxyprolin which is found only in the pupal case, indicating that the secretions of these lobes plays a part in production of the pupal case. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. 1964. Untersuchungen zur physiologischen Charakterisierung der einzelnen speicheldrüsenlappen von *Acricotopus lucidus*. *Struktur und Function des genetischen materials. Erwin-Baur-Gedächtnisverlesungen III, 1963*: 231-234. (English summary)
Cytological investigation of the salivary gland chromosomes of *A. lucidus* [=*A. lucens*] has shown different patterns of puffs and Balbiani-rings in the three lobes of the gland. Therefore chromatographic analysis of the three lobes was carried out. This revealed that in the main and side lobes, hydroxyproline is present although it is absent in the anterior lobe. Additionally, carotenoids are accumulated in the anterior lobe of the prepupae.

Specialised subjects: Polytene chromosomes - tissue differences; Puffs - Balbiani rings
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. 1970. Biochemische Differenzen in den Speicheldrüsen von *Acricotopus lucidus* in Beziehung zum Funktionsmuster der Riesen-chromosomen, pp.20-22. *In* Pfister, C.L. (Ed.), *Ergebnisse der Experimentellen Medizin*. Band 2. *Beitrage zur Molekulargenetik*. 74pp. Veb Verlag Volk & Gesundheit, Berlin.
Summarises the results obtained to date in the comparison of the puffing pattern of the salivary gland chromosomes of *A. lucidus* [=*A. lucens*] with the biochemistry of the lobes of the gland.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. 1976. Protein synthesis and puff pattern in the salivary glands of *Acricotopus lucidus* (Chironomidae). *First International Congress on Cell Biology, Boston, Massachusetts. Journal of Cell Biology* **70**: 406a. (Abstract)
Summarises the data on relationship between the proteins produced in the three lobes of the salivary glands of *A. lucidus* [=*A. lucens*] and the puffing patterns of the polytene chromosomes. Notes that the number of puffs in the anterior lobe equals the number of secretory fractions, while there is no correlation between the number of major puffs and the protein fractions for the other two lobes.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. 1977. Balbiani ring pattern and biochemical activities in the salivary gland of *Acricotopus lucidus* (Chironomidae). *Biochemical differentiation in insect glands. Results and Problems in Cell Differentiation* **8**: 197-212.
A. lucidus [=*A. lucens*] has three polytene chromosomes which show different puffing patterns in each of the three lobes of the salivary glands. The most conspicuous puffs are the Balbiani rings and it is found that the relative amounts of the protein fractions of the secretion is dependent on the sizes of the Balbiani rings. The production of a hydroxyproline-containing protein is prevented by the selective inhibition of Balbiani ring 2, suggesting that the genetic information for this protein is present in Balbiani ring 2.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. 1980. The proteins of the salivary gland secretion and the puffing pattern of *Acricotopus lucidus*. *Proceedings of the Sixth International Symposium on Chironomidae, Prague, 1976. Acta Universitatis Carolinae Biologica* **1978**: 21-26.
Demonstrates that the different proteins secreted by the cells of the anterior lobe of the salivary gland of *A. lucidus* [=*A. lucens*] correspond to a different pattern of Balbiani rings in this lobe. The quantity of protein produced is related to the relative size of the Balbiani ring.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus lucidus* [=*A. lucens*]

Baudisch, W. & Panitz, R. 1968. Kontrolle eines biochemischen merkmale in den Speicheldrüsen von *Acricotopus lucidus* durch einen Balbiani ring. *Experimental Cell Research* **49**: 470-476.
The main and lateral lobes of the salivary gland of *A. lucidus* [=*A. lucens*] synthesise hydroxyproline. When BR-2 is inactivated by treatment with gibberellin A_3 the production of hydroxyproline is inhibited. It is suggested that the BR-2 region codes for the synthesis of a secretion protein containing hydroxyproline.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Acricotopus ucidus* [=*A. lucens*]

Bauer, H. 1935*a*. Die Speicheldrüsenchromosomen der Chironomiden. *Die Naturwissenschaften* **23**: 475-476.
Gives the general features of the polytene chromosomes of chironomids, figuring the chromosome complement of *Chironomus thummi* [=*C. riparius*].

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus bathophilus* [=*C. anthracinus*], *C. dorsalis* [=*C. luridus*], *C. thummi* [=*C. riparius*], *Prodiamesa olivacea*, *Stictochironomus histrio* [=*S. stictus*]

Bauer, H. 1935b. Der Aufbau der Chromosomen aus den Speicheldrüsen von *Chironomus thummi* Kieffer. (Untersuchungen an den Riesenchromosomen der Dipteren. I.). *Zeitschrift fur Zellforschung und Mikroskopische Anatomie* **23**: 280-313.
Describes and figures the polytene complement of *C. thummi* [=*C. riparius*] and provides a chromosome map. Discusses the constancy of appearance of the chromosomes, the closeness of the pairing between homologues, and the structure of the nucleolus on chromosome IV.

Specialised subjects: Polytene chromosomes; Nucleolus - structure
Species: *Chironomus thummi* [=*C. riparius*]

Bauer, H. 1936a. Beiträge zur vergleichenden Morphologie der Speicheldrüsenchromosomen. (Untersuchungen an den Riesenchromosomen der Dipteren. II.). *Zoologische Jahrbücher Abteilung für Allgemeine Zoologie und Physiologie der Tiere* **56**: 239-276.
In 13 of the 16 species of Chironominae studied the chromosome number was n=4, the other three having n=3. Two other Chironomidae, from other

subfamilies, had higher chromosome numbers. *Trichotanypus pectinatus* has n=6, while *Prodiamesa olivacea* is stated to be n=5. This latter figure is higher than that given by Bauer & Beermann (1952b) or Michailova (1977,1980) and appears to be due to chromosome II having broken at the centromere and the inclusion of the heterochromatic B-chromosome as a part of the normal complement. The structure of the polytene chromosomes and of the nucleolus, the pairing of the chromosomes, and the occurrence of inversions is discussed. The polytene chromosomes of *Chironomus plumosus*, *C.* sp.I, *Endochironomus* sp.1, *Glyptotendipes* sp.I, *G. polytomus* [=*G. barbipes*], *Prodiamesa olivacea*, and *Trichotanypus pectinatus* are figured.

Specialised subjects: General Dipteran Cytogenetics, Karyotype - basic chromosome number; Polytene chromosomes; Nucleolus - structure; Inversions
Species: *Chironomus alpestris* [=*C. lacunarius*], *C. bathophilus* [=*C. anthracinus*], *C. dorsalis* [=*C. luridus*], *C. plumosus*, *C.* sp. I [=*C. pallidivittatus*], *C.* sp. II, *Cryptochironomus defectus*, *Endochironomus* sp. I, *E.* sp. II, *Glyptotendipes polytomus* [=*G. barbipes*], *G.* sp. I, *G.* sp. II, *Micropsectra praecox* [=*M. junci*], *Microtendipes pedellus*, *Prodiamesa olivacea*, *Sergentia profundorum* [=*S. coracina*], *Stictochironomus histrio* [=*S. stictus*], *Trichotanypus pectinatus*,

Bauer, H. 1936b. The structure of the salivary gland chromosomes in Chironomidae. *American Naturalist* **70**: 37. (Abstract)
General discussion of the structure and number of chromosomes in a variety of species of chironomid. The chromosome number of *Prodiamesa olivacea* is reduced to n=4 (see Bauer 1936a).

Specialised subjects: Chromosome structure; Karyotype - basic chromosome number
Species: *Chironomus thummi* [=*C. riparius*], *Cryptochironomus defectus*, *Glyptotendipes* spp., *Prodiamesa olivacea*, *Trichotanypus* sp. [?=*T. pectinatus*]

Bauer, H. 1937a. Cytologie. *Fortshritte Zoologie* (1935) **1**: 1-18.
Notes that, unlike *Drosophila*, *Chironomus* does not have a chromocentre. Considers each band to be composed of 16 points (i.e. 8 per homologue), as Bridges (1935) had claimed for *Drosophila*. States that there are over 100 chromonemata in thick chromosomes, and over 20 in smaller nuclei, of *Chironomus thummi* [=*C. riparius*]. In *Cryptochironomus defectus* there are about 350-400 chromonemata. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*], *Cryptochironomus defectus*

Bauer, H. 1937b. Cytologie. *Fortschritte Zoologie* (1936) **2**: 1-14.
Notes that although *Glyptotendipes polytomus* [=*G. barbipes*] has heavy heterochromatin at the centromere, it has no chromocentre. Also notes the existence of multiple nucleoli in *Stictochironomus histrio* [=*S. stictus*]. (Partim)

Specialised subjects: Polytene chromosomes - , Nucleolus - structure
Species: *Glyptotendipes polytomus* [=*G. barbipes*], *Stictochironomus histrio* [=*S. stictus*]

Bauer, H. 1937c. Cytogenetik. *Fortschritte Zoologie* (1936) **2**: 547-570.
Gives limited information on the frequencies of five inversions in *Chironomus pallidivittatus*. Also notes that 13 out of 16 species of Chironominae studied had a karyotype comprising three long V-shaped chromosomes and a short, straight chromosome. In *C. dorsalis* [=*C. luridus*] and *C. thummi* [=*C. riparius*], homologous segments could be recognised in the long chromosomes but not in the short chromosome.

Specialised subjects: Karyotype - basic chromosome number; Inversions - polymorphy
Species: *Chironomus dorsalis* [=*C. luridus*], *C. pallidivittatus*, *C. thummi* [=*C. riparius*]

Bauer, H. 1937d. Neue Ergebnisse der Cytogenetik. *Berichte der physikalisch-medicinische Gesellschaft zu Würzburg* **61**: 70-81.
A general review of work on polytene chromosomes. Includes illustrations of the metaphase and polytene karyotype of *Chironomus thummi* [=*C. riparius*]. (Partim)

Specialised subjects: Polytene chromosomes
Species: *Chironomus thummi* [=*C. riparius*]

Bauer, H. 1945. Chromosomen und Systematik bei Chironomiden. *Archiv für Hydrobiologie* **40**: 994-1008.
Indicates the way in which the polytene chromosomes may be used to differentiate the larvae of closely related species in the

Chironominae. In providing specific examples, the chromosomes of *Chironomus plumosus*, *C. tentans*, *Cryptochironomus defectus* group species 1 and 2, *Sergentia longiventris* and *Sergentia profundorum* [=*S. coracina*] are figured.

Specialised subjects: Cytotaxonomy -polytene chromosomes
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus*, *C.* [=*Chironomus*] *tentans, Cryptochironomus defectus* gp. sp. 1, *C. defectus* gp. sp. 2, *Sergentia coracina*, *S. longiventris*, *Tendipes* [=*Chironomus*] *plumosus, T.* [=*Chironomus*] *thummi* [=*C. riparius*]

Bauer, H. 1952a. Die Chromosomen im Soma der Metazoen. *verhandlungen der deutsche Zoologischen Gesellschaft, 1951. Zoologischer Anzeiger Supplement* **17**: 252-268.
Chromosome numbers can vary between the soma and the germ-line, e.g. in Orthocladiinae such as *Metriocnemus cavicola*, where there are 2 pairs in the soma but from 14 to 28 chromosomes in the germ-line. The effect of such differences within the gonads, and the means by which the elimination of the L-chromosomes is achieved is described. Most nematoceran somatic tissues are polyploid: with up to 2000 chromosome sets. In some tissues polytene chromosomes are formed. The characteristics of these are described, comparing chromosomes from different tissues of different species. Aspects are illustrated by line drawings. (Partim)

Specialised subjects: L-chromosomes; Polytene chromosomes - tissue differences
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*, *Cryptochironomus* species, *Metriocnemus cavicola* [=*M. martinii*], *Trichocladius* [=*Halocladius*] *vitripennis*

Bauer, H. 1953. Die Istanbuler Hypothese von Entwicklung und Bau der Riesenchromosomen. *Verhandlungen der deutsche Zoologischen Gesellschaft,* 1952. *Zoologischer Anzeiger Supplement* **17**: 275-279.
Notes that Sengün and Kosswig (1952*a*) find only relatively minor quantitative differences in the banding of the three long chromosomes of *Chironomus* in different tissues. The greatest differences are in the shortest chromosome, where they are largely due to the different form of the Balbiani rings in the salivary glands.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - tissue differences
Species: *Chironomus* species

Bauer, H. 1957. Chromosomenstruktur und -funktion. Ergebnisse der Untersuchungen an Riesenchromosomen. *Jahrbuch der Max-Planck-Gesellschaft* **1957**: 23-29.
Detailed review of polytene structure and puffing in Chironomidae, with 15 excellent illustrations covering several species.

Specialised subjects: Polytene chromosomes - structure; Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus thummi* [=*C. riparius*], *C. tentans*, *Smittia* species, *Trichocladius* [=*Halocladius*] ?*vitripennis*

Bauer, H. 1970. Rearrangements between germ-line limited and somatic chromosomes in *Smittia parthenogenetica* (Chironomidae, Diptera). *Chromosoma* **32**: 1-10.
On the basis of irradiation induced rearrangements of the chromosomes, it is concluded that the L-chromosomes (see Bauer and Beermann 1952*c*) are probably completely heterochromatic, since any insertion of euchromatic material was explainable by duplication of an S chromosome segment. From the L chromosome cycle it can be inferred that the L-complement consists of more or less identical elements and that genetic isolation has led to their heterochromatinisation.
Specialised subjects: L-Chromosomes - structure; Heterochromatin - somatic loss
Species: *Smittia parthenogenetica*

Bauer, H. & Beermann, W. 1952*a*. Die Polytänie der Riesenchromosomen. *Chromosoma* **4**: 630-648.
Haploid segments of the fourth chromosome of *Chironomus tentans*, resulting from heterozygosity for a large inversion or by pairing with the structurally different fourth chromosome of *C. pallidivittatus*, were studied with respect to the fibrillar structure of the Balbiani rings. Both thick and thin fibrillar bundles were observed, with even the finest bundles showing an organisation of stained and unstained sections. There was no visible connection between the two sides of the puff, from which it was concluded that the connections were made at the periphery of the Balbiani ring by submicroscopically thin fibrils. This supported the polyteny concept in its simplest form, rather than the other hypotheses then also current.

Specialised subjects: Polytene chromosomes - structure; Puffs - Balbiani rings
Species: *Chironomus pallidivittatus, C.tentans*

Bauer, H. & Beermann, W. 1952*b*. Chromosomale Soma-Keimbahn-Differenzierung bei Chironomiden. *Die Naturwissenschaften* **39**: 22-23.
While spermatogenesis in the Chironominae, Diamesinae and Tanypodinae is of the normal chiasmate type, and the number of bivalents in the testis is similar to the haploid number in the salivary glands, in a number of genera of the Orthocladiinae this is not the case. In these genera, which have n=2 or 3 in the salivary glands, the chromosome number in the testes varies considerably between species and between individuals (up to n=23). These chromosomes often do not pair, leading to unequal numbers following spermatogenesis. Differential mitoses also occur in the oogonia. These extra chromosomes are eliminated from the somatic cells. The chromosome number of *Prodiamesa olivacea* is given as n=3, which is lower than previous reports (Bauer 1936b).

Specialised subjects: Karyotype - evolution; Meiosis; L-chromosomes
Species: *Ablabesmyia monilis*, *Eucricotopus* spp. [=*Cricotopus ornatus*, *C. sylvestris*], *Limnophyes* species, *Metriocnemus* spp. [=*M. martinii*, *M. hygropetricus, M. inopinatus*], *Prodiamesa olivacea*, *Psectrocladius* spp. [=*P. obvius*, *P. platypus*, *P. sordidellus*], *Trichocladius* [=*Halocladius*] *vitripennis*

Bauer, H. & Beermann, W. 1952c. Der Chromosomencyclus der Orthocladiinen (Nematocera, Diptera). *Zeitschrift für Naturforschung* **7b**: 557-563.
A survey was made of 14 species from seven different genera of the Orthocladiinae. Except for two species of *Metriocnemus*, where n=2, the number of chromosomes in the soma (S-chromosomes) was three. However in the germ line there were variable numbers of extra chromosomes (L-chromosomes), ranging from 1 to 26. These L-chromosomes are eliminated from the soma in the early cleavage divisions. There is also germ line elimination, by differential mitosis, in which only S-chromosomes pass into one daughter cell which forms either a nurse cell or an aberrant spermatocyte. In addition there is a complicated process of elimination and redivision of the L-chromosomes. Meiosis is normal and the gametes possess a haploid complement of S- and L-chromosomes.

Specialised subjects: L-chromosomes - elimination
Species: *Acricotopus lucidus* [=*A. lucens*], *Clunio marinus*, *Eucricotopus atritarsis* [=*Cricotopus ornatus*], *E. silvestris* [=*C. sylvestris*], *Limnophyes* species, *Metriocnemus cavicola* [=*M. martinii*], *M. hygropetricus*, *M. inopinatus*, *M.* species, *Psectrocladius obvius*, *P. platypus*, *P. remotus* [=*P. sordidellus*], *P.* species, *Trichocladius* [=*Halocladius*] *vitripennis*

Bauer, H. & Caspersson, T. 1949. Cytochemical observations on nucleolus formation in *Chironomus*. *Proceedings VIII International Congress of Genetics*. *Hereditas Supplement* **8**: 533-534.
The nucleolar regions of the polytene chromosomes of certain *Chironomus* species offer particularly good opportunities for studying the synthesis of the nucleolar substances. The split-up of the chromonema bundle in the region of the nucleolus indicates the formation of substances inside the chromosome. This view is supported by cytochemical studies on the nucleolus of *C. thummi* [=*C. riparius*], where the chromosomal parts of the nucleolus show a similar shift in UV absorption to the main body of the nucleolus.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*], *C. tentans*

Beckmann, R. 1986. Giant chromosomes and the Z-DNA story. *Ecos* **50**: 26-27.
In reviewing work at the C.S.I.R.O., Division of Molecular Biology, in Australia, on Z-DNA in polytene chromosomes, it is noted that studies in Germany using *Chironomus* have confirmed that strong binding of antibodies to Z-DNA is an artefact of acid fixation.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Bedo, D.G. 1974. Heterochromatin and disproportionate chromosome replication in *Anatopynia dyari* (Diptera: Chironomidae). *Chromosoma* **48**: 181-190.
Unlike many Tanypodinae, *A.* [=*Psectrocladius*] *dyari* has good quality polytene chromosomes. The mitotic (2n=12) and polytene chromosomes are illustrated. As with *P. varius*, briefly described by Melland (1942), the small acrocentric chromosome is thicker than the other salivary gland chromosomes, assumed to be due to an extra

round of replication. The arm ratios of the mitotic and polytene chromosomes show discrepancies due to under-replication of heterochromatin in the latter. A complex rearrangement, involving most of IIIL, was found in three populations.

Specialised subjects: Polytene chromosomes - heterochromatin replication
Species: *Anatopynia* [=*Psectrotanypus*] *dyari*

Bedo, D.G. & Webb, G.C. 1990. Localization of the 5S RNA genes to arm 2R in polytene chromosomes of *Lucilia cuprina* (Diptera: Calliphoridae). *Genome* **33**: 941-943.
Note that, despite strong binding of a *Drosophila* 5S RNA probe to polytene chromosomes of *Lucilia cuprina,* there is little binding of this probe to polytene chromosomes of *Chironomus*. (Partim)

Specialised subjects: Polytene chromosomes - bands and genesSpecies: *Chironomus oppositus* gp.

Beermann, W. 1950. Chromomerenkonstanz bei *Chironomus*. *Die Naturwissenschaften* **37**: 543-544.
Contrary to what Kosswig & Sengün (1947*a-c*) have written, the polytene chromosome banding pattern in the salivary glands, Malpighian tubules and rectum of fourth instar, and apparently even younger larvae, of *Chironomus tentans* is shown to be effectively the same. Hence it is concluded that there is a constant chromomere constitution in polytene chromosomes of all sorts. Photographs and illustrations of comparable sections from different tissues and ages are provided.

Specialised subjects: Polytene chromosomes - structure, tissue differences
Species: *Chironomus tentans*

Beermann, W. 1952a. Chromomerenkonstanz und specifische Modifikation der Chromosomenstruktur in der Entwicklung und Organdifferenzierung von *Chironomus tentans*. *Chromosoma* **5**: 139-198.
Correlates puffing and other structural changes of the polytene chromosomes with phases of metabolic activity.

Specialised subjects: Polytene chromosomes - structure, tissue differences
Species: *Chironomus tentans*

Beermann, W. 1952b. Chromosomenstruktur und Zelldifferenzierung in der Speicheldrüse von *Trichocladius vitripennis*. *Zeitschrift für Naturforschung* **76**: 237-242.
The basic salivary gland chromosome complement of *T.* [=*Halocladius*] *vitripennis* (n=3) is described, with its two conspicuous nucleoli and several polymorphic inversions. Notes the existence of two types of cells in the salivary glands, normal cells and those containing granules.

Specialised subjects: Polytene chromosomes - tissue differences; Inversions - population studies
Species: *Trichocladius* [=*Halocladius*] *vitripennis*

Beermann, W. 1953. Chromosomen-polymorphismus und Bastardierung zweier *Chironomus*-Arten. *Verhandlungen der deutsche Zoologischen Gesellschaft* 1952, *Zoologischer Anzeiger,* Supplement **17**: 290-295.
Detailed comparison of the salivary gland chromosomes of the sibling species, *Camptochironomus* [=*Chironomus*] *tentans* and *C. pallidivittatus*, and in their hybrids. Inversion rearrangements are mapped on all four pairs of chromosomes against outline drawings. In the F_2 of hybrid crosses, about ten percent triploids are formed from diploid male gametes. Triploid males have reduced fertility due to meiotic abnormalities. The extent of recombination in the hybrids was examined in backcrosses. These indicate that arm 2L is sex linked in both species.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Crossing over
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans*

Beermann, W. 1955a. Cytologische Analyse eines *Camptochironomus*-Artbastards. I. Kreuzungergebnisse und die Evolution des Karyotypus. *Chromosoma* **7**: 198-259.
Provides detailed drawn chromosome maps of all chromosome arms of both *Camptochironomus* [=*Chironomus*] *tentans* and *C. pallidivittatus*, based on a Standard map, and photographs of the chromosome arms of the hybrid. The cytological differences between the species are detailed. Also gives data on inversion frequencies in both species. Chromosome arm 2L is rich in aberrations, while none occur on arm 3R of *C. pallidivittatus*. As well as Y-linked inversions on chromosome 2L, there are also Y-linked inversions on chromosome 1 in some populations. Comparisons of nucleoli and Balbiani rings in both species and their hybrid are given.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Hybridisation; Inversions - sex linked
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans*

Beermann, W. 1955b. Geschlechtsbestimmung und Evolution der genetischen Y-Chromosomen bei *Chironomus*. *Biologisches Zentralblatt* **74**: 525-544.
Genetic sex determination with male heterogamety was established through the identification of the sex linked inheritance of inversions in three *Chironomus* species and of a gene mutation in *C. pallidivittatus*. In *C. tentans*, and probably in *C. pallidivittatus*, sex determiners could be on either chromosome 2L or Chromosome 1. Some sequences of 2L are partially sex linked but 2L-k1 and 1-k1 are always on the Y-chromosome, as is inversion 1R-k1 of *C. annularius*. In all three species the male sex determiner is dominant and probably lies at or in the telomere of the chromosome.

Specialised subjects: Sex chromosomes - Y-chromosome evolution
Species: *Chironomus annularius*, *C. pallidivittatus*, *C. tentans*

Beermann, W. 1956a. Inversions-heterozygotie und Fertilität der Männchen von *Chironomus*. *Chromosoma* **8**: 1-11.
Traces the meiotic consequences of crossing-over within the inversion loop of laboratory-produced heterozygotes for inversion In(t)4-1 of *Chironomus tentans*, providing many plates and drawings. The production of dicentric bridges leads to aberrant spermatogenesis, reduced male fecundity and fertility for these inversion heterozgotes. However it should be noted that this is an unusual situation where the inversion occupies virtually the whole of an acrocentric chromosome. The more usual situation of smaller inversions, particularly in the metacentric chromosomes, was studied by Martin (1967).

Specialised subjects: Inversions - male meiosis, crossing over
Species: *Chironomus tentans*

Beermann, W. 1956b. Nuclear differentiation and functional morphology of chromosomes. *Cold Spring Harbor Symposia on Quantitative Biology* **21**: 217-232.
The chromosome elimination cycle of the Orthocladiinae is used to illustrate unequal distribution of genetic material in germ cell differentiation. Other aspects of differentiation are illustrated from the differential activity of particular regions of polytene chromosomes in different tissues, and by the relationship between the activity of certain Balbiani rings and the production of specific product in different lobes of the salivary glands in some chironomid species. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Cellular differentiation; Puffs - gene product; L-chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*], *Cardiocladius* species, *Chironomus pallidivittatus*, *C. tentans*, *C. thummi* [=*C. riparius*], *Cryptochironomus* species, *Metriocnemus hygropetricus*, *Pseudosmittia arenaria*, *Trichocladius* [=*Cricotopus*] *triannulatus, T.* [=*Halocladius*] *vitripennis* , *Zavrelia* species

Beermann, W. 1959. Chromosomal differentiation in insects. pp.83-103. *In* Rudnick, D. (ed.) *Developmental Cytology*. Ronald, New York.
Reviews the growth and differentiation of polytene chromosomes in *Chironomus*. Compares the development of puffs and bands in the closely related species, *Chironomus tentans* and *C. pallidivittatus*. Concludes that the differential puffing seen in polytene chromosomes is the result of differential gene activation.

Specialised subjects: Polytene chromosomes; Puffs - species differences
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1960. Der Nukleolus als lebenswichtiger Bestandteil des Zellkernes. *Chromosoma* **11**: 263-296. (English summary)
Uses crosses between *Chironomus tentans* and the sibling species *C. pallidivittatus* to show that their nucleoli are not homologous but that all are functionally equivalent. However larvae with no nucleolus regularly die as embryos. An accessory nucleolus, of different structure may occur on the fourth chromosome. The presence of this accessory nucleolus alone is not sufficient to maintain viability. The normal nucleoli may be fractionated by irradiation, and the presence of a single fragment is sufficient to maintain normal development. It is suggested that the nucleolus synthesises a special type of RNA, and that the nucleolus may be an essential link in a feed back mechanism involving RNA-synthesis and protein synthesis.

Specialised subjects: Nucleolus - function, RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1961. Ein Balbiani-ring als Locus einer Speicheldrüsen-Mutation. *Chromosoma* **12**: 1-25. (English summary)
The salivary secretion of *Chironomus tentans* lacks SZ granules, unlike other studied species of *Chironomus*. In crosses between *C. tentans* and *C. pallidivittatus*, it can be shown that the ability to produce these granules is inherited in a simple Mendelian fashion by a gene on chromosome 4. This gene is associated with a Balbiani ring near the centromere of the chromosome, which develops in four special cells in *C. pallidivittatus* but not in *C. tentans*. It is suggested that large puffs, such as the Balbiani rings, may represent loci which supply genetic information for non-enzyme proteins such as the proteins of the saliva.

Specialised subjects: Puffs - Balbiani rings, tissue specificity
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1962*a*. Riesenchromosomen. *Protoplasmatologia. Handbuch der Protoplasmaforschung* **6D**: 1-161.
A detailed review of the state of knowledge of all aspects of polytene chromosomes at the time of publication. In addition to many other figures and photographs, the whole chromosome complement is shown for *Chironomus aberratus*, *C. commutatus*, *C. obtusidens* and *Glyptotendipes barbipes*. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Chromosome structure; Hybridisation; Chromosomal polymorphisms
Species: *Acricotopus lucidus* [=*A. lucens*], *Anatopynia* species, *Chironomus aberratus*, *C. anthracinus*, *C. commutatus*, *C. crassimanus*, *C. melanotus*, *C. obtusidens*, *C. pallidivittatus*, *C. parathummi*, *C. plumosus*, *C. striatus*, *C. tentans*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *Cryptochironomus defectus*, *Glyptotendipes barbipes*, *Metriocnemus cavicola* [=*M. martinii*], *M. hygropetricus*, *Prodiamesa olivacea*, *Sergentia coracina*, *S. longiventris*, *Trichocladius* [=*Halocladius*] *vitripennis*, *Trichotanypus pectinatus*

Beermann, W. 1962*b*. Genaktivität und Genaktivierung in Riesenchromosomen. *Verhandlungen der deutsche Zoologischen Gesellschaft* 1961. *Zoologischer Anzeiger, Supplement* **25**, : 44-75.
Reviews, as well as providing original data, the evidence for puffs in polytene chromosomes being sites of gene activity. Figures autoradiographs of polytene puffing and the ultrastructure of larval salivary glands in *Chironomus tentans*, *C. pallidivittatus*, and their hybrids.

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1963*a*. Cytologische Aspekte der Informationsübertragung von den Chromosomen in das Cytoplasma. *Induktion und Morphogenes. Colloquium der Gesellschaft für Physiologische Chemie, Mosbach,* 1962, **13**: 64-100.
Reviews the evidence that puffs in polytene chromosomes are sites of gene activity. Covers the submicroscopic changes in morphology which occur and the available data on induction and control of puffing. Illustrated by some original autoradiographs and photographs, as well as reproductions from other papers.

Specialised subjects: Puffs - genetic control
Species: *Acricotopus lucens, Chironomus pallidivittatus*, *C. tentans*, *Trichocladius* species [=*Halocladius varians*]

Beermann, W. 1963*b*. Cytological aspects of information transfer in cellular differentiation. *American Zoologist* **3**: 23-32.
An abbreviated version of Beermann (1963*a*).

Specialised subjects: Puffs - genetic control
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1964*a*. Control of differentiation at the chromosome level. *Journal of Experimental Zoology* **157**: 49-61.
Reviews the evidence that puffs in polytene chromosomes are sites of gene activity. By the use of actinomycin D, it is shown that the degree of synthetic activity is correlated to the size of the puff. It is postulated that synthesis in at least some puffs of *Chironomus tentans* is directly under the control of ecdysone.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1964*b*. Kontrollierte RNS-Synthese in Riesenchromosomen, pp.211-223. *In* Stubbe, H. (ed.), *Struktur und Funktion des genetischen Materials*. Erwin-Baur-Gedächtnisvorlesungen, 1963. Berline Akademie-Verlag.
Reviews the evidence for the production of RNA from puffs and the nature of the control of its synthesis. Illustrated by photographs, autoradiographs and an electron micrograph. The hand drawn map of chromosome II of *Chironomus tentans* is also included.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1965*a*. Structure and function of interphase chromosomes. *Proceedings of the XI International Congress of Genetics, London* 1963. *Genetics Today* **2**: 375-384.
Suggests polytene chromosomes as a model for all interphase chromosomes and reviews the evidence for puffs as sites of active genes. Considers chromomeric organisation is of fundamental importance from the viewpoint of chromosome metabolism, and speculates on the importance of the division into chromomeres and interchromomeres.

Specialised subjects: Polytene chromosomes - bands and interbands; Puffs - RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1965*b*. Operative Gliederung der Chromosomen. *Die Naturwissenschaften* **52**: 365-375.
Reviews the structure and function of polytene chromosomes, including work on chromosome replication and the studies of puffs and Balbiani rings in *Chironomus* species. No illustrations. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - Balbiani rings
Species: *Chironomus* spp.,

Beermann, W. 1965*c*. Operative Gliederung der Chromosomen. *Bericht über die 103 versammlung der Gesellschaft Deutscher Naturforscher und Ärtze*.
Naturwissenschaftliche Rundschau **18**: 161.
Briefly reviews the structure of polytene chromosomes and the nature of puffs as understood by studies on *Chironomus*. No illustrations.

Specialised subjects: Polytene chromosomes - structure; Puffs - experimental induction
Species: *Chironomus* spp.,

Beermann, W. 1966*a*. Differentiation at the level of chromosomes, pp.24-54. *Cell differentiation and morphogenesis. International lecture course, Wageningen, The Netherlands*. North-Holland Publishing Co., Amsterdam.
A published lecture in which the author reviews some of the structural and functional aspects of the chromomeric organisation of higher chromosomes and concludes that the chromomeres are autonomous units of DNA replication, RNA synthesis and of RNA stabilisation and packaging. Such a situation offers many possibilities of regulation and the author concludes that it may be one of the keys to an understanding of differentiation in higher organisms. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Chromosome structure; Puffs - Balbiani rings
Species: *C. tentans*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *Trichocladius* [=*Halocladius*] *vitripennis*

Beermann, W. 1966*b*. Gen-Regulation in Chromosomen höherer Organismen. *Jahrbuch der Max-Planck-Gesellschaft* **1966**: 69-87.
Detailed review of puffs in polytene chromosomes of Chironomidae, with illustrations of various aspects from *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus* and *C. tentans*. The ultrastructure of puffs is discussed and illustrated from *C. tentans*. (Partim)

Specialised subjects: Polytene chromosomes; Puffs - Balbiani rings
Species: *Acricotopus lucidus* [=A. *lucens*], *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1967. Gene action at the level of the chromosome, pp.179-201. *In* R.A.Brink (ed.), *Heritage from Mendel*. University of Wisconsin Press.
In higher organisms the primary function of the genes, transcription, seems to be coordinated with other activities which control the flow of information from the nucleus into the cytoplasm. The elements of coordination seem to be the chromomeric subdivisions within the chromosome. This is illustrated from the puffs and Balbiani-rings of *Chironomus*. A model of such control is suggested, which would explain the evolution of large chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - bands and interbands; Puffs - Balbiani rings
Species: *Chironomus tentans, C. thummi piger* [=*C. piger*], *C. t. thummi* [=*C. riparius*]

Beermann, W. 1971. Effect of alpha-amanitine on puffing and intranuclear RNA synthesis in *Chironomus* salivary glands. *Chromosoma* **34**: 152-167.
Incubation of *Chironomus* salivary glands with alpha-amanitine results in suppression of puffing and chromosomal ^{3}H-uridine incorporation in 80% of cells. The incorporation of ^{3}H-uridine into the nucleolus is unaffected. Some cells are unaffected by the treatment, and distribution of these "resistant" cells suggests that the uptake of alpha-amanitine is subject to physiological restrictions.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. 1972. Chromosomes and genes. Developmental studies on giant chromosomes. *Results and Problems in Cell Differentiation* **4**: 1-33.
Reviews the band structure of polytene chromosomes. Bands show consistent differences in appearance, some are continuous but others are dotted. The thickness of bands ranges from 0.3micron down to the limits of resolution, while the interbands do not appear to exceed 0.2micron. This range in band thicknesses is correlated to the DNA content of the organism to give estimates of from 5000 nucleotides in very fine bands to 100000 in the thickest bands. Tissue specific variations in the appearance of bands are considered to be small and often due to differential puffing. However, tissue specific differences in DNA content also occur. Concludes that only one cistron exists for each chromomere-interchromomere complex and hence that the majority of the DNA would appear to be regulatory. The "super- operon" concept is favoured as an explanation for the chromomere unit. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Beermann, W. 1973. Directed changes in the pattern of Balbiani ring puffing in *Chironomus*: effects of a sugar treatment. *Chromosoma* **41**: 297-326.
Experiments reveal a regulatory relationship between the Balbiani rings, BR1, BR2 and BR6, in *Chironomus tentans* and *C. pallidivittatus*. Laboratory reared larvae normally show BR2>BR1 and no development of BR6. However, in those in which BR1>BR2, BR6 shows some puffing. Treatment of larvae with solutions of various sugars leads to a reversal of the normal relationship between BR1 and BR2, and, in *C. pallidivittatus* to the development of BR6. A rapid reversion occurs when the larvae are returned to the normal medium. Prepupae are refractory to the sugar treatments.

Specialised subjects: Puffs - genetic control
Species: *Chironomus pallidivittatus, C. tentans*

Beermann, W. & Bahr, G.F. 1954. The submicroscopic structure of the Balbiani-ring. *Experimental Cell Research* **6**: 195-201.
An electronmicroscopic study of the structure of the Balbiani rings following OsO_4-fixation. The results are consistent with the view that the chromonemata are individually expanded and lose their lateral connections with each other for short distance. Hence the results are considered to be support for the polytene theory of structure.

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus* species, *C. tentans*

Beermann, W. & Clever, U. 1964. Chromosome puffs. *Scientific American* **210**(4): 50-58.
Reviews the evidence that puffs in polytene chromosomes are due to active genes producing messenger RNA. Draws largely on previously published observations on *Chironomus tentans* and *C. pallidivittatus*. Some of the puffs are activated by ecdysone, and are apparently due to genes involved in moulting. Lavishly illustrated with diagrams, photographs and colour plates [these plates were reproduced in the textbook by Srb, Owen & Edgar (1965)]

Specialised subjects: Puffs - ecdysone
Species: *Chironomus pallidivittatus*, *C. tentans*

Beermann, W. Panitz, R. & Baudisch, W. 1971. Gliederung und Funktion des Interphasechromosoms: Untersuchungen an Riesenchromosomen, pp.164-214. *In* Altmann, H. (ed.), *Handbuch der Allgemeinen Pathologie*. Zweiter Band. *Die Zelle*. Zweiter Teil. *Der Zellkern. I.* 765pp. Springer Verlag, Berlin.

An extensive review of the structure, organisation, replication and function of polytene chromosomes based on evidence drawn from many lines of study. Much of it is based on investigations of Chironomidae, but information from other families is also included, drawing from 124 references as well as unpublished work. Illustrated by photographs, electron micrographs, autoradiographs and drawings. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure, chromosomal replication, puffs
Species: *Acricotopus lucidus* [=A. *lucens*], *Chironomus pallidivittatus, C. tentans*, *C. thummi* [=*C. riparius*], *Smittia* species [?=*S. parthenogenetica*]

Beermann, W. & Pelling, C. 1965. H^3-Thymidin-Markierung einzelner Chromatiden in Riesenchromosomen. *Chromosoma* **16**: 1-21. (English summary)
Tritiated thymidine was administered to fertilised eggs of *Chironomus tentans* and autoradiographs made of chromosome spreads from the resulting fourth instar larvae. Three principle patterns of labelling were found. One of these was a continuous labelled strand, due to intact mitotic half chromatids (or crossover products of these) which received label during DNA synthesis early in embryonic development. A second type showed incomplete label, where a smaller number, or no mitotic divisions must have preceded the formation of these salivary gland cells, indicating that not all parts of the gland have undergone the same number of mitotic divisions during embryogenesis. Approximately half of the nuclei were not labelled at all. The findings confirm the concept of polyteny.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Belaya, A.N. & Gruzdev, A.D. 1973. Size changes of active loci of isolated polytene chromosomes caused by some physicochemical agents. *Tsitologiya i Genetika* **7**: 269-273. (In Russian, English summary)
Size changes in the active loci of *Chironomus thummi*, such as Balbiani rings and the nucleolus, caused by salts or alkali are similar to those of inactive bands, suggesting that they are evoked by changes in the molecular conformation of the DNA. The active loci manifest hydrophobic properties depending on the concentration of organic solvents.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Belaya, A.D., Gruzdev, A.D., Svetshev, V.I. & Pinajev, G.P. 1971. Lipids of isolated polytene chromosomes. *Tsitologiya* **13**: 1491-1495. (In Russian, English summary)
The lipid fraction of the polytene chromosomes isolated from the salivary gland nuclei of *Chironomus thummi* [=*C. riparius*] was determined by thin layer chromatography. Polytene chromosomes are rich in neutral lipids, contain noticeable amounts of glycolipids (cerebrosides) and a low content of phospholipids.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Belcheva, R.G. & Michailova, P.V. 1974. Interphase nuclei of *Chironomus valkanovi* Michailova (Chironomidae, Diptera) detected after quinacrine dihydrochloride staining. *Doklady Bulgarskoi Academiia Nauk* **27**: 693-694.
C. valkanovi has 2n=6 but no sex chromosomes have been identified (c.f. Michailova 1973). However interphase nuclei of males fluoresce more brightly than do those of females, and those of larvae from higher salinities fluoresce more brightly than do those from lower salinities.

Specialised subjects: Sex chromosomes - allocycly
Species: *Chironomus valkanovi*

Belyanina, S.I. - see Nesterova, S.I. for publications prior to 1975.

Belyanina, S.I. 1975. On accessory microchromosomes of the chironomids from the Volga. *Tsitologiya* **17**: 208-209. (In Russian, English summary)
Three species studied were found to have moderate frequencies of accessory chromosomes (up to 15%). These are illustrated.

Specialised subjects: Supernumerary chromosomes - population studies
Species: *Chironomus heterodentatus, C. plumosus, Glyptotendipes gripekoveni*

Belyanina, S.I. 1976*a*. Chromosomal polymorphism of *Chironomus plumosus* L. (Chironomidae, Diptera) from different zones of its area. I. Karyological structure of populations from the Volga region near Saratov and Yaroslavl,

and from the Ob near Novosibirsk. *Tsitologiya* **18**: 712-717. (In Russian, English summary)
Three populations of *C. plumosus* were studied for the inversions present and the frequency of heterozygotes. Although the number of inversions varied from two to five, the frequency of heterozygotes was similar at about 60%. The population from the Ob had accessory chromosomes in 3% of individuals. The various karyotypes are illustrated.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus plumosus*

Belyanina, S.I. 1976*b*. Karyotype of *Stictochironomus pictulus* Mg. (Chironomidae, Diptera) from the lake of Issyk-kul. *Tsitologiya* **18**: 891-896. (In Russian, English summary).
The salivary gland chromosomes of *S. pictulus* are described and a photographic map provided. The karyotype is n=4 with 2 metacentric, 1 submetacentric and an acrocentric chromosomes. No inversions were present in the material examined.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Stictochironomus pictulus*

Belyanina, S.I. 1977. Chromosomal polymorphism of *Chironomus plumosus* L. from different parts of its area. II. The karyotype structure of three geographically isolated populations. *Tsitologiya* **19**: 565-570. (In Russian, English summary)
Describes the inversions and frequencies of heterozygotes for three additional populations of *C. plumosus*: Virtsiarv Lake, Estonia; Issyk-Kul, Kirgiz; and a pond in the Elan district of the Volgograd region. The Estonian and Volgograd populations had four inversions with very similar frequencies, while the Issyk-Kul population had only one inversion. The inversions are illustrated.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus plumosus*

Belyanina, S.I. 1978*a*. The karyotype of *Endochironomus tendens* F. (Chironomidae, Diptera) from the Volga. *Tsitologiya* **20**: 596-598. (In Russian, English summary)
E. tendens has three pairs of submetacentric chromosomes (2n=6). Photographic maps are provided of the polytene chromosomes. Inversions were found in two of the populations sampled but not in a population from the delta of the Volga. Inversion heterozygotes were very common in the polymorphic populations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Endochironomus tendens*

Belyanina, S.I. 1978*b*. Karyotypes of chironomids of the Aral Sea. *XIV International Congress of Genetics, Moscow. Abstracts Part* **1**: 247.
Summarises the results of population studies on the karyotypes of 4 species of Chironomini. Inversions were rare in *Chironomus halophilus* [=*C. aprilinus*] and *C. salinarius*, but common in *Glyptotendipes barbipes*. In *C. behningi*, no inversions were found but there was a low frequency of a heterozygous reciprocal translocation. In addition about 40% of the individuals of this species possessed a supernumerary chromosome.

Specialised subjects: Inversions, Supernumerary chromosomes - population studies
Species: *Chironomus behningi*, *C. halophilus* [=*C. aprilinus*,], *C. salinarius*, *Glyptotendipes barbipes*

Belyanina, S.I. 1979. Karyotypes of chironomids of Lake Issyk-Kul, pp.36-39. *In* Chubareva, L.A. (ed.), *Karyosystematics of the Invertebrate Animals*. Zoologicheskii Institut Academiia Nauk, S.S.S.R., Leningrad. 130pp. (In Russian)
Provides brief descriptions of the polytene chromosomes of ten species of Chironominae, with illustrations of three of them. One of the species studied is called *Chironomus nigricans*, a species considered morphologically to be a synonym of *C. cingulatus*. However the karyotype pictured is quite different to that of *C. cingulatus* given by Keyl & Keyl (1959).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. anthracinus, C. nigricans, C. plumosus, C. tentans*, *C. thummi thummi* [=*C. riparius*], *Cryptochironomus supplicans, Glyptotendipes barbipes, Stictochironomus pictulus, Tanytarsus* species

Belyanina, S.I. 1980. Karyotypical composition of the populations of chironomid *Endochironomus impar* Walk. from some reservoirs of Jamal and the Arctic Ural Mountains. *New data on karyosystematics of Diptera. Trudy Zoologicheskii*

Institut, Akademiia Nauk, S.S.S.R. **95**: 4-9. (In Russian; English summary)
Two different karyotypes for *E. impar* were identified, which differed in chromosome number as the result of a tandem fusion of the small acrocentric chromosome onto the left arm of chromosome III. The 2n=8 form is monomorphic, but inversion polymorphism occurred in the 2n=6 form. The two forms are believed to be reproductively isolated. Photographic maps of the two forms, as well as photographs of heterozygotes for four inversions, are presented.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Endochironomus impar*

Belyanina, S.I. 1981*a*. The chromosomal analysis of *Endochironomus albipennis* Mg. from the Volga. *Tsitologiya* **23**: 1060-1065. (In Russian, English summary)
E. albipennis has three pairs of chromosomes (2n=6). Photographic maps of the polytene chromosomes are provided. The populations are highly polymorphic, with 98.5% of the individuals examined being heterozygous for at least one of the seven inversions observed. The phylogenetic relationships in the genus *Endochironomus* are discussed.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Endochironomus albipennis*

Belyanina, S.I. 1981*b*. Comparative karyotypical characteristics of *Chironomus annularius* (Diptera, Chironomidae) from different geographic zones. *Zoologicheskii Zhurnal* **60**: 1030-1039. (In Russian, English summary)
Fourteen paracentric inversions, mostly heterozygous, were found in the studied populations. Some of the inversions were widespread and others were endemic. A high degree of heterozygosity was characteristic of the species, with individuals from three populations averaging from 1.38 to 1.74 inversions per specimen. A marked diversity of inversion combinations was noted in the Saratov and Chelyabinsk populations, suggesting the existence of intraspecific differentiation.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus annularius*

Belyanina, S.I. 1982. The karyotypic variations of *Glyptotendipes barbipes* Staeg. (Chironomidae, Diptera) examined from various localities. *Tsitologiya* **24**: 78-85. (In Russian, English summary)
Investigated the polytene chromosome cytology of eight populations from various regions of the U.S.S.R., comparing the inversion heterozygosity present. Concludes that there are three cytological races. Illustrated by photographs of the karyotype, including a photographic map, and heterozygous configurations.

Specialised subjects: Inversions - geographical distribution; Geographic races
Species: *Glyptotendipes barbipes*

Belyanina, S.I. 1983. *Karyotypic analysis of the chironomid (Chironomidae, Diptera) fauna of the U.S.S.R.* Dissertation, Saratov, Russia. 455pp. (In Russian)
This reference not seen, however it appears it must give information on the karyotypes of a number of species from the U.S.S.R., including the presence of B chromosomes in a form of *Chironomus plumosus*, now known to be *C. bonus* (Kiknadze *et al*. ATLAS, Nauka, Novosibirsk, 1991) The list of species for this paper has been compiled from those quoted in Petrova (1990).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.*[=*Chironomus*] *tentans, Chironomus aberratus, C. anthracinus, C. anchialicus, C. aprilinus, C. behningi, C. bonus, C. commutatus, C. heterodentatus, C. nigricans, C. obtusidens, C. pankratovae, C. plumosus, C. pseudothummi, C. riihimäkiensis, C. salinarius* gp., *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *C. valkanovi, C.* species, *C.* sp. 1, *C.* sp. 2, *Clinotanypus nervosus, Cryptochironomus defectus* gp., *C. vulneratus* [=*C. psittacinus*], *Demeijerea rufipes, Endochironomus impar, E. tendens, Fleuria lacustris, Glyptotendipes barbipes, G. glaucus, G. gripekoveni, Lipiniella araenicola, L.*species, *Microtendipes pedellus, Micropsectra* species, *Pentapedilum* [=*Polypedilum*] *exsectum, P.* [=*Polypedilum*] *sordens, Polypedilum nubeculosum, P.* species, *Sergentia coracina, Stenochironomus fascipennis, Stictochironomus crassiforceps, S. histrio* [=*S. stictus*], *S. pictulus, S. psammophilus, S. rosenscholdi, S.* species, *Tanytarsus* species

Belyanina, S.I. 1986*a*. The current state of the karyofund of chironomids of water reservoirs of the U.S.S.R., pp.45-49. *In* Kolesnikov, N.N. & Istomina, A.G. (eds.),*Evolution, species formation and systematics of chironomids*. 158pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
This reference has not been seen. Refers to *Chironomus tshernovsky* as a new species but gives no description..

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus tshernovsky*

Belyanina, S.I. 1986*b*. Chromosome polymorphism of *Chironomus plumosus* L. in the U.S.S.R. water bodies. *Biologiya Vnutrennykh Vod Informationii Byulleten* **22**: 39-43. (In Russian)
This article has not been seen.

Specialised subjects: Inversions - geographical distributionSpecies: *Chironomus plumosus*

Belyanina, S.I. 1989. A new cytological complex of the genus *Chironomus* Meig. (Chironomidae, Diptera). *Tsitologiya* **31**: 854-856. (In Russian, English summary)
Describes and provides photographs of the salivary gland chromosomes of *Chironomus aberratus* and an undescribed *Chironomus* species from the Polar Urals and the Yamal peninsular. *Chironomus* sp. has the chromosome arm combination GAB, CD, EF, which has not previously been recorded.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus, C*. species

Belyanina, S.I. & Kolosova, T.A. 1979. The karyotype of *Chironomus behningi* Goetgh. (Chironomidae, Diptera) from the basin of the Aral Sea. *Tsitologiya* **21**: 1103-1106. (In Russian, English summary)
Photographic maps of *C. behningi* (2n=8) are provided. No inversions were recorded but 2.3% of individuals are heterozygous for one of two reciprocal translocations. About 38% of individuals contain a supernumerary chromosome.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus behningi*

Belyanina, S.I., Maximova, F.L., Buchteeva, N., Ilyinskaya, N., Petrova, N. & Chubareva, L.A. 1983. Karyotype. pp.61-96. *In* Sokolova, N.J. [ed.], Chironomus plumosus *L. (Diptera, Chironomidae). Systematics, Ecology and Production*. Nauka, Leningrad. (In Russian)
Provide data on chromosomal variation and inversion polymorphism, noting the presence of different chromosomal races in different Soviet populations. Illustrate both the mitotic and salivary gland polytene chromosomes by figures and photographs. Both a drawn and a photographic chromosome map are provided.(Partim)

Specialised subjects: Inversions - geographical distribution; Geographic races
Species *Chironomus plumosus, C. plumosus* Belosiorsk race [=*C. agilis*], *C. plumosus* East Siberian race [=*C. entis*], *C. plumosus* Krassnosiorsk race [=*C. nudiventris*], *C. plumosus* Omsk race [=*C. balatonicus*], *C. plumosus* Armenia race [=*C.* (*forma larvalis bathophilus*)]

Belyanina, S.I. & Mosiash, S.A. 1980. The karyofund of the natural population of *Chironomus plumosus* L. from the Ivankovskyi reservoir, the region of the Konakovskaja water power station. *New data on karyosystematics of Diptera. Trudy Zoologicheskii Institut Academiia Nauk, S.S.S.R.* **95**: 10-13. (In Russian, English summary)
Observations were made on the chromosomal peculiarities of *C. plumosus* from different areas of the reservoir, with natural and higher temperatures. Under different conditions the populations differed karyologically.

Specialised subjects: Inversions - natural selection
Species: *Chironomus plumosus*

Belyanina, S.I. & Sigareva, L.E. 1978. Differential staining of the chironomid chromosomes. I. C-banding in polytene chromosomes of *Chironomus plumosus* L. *Tsitologiya* **20**: 707-709. (In Russian, English summary)
When the polytene chromosomes of *C. plumosus* were C-banded, chromosomes I, II, and III showed bands in the regions of centromeres and telomeres, while chromosome IV shows banding in the nucleolar organiser and in interstitial sites.

Specialised subjects: Polytene chromosomes - C-bands
Species: *Chironomus plumosus*

Belyanina, S.I. & Sigareva, L.E. 1981. The karyotype of *Clinotanypus nervosus* Mg. (Diptera,

Chironomidae) from the Volga. *Tsitologiya* **23**: 701-706. (In Russian, English summary)
Photographic maps of the polytene chromosomes of *C. nervosus* are provided. Mitotic metaphases showed 7 pairs of chromosomes. One pair of chromosomes is heteromorphic and may be the sex chromosomes. The polytene chromosomes are identified as chromosomes A to G. The G-chromosome is much shorter than expected. When C-banded, chromosomes A-F each show banding near one of the telomeres. Inversion heterozygotes are rare but five different inversions were observed in the population.

Specialised subjects: Cytotaxonomy - polytene chromosomes, mitotic metaphase
Species: *Clinotanypus nervosus*

Belyanina, S.I. & Sigareva, L.E. 1987. Evolution of the karyotype in the chironomids family, pp.115-117. *In* Narchuk, E.P. (ed.), *Diptera and their importance for animal husbandry and agriculture*. 158pp. Trudy Zoologicheskii Institut Akademiia Nauk, S.S.S.R., Leningrad. (in Russian)
This article has not been seen.

Specialised subjects: Karyotype - evolution
Species: Chironomidae spp.

Belyanina, S.I., Sigareva, L.E. & Kuzmina, K.A. 1982. The topography of the nucleolar organizer, tissue-specific regions and heterochromatin in the giant chromosomes of Chironomidae. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 7.
Determined the localisation of the nucleolar organisers, Balbiani rings, large puffs and structural heterochromatin in 59 species of the family Chironomidae from the U.S.S.R.

Specialised subjects: Polytene chromosomes - Nucleolus Organiser; Heterochromatin; Puffs - Balbiani rings, location
Species: *Chironomus* spp., *Stictochironomus* spp., Chironomidae spp.

Belyanina, S.I. Sigareva, L.E. & Loginova, N.V. 1990. A new species *Chironomus curabilis* sp. n. (Diptera, Chironomidae). *Zoologichesky Zhurnal* **69**: 60-70. (In Russian, English summary)
Describe the polytene chromosome complement which is characterised by a high content of heterochromatin. Describe and illustrate the polymorphic inversions, provide photographic chromosome maps, and compare the banding pattern to that of *C. plumosus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus curabilis*

Berdnikov, V.A. & Slobodyanyuk, S.Ya. 1978. Microelectrophoretic analysis of histones from single chromosomes and nucleoli of mosquito (*Chironomus plumosus*) larvae. *Biokhimiya* **43**: 1001-1005. (In Russian) [Translated in *Biochemistry (English translation)* **43**: 793-797]
Histone from individual chromosomes, or their fragments, from the salivary glands of *C. plumosus* were analysed by a simple electrophoretic technique which separated the histones into six bands. These six bands corresponded to fractions H4, H2b, H2a+H3, H3-dimer, and two subfractions of histone H1. The electrophoregrams of chromosomes I, II, and III were almost completely identical, and there was no difference between the nucleolus and the rest of chromosome IV.

Specialised subjects: Polytene chromosomes - structure; Nucleolus - structure
Species: *Chironomus plumosus*

Berendes, H.D. 1973. Synthetic activity of polytene chromosomes. *International Review of Cytology* **35**: 61-116.
A comprehensive review of various aspects relating to the synthetic activity of polytene chromosomes in Diptera, such as the occurrence and fate of polytene chromosomes, their ultrastructure, particularly in relation to the continuity of the DNA. For the Chironomidae it deals specifically with in vitro studies in media or in haemolymph and the effects on puffing patterns, the conflicting evidence for whether DNA synthesis begins with a continuous or discontinuous labelling pattern, and notes that there are 13 replication cycles in *Chironomus* salivary glands. In relation to disproportionate DNA synthesis, it notes that there may be a DNA-puff in a heterochromatic region of a *Glyptotendipes* species, probably *G. barbipes*, and that DNA is extruded from the heterochromatin of *C. melanotus*. Finally, it reviews the studies on the regulation of synthesis and the synthesis of nucleolar RNA. (Partim)

Specialised subjects: Polytene chromosomes - DNA synthesis
Species: *Chironomus melanotus*, *C. pallidivittatus*, *C. tentans*, *C. thummi* [=*C. riparius*], *Glyptotendipes barbipes*, *Smittia parthenogenetica*

Berendes, H.D. & Beermann, W. 1969. Biochemical activity of interphase chromosomes (polytene chromosomes), pp.500-519. *In* Lima-de-Faria, A. (ed.), *Handbook of Molecular Cytology*. North Holland Publishing Company, London.
Review the various studies of the structure and its relationship to gene activity in polytene chromosomes. Note that while it seems clear that there is structural continuity of the chromatids, evidence such as the difference in DNA content of homologous bands in *Chironomus thummi* [=*C. riparius*] and *C. piger* indicates that the chromomere DNA exhibits some individuality, particularly during replication. The replication patterns of the chromosomes from these species, when present in a hybrid, further indicates that the replication patterns of the chromomeres is not identical throughout the chromosome. The various studies on *C. tentans* and *Acricotopus* are used to illustrate aspects of RNA synthesis and its control. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - gene activity
Species: *Acricotopus lucens, Chironomus tentans, C. thummi piger* [=*C. piger,*], *C. th. thummi* [=*C. riparius*]

Berendes, H.D. & Ross, K.F.A. 1963. Measurements of the total solid material in the bands and interbands of the polytene chromosomes in living cells of *Chironomus*. *Chromosoma* **14**: 111-112.
The refractive indices of a number of bands and interbands of the polytene chromosomes in the living salivary gland cells of two *Chironomus* were measured, and values obtained for the total material present in each region. The values for the bands were about ten percent higher than those of the interband regions, although the media in which the chromosomes were mounted affected the absolute values obtained. The variation in value with the medium is interpreted as indicating that the isolated chromosomes are to some extent permeable so that protein may be taken up from, or lost to, the medium.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus pallidivittatus*, *C. plumosus*

Bernhard, W. 1969. A new staining procedure for electron microscopical cytology. *Journal of Ultrastructure Research* **27**: 250- 265.
Describes a preferential, but not specific, stain for ribonucleoproteins in ultrathin sections. Deoxyribonucleoproteins are not stained, therefore in polytene chromosomes the bands are pale but the RNP fibrils and puff granules, particularly of the nucleolus, are well stained. Illustrated by electron micrographs. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Berry, S.J. & Dietz, W. 1968. The action of dimethyl sulphoxide and DNase on the fine structure of chironomid salivary gland cells. *Journal of Insect Physiology* **14**: 847-854.
DNase by itself had no effect on isolated salivary glands, presumably because it is unable to enter the cells. However when dimethyl sulphoxide is also present the polytene chromosomes are destroyed. The DNA is not completely degraded but may be present in short lengths attached to nucleoprotein. Illustrated by photographs and electron micrographs. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Besserer, S. 1956. Das Wachstum der Speicheldrüsen- und Epidermis-kerne in der Larvenentwicklung von *Chironomus*. *Biologische Zentralblatt* **75**: 205-226.
The average volume of the *Chironomus* salivary gland doubles once or more in every instar. Twelve to 14 such steps occur up until pupation. If chromosomal duplication is proportional to volume, then polyteny will reach 8,192n to 16,384n (-32,768n). In the epidermis mitosis precedes each moult, but as well nuclear enlargement also occurs and chromosomal polyteny is believed to reach 16n during larval development, and at least 64n by the pupal stage. This latter conclusion was challenged by Keyl (1967).

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* species

Birnstiel, M.L. Jacob, J. & Sirlin, J.L. 1965. Analysis of nucleolar RNA synthesis in dipteran salivary glands. *Archives de Biologie, Paris* **76**: 565-589.
Salivary glands of *Smittia parthenogenetica*, at a late stage of larval development, were incubated *in vitro*. The studies revealed that the nucleolar RNA appears to synthesised in the nucleolus itself and not in the organiser. Most of the nucleolar RNA synthesised appears to be 4S RNA, and this RNA is transmethylated in the nucleolus. A footnote

indicates that >28S RNA is probably synthesised at the same rate as $S RNA, but is inhibited under the experimental conditions.

Specialised subjects: Nucleolus - gene activity
Species: *Smittia parthenogenetica*

Birnstiel, M.L. Sirlin, J.L. & Jacob, J. 1965. The nucleolus: a site of transfer ribonucleic acid synthesis. *Biochemical Journal* **94**: 10p-11p.
An abstract of a study of RNA synthesis in the nucleolus of a *Smittia* species, probably *S. parthenogenetica*. Provides evidence that the nucleolus is involved in the methylation of sRNA and the synthesis of tRNA.

Specialised subjects: Nucleolus - gene activity
Species: *Smittia parthenogenetica*

Blaylock, B.G. 1963. *Chromosomal aberrations in a natural population of* Chironomus tentans *exposed to chronic low-level environmental radiation*. Ph.D. thesis, University of Tennessee. 89pp.
Studied the occurrence of chromosomal aberrations in a species identified as *C. tentans*, but which is actually an undescribed member of the *C. decorus* group (Wülker, Sublette & Martin 1968). The results have been published in Blaylock (1965) and in Blaylock, Auerbach & Nelson (1964).

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions
Species: *Chironomus tentans* [=*C. decorus* gp.(B)]

Blaylock, B.G. 1965. Chromosomal aberrations in a natural populations of *Chironomus tentans* exposed to chronic low-level radiation. *Evolution* **19**: 421-429.
Salivary gland chromosomes of a member of the *C. decorus* group, misidentified as *C. tentans*, from the vicinity of Oak Ridge, Tennessee, were analysed for chromosomal aberrations. Three paracentric inversions were found at relatively high frequency in three different populations, but they generally showed no temporal fluctuations or significant differences in frequencies between populations. Samples from an area contaminated with low-level radioactive waste showed no significant difference in the amount of chromosomal polymorphism when compared with other populations. However ten aberrations which occurred at very low frequency were unique to the irradiated population. It was concluded that there was an increased occurrence of new aberrations due to the high background radiation, but that these new aberrations were rapidly eliminated by selection of genetic drift. The frequency of inversion 1Ra did not conform to Hardy-Weinberg expectation as its frequency fell from 55.6% to 16.1% over three months.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions
Species: *Chironomus tentans* [=*C. decorus* gp.]

Blaylock, B.G. 1966*a*. Chromosomal polymorphism in irradiated natural populations of *Chironomus*. *Genetics* **53**: 131-136.
Chromosomal polymorphism in a natural population of *C. tentans* [=*C. decorus* gp.(B)] inhabiting a stream contaminated by radioactive waste was compared with a nonirradiated population. Although the irradiated population had a higher incidence of novel aberrations, the frequency of three endemic inversions did not differ significantly.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions
Species: *Chironomus tentans* [=*C. decorus* gp.(B)]

Blaylock, B.G. 1966*b*. Cytogenetic study of a natural population of *Chironomus* inhabiting an area contaminated by radioactive waste, pp.835-846. *In Disposal of Radioactive Wastes into Seas, Oceans and Surface Waters*. International Atomic Energy Agency, Vienna. (English, French, Russian and Spanish summaries)
Basically the same data as that presented in previous work (Blaylock 1965, 1966*a*), with the same conclusion that the chronic radiation in the substrate of the habitats of *C. tentans* [=*C. decorus* gp.(B)] has lead to an increase in the frequency of chromosomal aberrations. However it has not affected the fitness of the population by producing a change in the frequency of endemic inversions.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions
Species: *Chironomus tentans* [=*C. decorus* gp.(B)]

Blaylock, B.G. 1971*a*. The production of chromosome aberrations in *Chironomus riparius* (Diptera: Chironomidae) by tritiated water. *Canadian Entomologist* **103**: 448-453.
An increased frequency of chromosome aberrations was detected in the progeny of *C. riparius* reared in two levels of tritiated water. The frequency of aberrations produced was approximately the same as the frequency produced

by an equivalent dose of chronic gamma irradiation.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, translocations
Species: *Chironomus riparius*

Blaylock, B.G. 1971*b*. Chromosome aberrations in *Chironomus riparius* developing in different concentrations of tritiated water. *Radionuclides in Ecosystems. Proceedings of the Third National Symposium on Radioecology*: 1169-1173.
Largely similar in content to Blaylock (1971*a*). Includes a dose response curve and a figure of rearrangements caused by partial breakage of the polytene chromosomes.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects
Species: *Chironomus riparius*

Blaylock, B.G., Auerbach, S.I. & Nelson, D.J. 1964. Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation. *Oak Ridge National Laboratory Report* ORNL-**3531**: 1-77.
The contents are essentially those published in Blaylock (1965). Includes photographic maps of the salivary gland chromosomes of the species identified as *C. tentans*, but which is actually a member of the *C. decorus* group.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions; Karyotype
Species: *Chironomus tentans* [=*C. decorus* gp.(B)]

Blaylock, B.G. & Koehler, P.G. 1969. Terminal chromosome rearrangements in *Chironomus riparius*. *American Naturalist* **103**: 547-551.
Reports terminal rearrangements in the salivary gland chromosomes of *C. riparius* following irradiation. These included inversions and translocations but not deficiencies, compared to *Drosophila* where radiation-induced deficiencies but not translocations have been observed. The results lead the authors to question whether it is universally true that broken ends of chromosomes fuse only with other broken ends.

Specialised subjects: Mutagenesis - ionising radiation, environmental effects, inversions, translocations
Species: *Chironomus riparius*

Blaylock, B.G. & Trabalka, J.R. 1976. Effectiveness of tritium and ^{239}Pu in producing chromosome aberrations in *Chironomus riparius*. *Biological Energy Agency, Vienna* **2**: 45-50.
Larvae of *C. riparius* were reared in water containing various concentrations of tritium or ^{239}Pu to determine whether the high linear energy transfer (LET) radiation of plutonium is more effective in producing chromosomal aberrations in the salivary gland chromosomes than the low LET radiation of tritium. However, these preliminary data did not support such an hypothesis. It is possible that plutonium metal toxicity contributed to a difficulty in obtaining data from the plutonium trials.

Specialised subjects: Mutagenesis - ionising radiation, chromosome sensitivity
Species: *Chironomus riparius*

Bogachev, S.S., Blinov, A.G., Blinov, V.M., Gaidamakova, E.K., Kolesnikov, N.N., Kiknadze, I.I. & Shakhmuradov, I.A. 1986. Some structural elements of the DNA sequence from the region of Balbiani's ring of chromosome IV in *Chironomus thummi*. *Doklady Akademiia Nauk, S.S.S.R.* **288**: 230-233. (In Russian, English summary) [Translated in *Doklady Biological Sciences* **288**: 251-254].
A DNA clone was obtained from the A1-2 region of chromosome IV in *C. thummi* [=*C. riparius*], homologous to Balbiani ring BRa. Upon *in situ* hybridisation to the polytene chromosomes, it was found to hybridise to BRa and BRb, with additional weak hybridisation at up to 10 sites, including on other chromosomes. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, homology Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Bogachev, S.S., Blinov, A.G., Kolesnikov, N.N., Blinov, V.M., Fedorov, S.P., Gaidamakova, E.K., Panova, T.M. & Kiknadze, I.I. 1987. Analysis of DNA sequence from BRa tissue specific puff. *Doklady Akademiia Nauk, S.S.S.R.* **296**: 1473-1476. (In Russian). [Translated in *Doklady Biological Sciences* **296**: 495-498 (1988)]
Three clones of *Chironomus thummi* [=*C. riparius*] genomic DNA were found to hybridise to the Balbiani rings when used as probes for *in situ* hybridisation to the salivary gland chromosomes. Illustrated by a photograph. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Bogachev, S.S., Scherbik, S.V., Taranin, A.V. & Sebeleva, T.E. 1989. Analysis of expression of a gene from the tissue specific puff BRa in *Chironomus thummi* encoding a low-molecular weight secretory polypeptide. *Genetika* **25**: 1541-1550. (In Russian). [Translated in *Soviet Genetics* **25**: 1003-1011 (1990)].
Note that the clone used, pF6.2, hybridises to the A2b region of chromosome IV to BRa which is transcribed in the cells of the special lobe of the salivary gland. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Bolsius, H. 1911. Sur la structure spiralée ou discoide de l'élément chromatique dans les glandes salivaires des larves des *Chironomus*. *La Cellule* **27**: 75-86.
Studied the chromatin material of the salivary gland cells in an unspecified number of *Chironomus* species. Recognised that the chromatin material was composed of four elements. Concludes that the different species are polymorphic for either a spiral structure of the chromatin or for alternating dark and achromatic discs. Illustrated by line drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp.

Bolsius, H. 1913. [On chromosome structure.] *Tijdschrift der Nederlandse Dierkundige Vereniging*, 1910. 12: vii. (In Dutch)
Report of a seminar discussing the controversy as to whether polytene chromosomes were banded or threaded. The ideas were published in Bolsius (1911).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp.

Bolton, E.T., Britten, R.J., Byers, T.J., Cowie, D.B., Hoyer, B., Kato, Y., McCarthy, B.J., Miranda, M. & Roberts, R.B. 1964. Biophysics: Functioning chromosomes and cellular differentiation. *Carnegie Institution of Washington Yearbook* **63** (1963-1964): 377-379.
Describe a technique for isolating large numbers of biologically active polytene chromosomes from *Chironomus thummi* [=*C. riparius*] and other nematocerous Diptera by centrifugation in a density gradient. No illustrations. (Partim)

Specialised subjects: Techniques; Polytene chromosomes
Species: *Chironomus thummi* [=*C. riparius*]

Botella, L., Grond, C., Saiga, H. & Edström, J.-E. 1988. Nuclear localization of a DNA-binding C-terminal domain and Balbiani ring coded secretory protein. *The EMBO Journal* **7**: 3881-3888.
In an analysis of the highly conserved C-terminal domain of the sp-I family of giant secretory proteins, immunochemistry of an antibody to this domain on frozen sections of salivary gland nuclei indicated that BR1 and BR2 were specifically enriched with reactive material. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene productSpecies: *Chironomus tentans*
Boyes, J.W. 1958. Chromosomes in classification of Diptera. *Proceedings Tenth International Congress of Entomology, Montreal, 1956,* **2**: 899-906.
The great majority of Nematocera are reported to have 2n=6 or 8, but a variety of numbers from 2n=4 to 2n=8 are reported in the Chironomidae. Notes the existence of polytene chromosomes, the tissues in which they have been found and some of the studies undertaken. The meiotic chromosomes of the Chironomidae are placed in Group 2, as having derived from a basic set of four metacentric chromosomes. Chromosome studies are considered important for the solving of problems of relationship in the Diptera. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Karyotype - basic chromosome number
Species: *Camptochironomus* [=*Chironomus*] spp., *Tendipes* [=*Chironomus*] spp., *Sergentia coracina, S. longiventris*

Brady, T., Bailey, J.F. & Payne, M.B. 1977. Scanning electron microscopy of isolated *Chironomus* polytene chromosomes. *Chromosoma* **60**: 179-186.
Under the scanning electron microscope the three dimensional ultrastructure of the polytene chromosomes of *C. stigmaterus* consists of a series of chromatin strands, extended in the interbands and more tightly coiled in the bands. The nucleolus appears as a dense disc or doughnut-shaped structure surrounding the chromosome, while the Balbiani rings appear as diffuse regions consisting of both fibrillar and granular elements.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus stigmaterus*

Brady, T. & Payne, M.B. 1976. Scanning electron microscopy of isolated polytene chromosomes. Abstracts of First International Congress on Cell Biology, Boston, Massachusetts. *Journal of Cell Biology* **70**: 373a.
Summarises the contents of Brady, Bailey & Payne (1977).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus stigmaterus*

Buck, J.B. 1939. Structure of living salivary gland chromosomes. *Genetics* **24**: 96 (Abstract)
Chromosomes of an unidentified *Chironomus* species (possibly *C. plumosus*), and of some other Diptera, were observed through the body wall of the living larvae. The chromosomes plus the nucleolus were found to virtually fill the nucleus. The bands were sharp and detailed, as in fixed preparations. No longitudinal fibrillae were visible. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species [?=*C. plumosus*]

Buck, J.B. 1942. Micromanipulation of salivary gland chromosomes. *Journal of Heredity* **33**: 3-10.
Polytene chromosomes of *Chironomus plumosus* were isolated by an osmic vapour technique and subjected to micromanipulation. Such chromosomes withstood about 100% elongation without permanent deformation, and about 300% before breaking. Most of the elongation occurred in the interband region and breakage occurred at right angles to the main axis. There was no evidence of any longitudinal differentiation. It is suggested that lipoids may play a role in bonding the fabric of the chromosomes, while the properties of the chromosomes suggest a possible chemical comparison with those of fibrous proteins.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Buck, J.B. & Melland, A.M. 1942. Methods for isolating , collecting and orienting salivary gland chromosomes for diffraction analysis. *Journal of Heredity* **33**: 173-184.
Techniques are described for isolating single chromosomes from salivary gland nuclei of *Chironomus*, and of mounting and orienting them for X-ray and electron diffraction photography. The techniques have not been adequately tested to permit definite conclusions regarding the structure of the chromosomes.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus plumosus, C. tentans*

Bürki, E. 1978. *Cytologische und Enzymelektrophoretische Untersuchungen an einer Population der zückmucke* Chironomus plumosus *L. aus dem Murtensee*. Lizentiatsarbeit, Zoologisches Institut der Universität Bern, Switzerland. 62pp.
On the basis of inversion frequencies and combinations, plus the frequencies of four enzyme loci, it appears that two distinct populations of *Chironomus plumosus* are present in Lake of Murten. The question of whether *C. plumosus* comprises a complex of several species is considered (see Bürki *et al*. 1978)

Specialised subjects: Inversions - incipient speciation
Species: *Chironomus plumosus* [=*C. muratensis C. plumosus*]

Bürki, E., Rothen, R. & Scholl, A. 1978. Koexistenz von zwei cytologisch verschiedenen Populationen der Zuckmücke *Chironomus plumosus* im Murtensee. *Revue Suisse de Zoologie* **85**: 625-634. (English & German Summary)
Uses the cytological data from Bürki (1978), plus data on additional populations to assess the possibility that *C. plumosus* is a complex of at least two species. The second species was subsequently described as *C. muratensis* (Ryser *et al*. 1983).

Specialised subjects: Inversions - incipient speciation
Species: *Chironomus plumosus* Group I [=*C. plumosus*], *C. plumosus* Group II [=*C. muratensis*]

Bukhteeva, N.M. 1974. The characteristics of the karyotype and inversion polymorphism of *Chironomus plumosus* var. *flaveolus* Meig. from Eastern Siberia. *Tsitologiya* **16**: 358-361. (In Russian, English summary)
Reports a high rate of inversion polymorphism in four inversions on chromosomes I, II, and III; with some inversions present only in spring populations and others only in autumn populations. Only the

small inversion IR3 was found in both seasons. There were also two types of chromosome IV, one with 2 BRs (or occasionally polymorphic), the other with only 1 BR. In the light of subsequent studies t appears likely that two species were present. Illustrated by a photographic map and other photographs.

Specialised subjects: Polytene chromosomes - karyotype; Inversions - heterozygosity
Species: *Chironomus plumosus* var. *flaveolus*

Bukhteeva, N.M. 1979. Karyotypic characteristics of the main species of the genus *Chironomus* Meig. of the Baikal River, pp.40-43. *In* Chubareva, L.A. (ed.), *Karyosystematics of the Invertebrate Animals*. Zoologicheskii Institut Academiia Nauk, S.S.S.R., Leningrad. 130pp. (In Russian)
Describes the main features of the polytene chromosomes of eight species. No illustrations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anthracinus, C. cingulatus, C. luridus, C. pallidivittatus*, *C. plumosus, C. salinarius, C. sollicitus, C. tentans*

Bukhteeva, N.M. 1980. *Karyotypical characterisation of the bulk of the species in the benthos of reservoirs of the Baikal River*. Candidature Thesis, Biological Sciences, Irkutz, Russia. 125pp. (In Russian)
This thesis has not been seen, but is likely to refer to at least those species considered by Bukhteeva (1979).

Specialised subjects: Cytotaxonomy - polytene chromosomesSpecies: *Chironomus anthracinus, C. cingulatus, C. luridus, C. pallidivittatus*, *C. plumosus, C. salinarius, C. sollicitus, C. tentans*

Bukhteeva, N.M. 1982. Polymorphism of the structure of the polytene chromosomes of larvae of *Camptochironomus tentans*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 9.
Populations of *C. tentans* from the Pribaikal region of the U.S.S.R. were found to show intraspecific variations or polymorphisms in a number of chromosomal characters.

Specialised subjects: Karyotype - evolution; Inversions - polymorphy; Puffs - Balbiani rings
Species: *Camptochironomus* [=*Chironomus*] *tentans*

Burgauer, S.A. & Stockert, J.C. 1975. Observations on the selective demonstration of nucleolar material by protein staining techniques in epon thick sections. *Histochemistry* **41**: 241-247.
Thick sections of salivary gland chromosomes of *Chironomus pallidivittatus* were subjected to various pretreatments in order to obtain selective nucleolar staining. Pretreatment with uranyl acetate or ammonium aluminium sulphate, followed by aniline blue black staining, resulted in highly selective staining. It is suggested that the selectivity could be due to qualitative differences between the nucleolar and other cellular proteins.

Specialised subjects: Nucleolus - structure
Species: *Chironomus pallidivittatus*,

Burkholder, G.D. 1975. Whole mount electron microscopy of polytene chromosomes and nucleoli from *Drosophila* and *Chironomus*. *Abstracts of the Fifteenth Annual Meeting of the American Society for Cell Biology*. *Journal of Cell Biology* **67**: 48a.
Gives a simple method for preparing polytene chromosomes for whole mount electron microscopy. Chromosome bands were electron dense regions composed of closely packed groups of chromomeres, while interband regions contained relatively straight chromatin fibres. Presumptive puff regions contained extended, longitudinally arranged fibres but some transverse rows were also present, suggesting that not all of the chromomeres of a band may be involved in puff formation. In stretched chromosomes there was no distinction between the bands and the interband regions, supporting the hypothesis that the chromatids are continuous. (Partim)

Specialised subjects: Polytene chromosomes - ultrastructure
Species: *Chironomus* species

Burkholder, G.D., Latimer, L.J.P. & Lee, J.S. 1988. Immunofluorescence localization of triplex DNA in eukaryotic nuclei and chromosomes. Abstracts of the XVIth International Congress of Genetics. *Genome* **30**(Suppl.1): 103.
A monoclonal antibody was used to localise triplex DNA in the polytene chromosomes of *Chironomus tentans*. The correspondence between the pattern of triplex DNA distribution and bands of the chromosomes supported the view that triplex formation has a role in chromosome structure and chromatin condensation. This work was

subsequently published in *Chromosoma* **101**: 11-18 (1991). (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Bustin, M. 1977. Histone antibodies and chromatin structure. *Molecular Human Cytogenetics. ICN - UCLA Symposia on Molecular and Cellular Biology* **7**: 24-50.
Antibodies specific to the five main histone classes were used to examine the organisation of histones in the bands of polytene chromosomes. Antisera to histones H2B, H3 and H4 produced bands closely resembling those visible with aceto-orcein staining. The three antisera stained the same bands suggesting that the gross organisation of the histones is similar in the various bands. The permanently puffed region of chromosome 4 stained only very weakly, suggesting that the exposure of histone determinants is different from that in bands. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Bustin, M., Kurth, P.D., Moudrianakis, E.N., Goldblatt, D., Sperling, R. & Rizzo, W.B. 1978. Immunological probes for chromatin structure. *Cold Spring Harbor Symposia on Quantitative Biology, 1977,* **42**: 379-388.
Antibodies elicited against histones purified from calf thymus were used to study the organisation of histones in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*]. The antisera were found to bind specifically to the chromosomes, the pattern of fluorescence depending upon the concentration of antisera used. At a concentration of 1:20 of the antiserum, strong fluorescence along the entire chromosome was obtained. At a fourfold reduction in antiserum concentration, immunofluorescence of single bands could be determined. Antisera to histones H1, H2A, H2B and H3, stained the same bands, suggesting that the gross organisation of histones is very similar in different bands. The antisera did not however bind very strongly to puffed regions, such as the Balbiani rings on chromosome 4. It was not determined whether the reason for the reduction in binding was due to an influx of non-histone proteins, which masks the antigenic determinants, or whether the chromosome structure in the puffed regions facilitates the removal of the histones during fixation. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Calvet, J.P. Laufer, H. & Krider, H. 1976. Repetitive nucleotide sequences in the *Chironomus* genome. *Abstracts of the First International Congress on Cell Biology, Boston, Massachusetts. Journal of Cell Biology* **70**: 291a.
Estimate the amount of repetitive DNA and the total genome size in *C. thummi* [=*C. riparius*] and *C. tentans*. *In situ* hybridisation of a highly purified fast fraction to the polytene chromosomes of *C. thummi* produced labelling over the centromeres, with less intense labelling adjacent to the centromeres and over telomeres. (Partim)

Specialised subjects: Polytene chromosomes - structure, DNA sequences
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*],

Carmona, M.J., Morcillo, G., Galler, R., Martinez-Salas, E., de la Campa, A.G., Diez, J.L. & Edström, J.E. 1985. Cloning and molecular characterization of a telomeric sequence from a temperature-induced Balbiani ring. *Chromosoma* **92**: 108-115.
Telomere specific clones were obtained from a Balbiani ring-like structure, induced by heat shock at the end of chromosome III. *In situ* hybridisation of such clones to the salivary gland chromosomes showed binding at all telomeres except one on chromosome IV. When the clone was used to probe to the RNA produced by the chromosome following heat shock, binding occurred to the RNA transcribed at T-BRIII and occasionally at some of the other telomeres. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus thummi thummi* [=*C. riparius*]

Carnoy, J.B. 1884. *La Biologie Cellulaire. Fasc.* I. Lierre.
This publication not seen, but according to White (1973) it gives an accurate figure of the morphology of the polytene chromosomes of *Chironomus*. However it is assumed that the same type of nucleus would occur in other insect orders and that the cross-banded structures formed a continuous spireme. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Carretero, M.T., Carmona, M.J., Morcillo, G., Barettino, D. & Diez, J.L. 1986. Asynchronous expression of heat-shock genes in *Chironomus thummi*. *Biology of the Cell* **56**: 17-21.
Following brief drastic heat shocks, there was asynchronous appearance of t-puffs on chromosome III of *C. thummi* [=*C. riparius*]. A puff at A3b was formed during the first 30 min, with three more developing at about 90 min.
Illustrated by autoradiographs of ^{3}H-uridine incorporation, and a drawn map of chromosome III to show the sites of the hsps.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Case, S.T. 1987. Correlated changes in steady-state level of Balbiani ring mRNAs and secretory polypeptides in salivary glands of *Chironomus tentans*. *Chromosoma* **94**: 483-491.
Discusses the number and chromosomal location of different Balbiani rings in *C. tentans*. Notes that BR1 and BR2 each contain more than one gene type and it is uncertain whether these arise from the same chromomere. BR1 can arise independently from two polytene bands, while BR2 arises from only one. Notes that a single band and interband region could contain more than enough DNA to accommodate more than one gene. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Case, S.T. & Bower, J.R. 1983. Characterization of a cloned, moderately repeated sequence from Balbiani ring 2 in *Chironomus tentans*. *Gene* **22**: 85-93.
A recombinant plasmid with a 750-bp insert of *C. tentans* genomic DNA was *in situ* hybridised to the salivary gland chromosomes. It was found to hybridise exclusively to BR2. Illustrated by an autoradiograph. (Partim)

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus tentans*

Case, S.T. & Byers, M.R. 1983. Repeated nucleotide sequence arrays in Balbiani ring 1 of *Chironomus tentans* contain internally nonrepeating and subrepeating elements. *Journal of Biological Chemistry* **258**: 7793-7799.
A 385 base pair long clone of genomic DNA of *C. tentans*, thought to contain material from BR1, was *in situ* hybridised to salivary gland chromosomes. It hybridised strongly to BR1 and less strongly to BR2. Illustrated by a photograph. (Partim)

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus tentans*

Case, S.T. & Daneholt, B. 1977. Cellular and molecular aspects of genetic expression in *Chironomus* salivary glands. *International Review of Biochemistry* **15**: 45-77.
Describe the structure of polytene chromosomes, including a photograph of the salivary gland complement of *C. tentans*, and the structure of chromosomal puffs. Review the evidence that Balbiani rings are sites of salivary polypeptide secretion, and for RNA synthesis at puffs and the nucleoli.

Specialised subjects: Polytene chromosomes - structure, Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Case, S.T. & Daneholt, B. 1978. The size of the transcription unit in Balbiani ring 2 of *Chironomus tentans* as derived from analysis of the primary transcript and 75S RNA. *Journal of Molecular Biology* **124**: 223-241.
The size of the transcription unit for 75S RNA in Balbiani ring 2 (BR2) of *C. tentans* was determined to be about $37x10^{3}$ base pairs. This estimate was compared to available information on the BR2 chromomere and the adjacent interchromomeres. It was concluded that only a minor part of the unit, less than $5x10^{3}$ base pairs, could be accommodated in the inter-chromomere and that most of the transcription unit must be in the BR2 chromomere. Since there are over $100x10^{3}$ base pairs in the chromomere, it is possible that more than one transcription unit is present. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Case, S.T. Summers, R.L. & Jones, A.G. 1983. A variant tandemly repeated nucleotide sequence in Balbiani ring 2 of *Chironomus tentans*. *Cell* **33**: 555-562.
A clone carrying nearly four copies of a tandemly repeated 180bp sequence was found to hybridise *in*

situ to BR2 of *C. tentans*. Illustrated by an autoradiograph. (Partim)

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus tentans*

Casperrson, T. 1936. Über den Chemischen Aufbau der Strukturen des Zellkernes. *Skandinavisches Archiv für Physiologie* **73**, *Supplement* **8**: 1-151. (English summary)
Studied the distribution of nucleic acid-protein in the salivary gland chromosomes of a *Chironomus* species which the photographs indicate to be *C. thummi* [=*C. riparius*]. The chromosomes are built alternatingly of nucleic acid-rich and nucleic acid-free segments. Following digestion of some of the nucleic acid-rich segments, there appeared a highly organised structure, not previously seen. Both segment-types contained proteins. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Caspersson, T. 1956. Quantitative cytochemical determinations on endonuclear structures. *Cold Spring Harbor Symposia on Quantitative Biology* **21**: 1-18.
Describes and figures studies of ultra-violet absorption spectra in the nucleolus and Balbiani rings of *Chironomus thummi* [=*C. riparius*], indicating that the curves obtained, and those of the corresponding parts of the chromosome, showed characteristic similarities. Following quantitation of the technique, it was shown that the mass of the nucleolus of small larvae was 30 times lower than that of fullgrown larvae. (Partim)

Specialised subjects: Techniques, Polytene chromosomes - nucleolus organiser
Species: *Chironomus thummi* [=*C. riparius*]

Cavalier-Smith, T. 1978. Nuclear volume control by nucleoskeletal DNA, selection for cell volume and cell growth rate, and the solution of the c-value paradox. *Journal of Cell Science* **34**: 247-278.
In speculating that middle repetitive DNA has a role in transcriptional control, it is noted that *Chironomus*, along with *Drosophila*, has a different pattern of interspersion of such DNA. This is considered consistent with the possibility that polytene chromosomes require different replication controls. It is also postulated that eukaryote DNA can be divided into genic DNA (G-DNA) and nucleoskeletal DNA (S-DNA), the latter serving to determine nuclear volume. The E-chromosomes of Orthocladiinae are suggested to be composed of only S-DNA, which is not needed in somatic cells. (Partim)

Specialised subjects: Chromosomal morphology - DNA content
Species: *Chironomus* spp.

Cave, M.D. 1968a. Chromosomal protein and DNA synthesis studied in giant polytene chromosomes. *Abstracts of the 81st Session of the American Association of Anatomists. Anatomical Records* **160**: 329.
Double isotope autoradiographs of the salivary gland of *Chironomus thummi* [=*C. riparius*] show that all of the cells in the gland incorporate amino acids into the chromosomal protein. Few cells incorporate thymidine-^{14}C into DNA. Incorporation of amino acids into chromosomal protein is blocked by treatment with cyclohexamide. Other findings summarise those of Cave (1968b).

Specialised subjects: Polytene chromosomes - structure; Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Cave, M.D. 1968b. Chromosome replication and synthesis of non-histone proteins in giant polytene chromosomes. *Chromosoma* **25**: 392-401.
Studied synthesis of chromosomal proteins in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] by means of autoradiography. Incorporation of tryptophane-^{3}H into non-histone proteins does not increase during DNA synthesis, nor is there a difference in incorporation between cells which are actively replicating DNA and those that are not. Chromosomes of cells which are replicating DNA incorporate about twice as much lysine-^{3}H as those of cells which are not replicating DNA, as a result of histone synthesis.

Specialised subjects: Polytene chromosomes - structure; Chromosomal replication - protein synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Chu, J. 1946. Reaction of nucleic acid to aceto-carmine. *Nature* **157**: 513-514.
Tested the effect of N hydrochloric acid on the staining of the salivary gland chromosomes of a *Chironomus* species. Concludes that the clarity of staining can be improved by treating the glands for three minutes. After this time the level of staining progressively decreases. No illustrations. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Chu, J. & Pai, S. 1945. Constitution of the salivary gland chromosomes of *Chironomus*. *Nature* **155**: 482.
Isolated salivary gland chromosomes and treated them with N hydrochloric acid for varying times in order to resolve the problem of whether the nucleic acid was in the chromosomes themselves or in the nuclear sap. When stained with Feulgen immediately following isolation the chromosomes showed the normal bands and interbands. Following progressively longer periods of HCl treatment, the chromosomes became progressively less stained. The results are interpreted as indicating the nucleic acid is a component of the chromosomes themselves. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Chubareva, L.A. 1971. On the problem of supplementary chromosomes and the parallelism of hereditary variation in certain dipterous insects. *Doklady Akademiia Nauk, S.S.S.R.* **196**: 695-697. [Translated in *Doklady Biological Sciences* **196**: 35-37]
Notes the collection of five different *Chironomus* species, but deals only with *Chironomus* gp. *salinarius*, a species which is different from the *C. salinarius* described by Keyl and Keyl (1959). In seven of the 22 larvae analysed there was a small supernumerary chromosome in addition to the usual four pairs of chromosomes. This is considered to be further evidence of similarity in the genetic variability of Chironomidae and Simuliidae. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes, B chromosomes
Species: *Chironomus salinarius* gp.

Chubareva, L.A. 1974. Chromosomal polymorphism in the natural populations of the black flies and some other Diptera. *Tsitologiya* **16**: 267-280. (In Russian, English summary)
Notes the occurrence of supernumerary chromosomes in three species of chironomid, and makes comparison to the occurrence of such chromosomes in simuliids. Uses the name *Chironomus melanopus* which is considered a nomen dubium.(Partim)

Specialised subjects: Supernumerary chromosomes - population studies
Species: *Chironomus melanopus*, *C. salinarius* gp., *Glyptotendipes paripes*

Chubareva, L.A. 1977. Karyological features and phylogenetic connections of the relict species in the subfamily Gymnopaidinae (Diptera, Simuliidae). *Tsitologiya* **19**: 198-209. (In Russian, English summary)
A photograph of the polytene chromosomes of *Orthocladius* sp., is given to enable comparison of certain similarities of chromosome structural peculiarities with primitive Simuliidae such as *Gymnopais trifaistulatus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Orthocladius* species

Chubareva, L.A. 1980. The karyotypes of three species of Tanypodinae (Chironomidae). *New data on karyosystematics of Diptera. Trudy Zoologicheskogo Institut Academiia Nauk, S.S.S.R.* **95**: 65-67. (In Russian, English summary)
Three species of Tanypodinae were examined and found to have different chromosome numbers, chromosome lengths and structural characteristics of the polytene chromosomes. Photographic maps of the polytene chromosomes, as well as figures of the mitotic complement, are given for *Anatopynia plumipes* (2n=10), *Psectrotanypus varius* (2n=16), and *Procladius* sp. (2n=8).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Anatopynia plumipes*, *Psectrotanypus varius*, *Procladius* species

Chubareva, L.A. 1986. Juxtaposition of karyological characters of blackflies and chironomids. *Evolyutsiya, vidoobrazovanie i sistematika khironomid, Novosibirsk,* pp 36-44. (In Russian)
This article not seen.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Not known

Ciaccio, G. 1939a. Osservazioni in campo oscuro e a luce ordinaria sulle ghiandole salivari di *Chironomus*. *Atti della Reale Accademia nazionale dei Lincei Rendiconti (6s)* **29**: 89-94.
Reviews the occurrence and appearance of salivary gland polytene chromosomes in Diptera, particularly Chironomidae. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*, *C. thummi* [=*C. riparius*]

Ciaccio, G. 1939b. Nuove osservazioni sui nuclei delle ghiandole dei Ditteri. *Atti della Reale Accademia nazionale dei Lincei Rendiconti (6s)* **29**: 507-511.
Follows on from earlier review (Ciaccio 1939a), but dealing mainly with the structure of the salivary gland polytene chromosomes. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Ciaccio, G. 1943. Ricerche sulle ghiandole salivari dei Ditteri. I. Cromosomi giganti studiati con la microfotografia a raggi ultra-violetti. *Protoplasma* **37**: 161-170. (German summary)
Observations on microphotography of living salivary gland chromosomes and of the effects of various fixatives and stains on the appearance. Illustrated with photographs from *Chironomus thummi* [=*C. riparius*].

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Clever, U. 1961a. Genaktivitäten in den Riesenchromosomen von *Chironomus tentans* und ihre Beziehungen zur Entwicklung. I. Genaktivierungen durch Ecdyson. *Chromosoma* **12**: 607-675. (English summary)
Investigates the relationship between metamorphosis, induced by injection of ecdysone, and the correlated changes in gene activity in the salivary gland chromosomes of *Chironomus tentans*. A new puff is induced within 15-30 mins after the injection and further puffs continue to appear over the following 72hrs. Not all puffs are affected however, since the Balbiani rings show no reaction. Concludes that the puffing reactions fall into three categories: Early reacting genes, puffs that are not specific for development, and late reacting genes. Puff I-18-C appears to be closest to the primary reaction site of the hormone. Some of the induced puffs are illustrated.

Specialised subjects: Puffs - developmental sequence, experimental induction
Species: *Chironomus tentans*

Clever, U. 1961*b*. Zur Wirkungsweise der Gene. Untersuchungen an Funktions-strukturen von Chromosomen. *Umschau in Wissenschaft und Technik* **61**: 715-719.
Reviews studies on the structure of bands and puffs in salivary gland chromosomes of *Chironomus*. Includes photographs, drawings and an autoradiograph.

Specialised subjects: Puffs - structure
Species: *Chironomus pallidivittatus, C. tentans*

Clever, U. 1962*a*. Genaktivitäten in den Riesenchromosomen von *Chironomus tentans* und ihre Beziehungen zur Entwicklung. II. Das Verhalten der Puffs während des letzen Larvenstadiums und der Puppenhäutung. *Chromosoma* **13**: 385-436. (English summary)
Investigated the constancy of puffing pattern in the fourth instar larvae of *C. tentans*. While the puffing frequency may be altered experimentally, the pattern reflected environmental conditions rather than developmental stage. At the onset of pupation the frequency of those puffs which were not specific for development decreased. There is also variation in the size of puffs which was taken to indicate differential levels of activity. There were further puffs which were specific to the time of larval moult. These puffs could be activated by hormone injection and become active in less than an hour. These genes are therefore regulated by ecdysone and may be used for discussions of gene regulation.

Specialised subjects: Puffs - developmental sequence, experimental induction
Species: *Chironomus tentans*

Clever, U. 1962*b*. Genaktivitäten in der Riesenchromosomen von *Chironomus tentans* und ihre Beziehungen zur Entwicklung. III. Das Aktivität-muster in phasen der Entwicklungsruhre. *Journal of Insect Physiology* **8**: 357-376. (English summary)
Puffs are less frequent in dormant larvae, indicative of the lower metabolism during dormancy. While some puffs are greatly reduced in frequency, the frequency of others is unchanged or even increased. Dormant prepupae lack all puffs specific for metamorphosis. However in the pupal moult following dormancy the same sequence of gene activations occurred. Many drawings of segments of the polytene chromosomes of *C. tentans* are provided.

Specialised subjects: Puffs - developmental sequence

Species: *Chironomus tentans*

Clever, U. 1962*c*. Über das Reaktionssystem einer hormonalen Induktion. Untersuchungen an *Chironomus tentans*. *Zoologische Anzeiger Supplement*. 1961, **25**: 75-92.
Reviews the work on puff induction in the polytene chromosomes of *C. tentans* by ecdysone, including original data. Illustrated by line drawings and electron micrographs. Includes discussion following the paper.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Clever, U. 1962*d*. Hormone kontrollieren Gen-Aktivitäten in der Insekten-entwicklung. *Umschau in Wissenschaft und Technik* **62**: 70-73.
A semi-popular review of the evidence for hormonal control of puffing in polytene chromosomes, and for puffs as indicators of gene activity. Illustrated by line drawings, including puffs from salivary gland and rectal polytene chromosomes.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1962*e*. Untersuchungen an Riesenchromosomen über die Wirkungs-weise der Gene. *Materia medica Nordmark* **14**: 438-452.
Reviews the structure of polytene chromosomes and the evidence for puffs as active genes. Describes the normal time course of activity of puffs and the results of studies on experimental induction. Illustrated by photographs and drawings, some original and some reproduced from other publications.

Specialised subjects: Puffs - gene activity
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus, C. tentans*

Clever, U. 1962*f*. Quantitative relationships between hormone dosage and gene activity patterns in the development of *Chironomus tentans*. *Abstracts of Papers Presented at the Conference of European Endocrinologists*. *General and Comparative Endocrinology* **2**: 604.
Injections of low doses of pure ecdysone into fourth instar larvae of *C. tentans* indicated that, when first induced, the puffs are small but increase in size as the dose increases. The results reflect the time course of puff development in normal larval development. It is therefore concluded that hormone titres at the beginning of the pupal moult are low (about 10^{-12} g/ mg larval weight) but increase to more than 10^{-9} g for old prepupae. It is estimated that there are about 10 molecules of ecdysone per haploid set of chromatids.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1963*a*. Einige Bemerkungen über die Regulation von Genaktivitäten in Riesenchromosomen. *Funktionelle und morphologische Organisation der Zelle. Wissenschaftliche Konferenz der Gesellschaft Deutscher Natur-forscher und Ärtze, Rottach-Egern, 1962*: 30-39.
Reviews the time-course of development of puffs in the salivary gland chromosomes of *Chironomus tentans*, and the effect of ecdysone injections.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus tentans*

Clever, U. 1963*b*. Von der Ecdyson-konzentration abhängige Genaktivitäts-muster in den Speicheldrüsenchromosomen von *Chironomus tentans*. *Developmental Biology* **6**: 73-98. (English summary)
Presents a more detailed account of the results summarised in Clever (1962f). In addition it studies the duration of puffs following an injection of hormone. Puff I-18-C disappears more slowly than does puff IV-2-B, in agreement with the higher doses needed to activate the latter puff. The results are in accord with the pattern seen in natural development, where puff IV-2-B appears about two days after puff I-18-C, when ecdysone titres would be higher. Line drawings of the changes in the two puffs are given.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1963*c*. Gene activities and gene activations in the hormonal control of molting in insects. *Proceedings of the 16th International Congress of Zoology, Washington, D.C.*, **4**: 256-263.
Different loci in the salivary gland chromosomes of *Chironomus tentans* respond differently during development. Some are continuously active while others only become active for specified periods during development. Loci in this latter category respond to treatment with ecdysone, some

producing puffs within 15-30 minutes. The evidence suggests that most of the response to ecdysone is for metamorphosis rather than for moulting. There is no evidence for a direct action of ecdysone on the chromosome.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus tentans*

Clever, U. 1963*d*. Genaktivitäten in den Riesenchromosomen von *Chironomus tentans* und ihre Beziehungen zur Entwicklung. IV. Das Verhalten der Puffs in der Larvenhäutung. *Chromosoma* 14: 651-675. (English summary)
A detailed study of puffing patterns in the third instar larva, and in the final larval moult, of *C. tentans*. This differs markedly from the pupal moult previously studied (e.g. Clever 1962*a*). The major difference is in the titre of juvenile hormone which is much higher than during the pupal moult. All long lasting puffs and most intermittent puff loci are the same throughout the larval instars and the larval and pupal moults. Puffs which occur during the larval moult also appear during the pupal moult, only one puff being larger during the larval moult than at any other stage. Most puffs occurring during the pupal moult are not active during the larval moult. From the puffs which do occur at both moults it is concluded that the primary action of ecdysone is the same in both larval and pupal moults and is therefore independent of the titre of the hormone. The behaviour of puffs during development is classified into eight categories, based on their activity during and between moults.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus tentans*

Clever, U. 1963e. *Über die Genaktivitäten und ihre Regulation in der Entwicklung von* Chironomus tentans. Habilitationsschrift, Mathematisch-naturwissenschaftlichen Fakultät, Universität Tübingen, Germany. 61pp.
Studied changes in gene activity during development and under the effects of juvenile hormone and ecdysone. Drawn from the studies published in Clever (1961*a*, 1962*b*, 1962*c*, 1962*f*) and Clever & Karlson (1960). Illustrated by photographs and drawings.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus tentans*

Clever, U. 1964*a*. Puffing in giant chromosomes of Diptera and the mechanism of its control, pp. 317-334. *In* Bonner, J. & Ts'o, P. (eds.), *Nucleohistones*. 398pp. Holden Day, San Francisco.
Reviews the structure of puffs in polytene chromosomes, the time-course of their development and the effect of ecdysone injections, with reference to *Chironomus tentans*. Some illustrations, as well as photographs of chromosome IV to show puffs and the Balbiani rings.

Specialised subjects: Puffs - structure, developmental sequence
Species: *Chironomus tentans*

Clever, U. 1964*b*. Genaktivitäten und ihre Kontrolle in der tierischen Entwicklung. *Die Naturwissenschaften* **51**: 449-459.
A review of gene activation and regulation in insect development based largely on studies of salivary gland puffs of *Chironomus tentans*. Notes that puffs can be modified in size, and therefore in metabolic efficiency, by environmental factors. Transplantation experiments show that a transplanted gene takes on the pattern of development appropriate to the stage of development of the host. While differential gene activity is the major cause of tissue and stage specific manifestation of genetic information, it is possible that other processes may also be involved. Includes some original work as well as photographs or drawings of some puffed regions.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1964*c*. Actinomycin and puromycin: effects on sequential gene activation by ecdysone. *Science* **146**: 794-795.
Treatment with actinomycin to inhibit RNA synthesis leads to a delay in the appearance of all puffs normally stimulated by ecdysone. However treatment with puromycin, to inhibit protein synthesis, delays the appearance of only those puffs which normally appear some time after ecdysone stimulation. It is therefore concluded that ecdysone stimulates the early appearing puffs, whose gene products in turn stimulate the later appearing puffs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1964*d*. Gene physiological studies in giant chromosomes of Diptera. *Proceedings of the 6th International Congress of Biochemistry*, **3**: 195-196. (Abstract)
Briefly describes polytene chromosomes and the phenomenon of puffing. Notes that puffs correspond to a single informational locus and that they can be regulated by ecdysone. List other substances that have been investigated for their effect of puffing patterns in the salivary glands.

Specialised subjects: Puffs - genetic control
Species: *Chironomus tentans*

Clever, U. 1965*a*. The effect of ecdysone on gene activity patterns in giant chromosomes, 142-148. *In* Karlson, P. (ed.), *Mechanisms of hormone action. NATO Advanced Study Institute, Meersburg,* 1964, 275pp. Georg Thieme, Stuttgart.
A brief review of the effect of ecdysone and puromycin on puffing in the salivary gland chromosomes of *Chironomus tentans*.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1965*b*. The control of gene activity as a factor of cell differentiation in insect development. *Developmental and metabolic control mechanisms and neoplasia. Proceedings of the 19th Symposium on Fundamental Cancer Research, Houston, Texas*: 361-375.
A review of puff formation in the salivary gland chromosomes, mostly in *Chironomus tentans*. Discusses the time-course of puff formation and hormonal control.

Specialised subjects: Puffs - developmental sequence
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus,C. tentans*

Clever, U. 1965*c*. Chromosomal changes associated with differentiation. *Genetic Control of Differentiation. Brookhaven Symposia in Biology* **18**: 242-253.
Reviews recent work on the changes in chromosomal morphology during differentiation, particularly in Chironomidae, and considering especially the factors which affect puff formation and the nature of heterochromatin.

Specialised subjects: Polytene chromosomes - :structure; Puffs - gene activity
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Clever, U. 1965*d*. Puffing changes in incubated and ecdysone treated *Chironomus tentans* salivary glands. *Chromosoma* **17**: 309-322.
Salivary glands of *C. tentans* were incubated in a variety of media to investigate their effect on puffing patterns. While high concentrations of sodium or potassium (0.18M) led to appearance of oversize puffs, no changes resembled the pattern produced by the moulting hormone. Incubation of prepupal gland did not lead to disappearance of the puffs characteristic of this stage. In most media, ecdysone had the same effect in inducing puffs as *in vivo*. The results suggest that ecdysone does not exert its effect via a change in the intracellular K^+/Na^+ ratio.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1966*a*. Gene activity patterns and cellular differentiation. *American Zoologist* **6**: 33-41.
Reviews the data relating puffing in polytene chromosomes of chironomids and gene activity. The data are discussed in relation to the general problem of the relationships between patterns of gene activity and differentiation.

Specialised subjects: Puffs - genetic control
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus thummi* [=*C. riparius*], ;*C. pallidivittatus*, *C. tentans, Trichocladius* sp. [=*Halocladius varians*]

Clever, U. 1966*b*. Induction and repression of a puff in *Chironomus tentans*. *Developmental Biology* **14**: 421-438.
Puffs I-18-C and IV-2-B seem to be controlled by the concentration of ecdysone. Towards the end of the pupal moult, the latter puff regresses while the former is still of maximal size. Injection of ecdysone at this stage does not reinduce IV-2-B. If haemolymph from prepupae at this stage is injected into intermoult larvae it simulates the effect of ecdysone, indicating the titre of ecdysone is still high. Treatment with cycloheximide results in the reappearance of IV-2-B, unless actinomycin D is present. There appears to be an antagonistically acting factor present at this late prepupal stage, the action of which relies on continuous protein synthesis. The effects are illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. 1967. Control of chromosome puffing, pp161-186 *In* Goldstein, L. (ed.) *The Control of Nuclear Activity. Twentieth Annual Meeting of the Society of General Physiologists*. 498pp. Prentice Hall, New Jersey.
Reviews the factors which affect chromosomal puffing in Chironomidae and Drosophilidae. Reports also some new studies on the effects of actinomycin and ecdysone on puffs in *Chironomus tentans*, including photographs.

Specialised subjects: Puffs - developmental sequence,experimental induction
Species: *Chironomus tentans, C. :thummi* [=*C. riparius*]

Clever, U. 1968. Regulation of chromosome function. *Annual Review of Genetics* **2**: 11-30.
Reviews the morphology of puffs in salivary gland chromosomes, the evidence that they are sites of gene action and the data for regulation of their activity. No illustrations. (Partim)

Specialised subjects: Puffs - structure,genetic control
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus,C. tentans, C. :thummi* [=*C. riparius*]

Clever, U. 1969. Chromosome activity and cell function in polytenic cells. II. The formation of secretion in the salivary glands of *Chironomus*. *Experimental Cell Research* **55**: 317-322.
When RNA synthesis was inhibited in *Chironomus* for long periods, there was continued production of secretory proteins. This indicates that the RNA produced by the Balbiani rings must be stable over long periods and that this stability does not change during the course of development.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus pallidivittatus, C. tentans*

Clever, U. & Beermann, W. 1963. Studies of nucleo-cytoplasmic inter-relations in giant chromosomes of Diptera. *Proceedings of the 16th International Congress of Zoology, Washington, D.C.* **3**: 210-215.
Ecdysone was injected into larvae of *Chironomus tentans* to examine the effect on specific puffs, known to respond to the hormone. The results were consistent with the hypothesis that the hormone acts directly on the genes themselves, although subsequent changes at other loci are not directly influenced by ecdysone, but rather through the action of those loci which are directly regulated by it.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U., Bultmann, H. & Darrow, J.M. 1969. The immediacy of genomic control in polytenic cells, pp 403-423. *In*: Hanly, E.W.(ed.), *Problems in Biology: RNA in Development. Park City International Symposium on Problems in Biology, 1968*. University of Utah Press, Salt Lake City.
Reviews studies which indicate the relationship between puff formation and RNA synthesis in salivary gland cells. (Partim)

Specialised subjects: Puffs - RNA synthesis, experimental induction
Species: *Chironomus pallidivittatus, C. tentans*

Clever, U. & Ellgaard, E. 1970. Puffing and histone acetylation in polytene chromosomes. *Science* **169**: 373-374.
Studies the effect of different fixatives on the retention of histones in polytene chromosomes in an attempt to resolve the controversy concerning this matter (see Allfrey *et al*. 1968). They found that [^{3}H]acetate is not incorporated preferentially into existing or newly induced puffs but diffusely into the polytene chromosomes. They conclude that puff formation does not include an acetylation of histones.

Specialised subjects: Puffs - structure
Species: *Chironomus tentans*

Clever, U. & Karlson, P. 1960. Induktion von Puff-Veränderungen in den Speicheldrüsen-chromosomen von *Chironomus tentans* durch Ecdyson. *Experimental Cell Research* **20**: 623-626. (English summary)
Two hours after injection of ecdysone into fourth instar larvae of *C. tentans* a new puff in the chromosome I appears while another one disappears. Since these changes are characteristic of those occurring at metamorphosis, it is suggested that the primary effect of ecdysone is to alter the activity of specific genes. The development of the puff is illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Clever, U. & Romball, C.G. 1966. RNA and protein synthesis in the cellular response to a

hormone, ecdysone. *Proceedings of the National Academy of Sciences, U.S.A.* **56**: 1470-1476.
Inhibition of RNA synthesis prevented the appearance of the usual puffs in response to ecdysone, the puffs appearing only after RNA synthesis resumed. Inhibition of protein synthesis had no effect on the appearance of the first puffs but no further puffs in the sequence appeared. The effect of the addition of cyclohexamide is illustrated.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Clever, U. & Storbeck, I. 1970. Chromosome activity and cell function in polytenic cells. IV. Polyribosomes and their sensitivity to actinomycin. *Biochimica et Biophysica Acta* **217**: 108-119.
The idea that puffing reflected gene activity was extended to include the usage of mRNA by polyribosomes. Inhibition of RNA synthesis by actinomycin causes a decay of polyribosomes in young fourth instar larvae but has no effect in older ones. This supports the hypothesis that mRNAs of different stability are active in these two different developmental stages.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Colman, O.D. & Stockert, J.C. 1975. Puffing patterns during the fourth larval instar in *Chironomus pallidivittatus* salivary glands. *Chromosoma* **53**: 381-392.
Studied the time course of development of the Balbiani rings and other puffs in fourth instar larvae and prepupae of *C. pallidivittatus* or F1 hybrids of this species and *C. tentans*.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus pallidivittatus, C. tentans*

Cortés, E., Botella, L.M., Barettino, D. & Díez, J.L. 1989 Identification of the spI products of Balbiani ring genes in *Chironomus thummi*. *Chromosoma* **98**: 428-432.
Examined the spI proteins electrophoretically and found a fast and a slow component. The slow migrating component (spIb) is present throughout the 4th larval instar, while the faster fraction (spIa) is abundant in the early 4th instar larva and the prepupa, but is only present in small amounts in the mid 4th instar. By correlation with the puffing pattern of the Balbiani rings, it is assumed that BR1 encodes spIa and BR2 encodes spIb. Treatment with galactose supported this conclusion. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus :thummi* [=*C. riparius*]

Crozier, R.H. 1975. Centromeric region pairing in somatic chromosomes of the midge *Chironomus tentans* (Diptera, Chironomidae). *Canadian Journal of Genetics and Cytology* **17**: 193-195. (English and French summary)
At mitotic metaphase in the supraoesophageal ganglion cells of *C. tentans* there appear to be seven metacentric chromosomes due to the pairing of the centromere regions of the two acrocentric chromosomes. A small percentage of cells appear to be haploid but with larger chromosomes. These are interpreted as the result of centromeric pairing of all chromosomes. The results are similar regardless of whether the larvae are of normal biparental origin or restituted eggs from virgin females.

Specialised subjects: Centromere - interactions between chromosomes
Species: *Chironomus tentans*

Da Cunha, A.B. 1955. Chromosomal polymorphism in Diptera. *Advances in Genetics* **7**: 93-138.
Reviews the occurrence of chromosomal polymorphism in various species of Diptera. For *Chironomus* he notes that inversions are present in some species but not in others, and that differences in inversion frequency occur between populations of the same species. In some species there is evidence of heterozygote superiority, while in others no such evidence is apparent. The presence of a complex rearrangement, requiring four simultaneous breaks, is noted in a Chinese *Chironomus* species, which also was heterozygous for a 'bulb'. Hybridisation can occur between *C. pallidivittatus* and *C. tentans* to give individuals with normal viability but which are heterozygous for a number of inversions. Finally, it is noted that in meiosis of *C. dorsalis* [=*C. luridus*] and *C. riparius* heterozygous for inversions, no chiasmata appear to occur within the inversions. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Inversions - polymorphy
Species: *Chironomus cingulatus*, *C. dorsalis* [=*C. luridus*], *C. pallidivittatus*, *C. tentans*, *C. :thummi* [=*C. riparius*]

Da Cunha, A.B. 1966. Chromosomal variation and adaptation in insects. *Annual Review of Entomology* **5**: 85-110.
Reviews the evidence for chromosomal polymorphism being adaptive in insects. Notes that there is no evidence of differential mortality of the carriers of different karyotypes in *Chironomus tentans* and *C. dorsalis* [=*C. luridus*]. The occurrence of non-random associations between inversion polymorphisms has been detected in *C. tentans*, and between an inversion and the male determining gene in *C. annularius* and *C. luridus*. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Inversions - adaptive significance
Species: *Chironomus annularius*, *C. dorsalis* [=*C. luridus*], *C. tentans*

Daneholt, B. 1970. Base ratios in RNA molecules of different sizes from a Balbiani ring. *Journal of Molecular Biology* **49**: 381-391.
The base ratio of high molecular weight RNA produced by BR2 in the salivary gland chromosomes of *Chironomus tentans* was found to differ from that of high molecular weight RNA produced in the nucleoli or on chromosomes I to III. RNA molecules of different sizes produced within BR2, or within chromosomes I-III, showed no difference in base ratio. The conclusion that this may indicate that the different size RNA molecules produced by the BR contain repeating sequences was confirmed by later work (e.g. Degelmann & Hollenberg 1981; Case & Brower 1983).

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. 1972. Giant RNA transcript in a Balbiani ring. *Nature New Biology* **240**: 229-232.
It is demonstrated that a very high molecular weight RNA molecule is transcribed from Balbiani ring 2 in *Chironomus tentans* salivary gland chromosomes. This supports the concept of the chromomere as a unit of transcription.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. 1974. Transfer of genetic information in polytenic cells. *International Review of Cytology, Supplement* **4**: 417-462.
Reviews the structure of polytene chromosomes, chromomeres and puffs, and the evidence for the chromomere as a genetic unit. It then reviews the progress made in studying gene action using puffs, particularly Balbiani rings in *Chironomus*, concluding that molecular analysis will add more to our knowledge. However, he cautions that the results may not be of universal applicability. Illustrated by line drawings, photographs and electron micrographs of polytene chromosomes from *C. tentans*. (Partim)

Specialised subjects: Polytene chromosomes - structure, Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. 1975. Transcription in polytene chromosomes. *Cell* **4**: 1-9.
Reviews the structure of polytene chromosomes and studies of gene activity using these chromosomes. Includes a photograph of chromosome 4 of *Chironomus tentans* and an electronmicrograph of portion of a chromatin loop from BR2.

Specialised subjects: Polytene chromosomes - structure, Puffs - Balbiani rings, gene activity
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Daneholt, B. 1976. Nuclear RNA. *Handbook of Genetics* **5**: 189-217.
In a general review of RNA in the nucleus, makes mention of Balbiani ring RNA, particularly that produced by BR2 of *Chironomus tentans*. The HnRNA produced from such sites is growing RNA, and may constitute a larger proportion of total HnRNA than previously realised. Briefly considers the data on the transport of BR2 75S RNA from the site of production to the cytoplasm. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B., Andersson, K. & Fagerlind, M. 1977. Large-sized polysomes in *Chironomus tentans* salivary glands and their relation to Balbiani ring 75S RNA. *Journal of Cell Biology* **73**: 149-160.
The RNA in large polysomes from the salivary glands of *C. tentans* is shown to contain sequences from Balbiani rings 1 and 2.

Specialised subjects: Puffs - Balbiani rings, gene activity

Species: *Chironomus tentans*

Daneholt, B., Case, S.T., Derksen, J., Lamb, M.M., Nelson, L. & Wieslander, L. 1977. The size and chromosomal location of the RNA transcription unit in Balbiani ring 2. *Cold Spring Harbor Symposia on Quantitative Biology, 1976,* **42**: 867-876.
Present evidence that BR2 of *Chironomus tentans* is formed by a broad band in region 3B of chromosome 4. The transcription unit of this Balbiani ring was estimated to be 37kb, most of which must be in the chromomere itself, but may include repeats within its length. Photographs of BR2 location, including in Malpighian tubule chromosomes, are presented. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Daneholt, B., Case, S.T., Hyde, J., Nelson, L. & Wieslander, L. 1977. Production and fate of Balbiani ring products. *Progress in Nucleic Acid Research and Molecular Biology* **19**: 319-334.
Briefly describe the morphology of Balbiani rings as seen under the electron microscope, with electron micrographs. Notes that granules similar to those seen on the BRs, but lacking stalks are abundant in the nuclear sap. These granules are assumed to represent packaged RNA from the puffs. Polysomes from the salivary gland cells can be categorised as heavy or light. RNA was extracted from both types and tested for homology to that in the BRs by *in situ* hybridisation. The results, illustrated, indicate that RNA from BR1 and BR2 goes into both the heavy and light polysomes. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Daneholt, B., Case, S.T., Lamb, M.M., Nelson, L. & Weislander, L. 1978. The 75S RNA transcription unit in Balbiani ring 2 and its relation to chromosome structure. *Philosophic Transactions of the Royal Society of London, B* **283**: 383-389.
The transcription unit of BR2 producing 75S RNA is further investigated. RNA from polysomes is shown to *in situ* hybridise to the same chromosomal location in both salivary gland and rectal polytene chromosomes (illustrated by photographs). It is concluded that the size of the transcription unit is about 30,000 base pairs, with a long coding segment (at least 6,000bp). The sequences are probably distributed over three chromomeres. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B., Case, S.T. & Weislander, L. 1977. Evidence for expression of Balbiani ring products, pp.485-496. *In* The Organization and Expression of the Eukaryotic Genome. Proceedings of the International Symposium on the Organization and Expression of the Eukaryotic Genome, Teheran, Iran, 1976. Academic Press, London.
RNA from Balbiani rings (BR1 and BR2) of *Chironomus tentans* is present in large polysomes as 75S RNA. RNA extracted from large polysomes was shown to label both BR1 and BR2 in *in situ* hybridisation experiments, which are illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. & Edström, J.-E. 1967. The content of deoxyribonucleic acid in individual polytene chromosomes of *Chironomus tentans*. *Cytogenetics* **6**: 350-356.
The DNA content of individual polytene chromosomes was measured for the two largest size classes in fourth instar larvae. The results indicate that most or all chromatids carry out one replication between these two stages. DNA contents were correlated to chromosome lengths and the average amount of DNA per band was similar in each of the chromosomes. Using estimates of the number of bands in the genome and the probable DNA content per chromatid, the average amount of DNA per band was estimated as 10^{-16}g, corresponding to about 10^{5} base pairs. The bands therefore either represent complex functional units or contain much DNA with no informational content.

Specialised subjects: Polytene chromosomes - structure
Species: *:tentans*

Daneholt, B. & Edström, J.-E. 1969. The DNA base composition of individual chromosomes and chromosome segments from *Chironomus tentans*. *Journal of Cell Biology* **41**: 620-624.
The base composition of the DNA was determined for each chromosome of *C. tentans*, as well as for each of six segments of chromosome 1. The results indicate a low guanine + cytosine content of about

30%, although variation existed between chromosomes and between segments of the same chromosome. This variation could, however, be due to the limits of accuracy of the technique. The low GC value was not a function of the polytenic nature of the chromosomes since DNA from testis gave similar values.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Daneholt, B., Edström, J.-E., Egyhazi, E., Lambert, B. & Ringborg, U. 1969*a*. Physico-chemical properties of chromosomal RNA in *Chironomus tentans* polytene chromosomes. *Chromosoma* **28**: 379-398.
Polytene chromosomes were isolated from the salivary glands, free of nucleoli and nuclear sap. The RNA produced from these chromosomes was analysed by electrophoresis in agarose. Most of the material was between 10S and 90S, with a peak at about 35S, with some activity also at 4-5S. This indicated the formation of molecules of high molecular weight.

Specialised subjects: Polytene chromosomes - structure, Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Daneholt, B., Edström, J.-E., Egyhazi, E., Lambert, B. & Ringborg, U. 1969*b*. Chromosomal RNA synthesis in polytene chromosomes of *Chironomus tentans*. *Chromosoma* **28**: 399-417.
The salivary gland chromosomes of *C. tentans* were separated into two groups, one containing the three long chromosomes, the other containing just chromosome 4. Chromosomes 1-3 produced heterogeneous , high molecular weight RNA with a peak around 35S. This RNA was completely turned over within 45 min. Chromosome 4 produced a similar spectrum of RNA but the turnover time from a Balbiani ring was less than 30 min. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Daneholt, B., Edström, J.-E., Egyhazi, E., Lambert, B. & Ringborg, U. 1969*c*. RNA synthesis in a Balbiani ring in *Chironomus tentans* salivary gland cells. *Chromosoma* **28**: 419-430.
In a continuation of the work reported in the previous two papers (Daneholt *et al. 1969a*, 1969*b*), the RNA produced by the single chromomere of BR2 was analysed and found to be as heterogeneous as that produced by whole chromosomes, but that the peak of the size range was somewhat larger at about 50S. When the synthetic activity of BR2 was high, there was an increased production of molecules of high molecular weight. When the synthetic activity of BR1 and BR2 was compared, there was good correlation with the relative sizes of the puffs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B., Edström, J.-E., Egyhazi, E., Lambert, B. & Ringborg, U. 1970. RNA synthesis in a Balbiani ring in *Chironomus tentans*. *Cold Spring Harbor Symposia on Quantitative Biology, 1969,* **35**: 513-519.
Review the evidence that the transcription unit of BR2 is redundant and that, therefore, the variable size of the RNA molecules produced is due to uninterrupted transcription of a number of unit templates. Illustrated with phase contrast photographs of salivary gland chromosomes *in vitro*. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. & Hosick, H. 1973. Evidence for transport of 75S RNA from a discrete chromosome region via nuclear sap to cytoplasm in *Chironomus tentans*. *Proceedings of the National Academy of Sciences* **70**: 442-446.
Nonribosomal, high molecular weight RNA molecules of from 15S to 100S were produced by salivary gland chromosomes 1 to 3, while BR2 produced mainly 75S RNA. Since 75S RNA can be demonstrated in the cytoplasm up to a week later, it is assumed that the RNA is transferred from BR2 to the cytoplasm via the nuclear sap with no measurable reduction in size. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Daneholt, B. & Hosick, H. 1974. The transcription unit in Balbiani ring 2 of *Chironomus tentans*. *Cold Spring Harbor Symposia on Quantitative Biology, 1973*. **38**: 629-635.
BR 2 in the salivary gland chromosomes of *C. tentans* is described and illustrated. Experiments are described which attempt to answer the question on the relationship between the product of this puff

and the size of the transcription unit. Only one main product is produced, the primary transcript having a size of about 15-35 million Daltons. Based on the estimated size of an average chromomere, it is concluded that the transcription unit constitutes a large part, perhaps all, of the BR2 chromomere. The transcription unit contains repeated sequences. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Daneholt, B. & Svedhem, L. 1971. Differential representation of chromosomal HRNA in the nuclear sap. *Experimental Cell Research* **67**: 263-272.
The HRNA synthesised in the salivary glands by chromosomes 1-3 and by four defined sections of chromosome 4 was analysed. All components produced HRNA in the ranges 10-15S and 80-90S, but whereas that produced by all other chromosome segments had a similar base composition, the HRNA produced by BR2 had a different base composition characterised by a high CMP/UMP activity quotient. The HRNA is preferentially represented in the nuclear sap. (Partim)

Specialised subjects: Polytene chromosomes - , Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

D'Angelo, E.G. 1946. Micrurgical studies on *Chironomus* salivary gland chromosomes. *Biological Bulletin* **90**: 71-87.
Describes the properties of nuclei and polytene chromosomes isolated into media.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus plumosus*, *C. tentans*, *C.* spp.,

Darrow, J.M. & Clever, U. 1970. Chromosome activity and cell function in polytenic cells. III. Growth and replication. *Developmental Biology* **21**: 331-348.
Chromosomes in the salivary glands of *Chironomus tentans* may show the presence of label following incubation with thymidine-^{3}H, or they may show no label. Further, the chromosomes may be continuously or discontinuously labelled as is indicated by photographs. The number of cells showing label is highest during intermolt periods and shows a marked decrease towards the end of all moulting periods. A similar pattern is shown in the Malpighian tubules. Inhibition of RNA or protein synthesis does not markedly interfere with replication at the middle of the fourth instar, but inhibits the initiation of replication at the beginning of this instar.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus tentans*

David, L.A. & Corey, M.J. 1970. Immunofluorescent studies of basic nuclear proteins. *Canadian Journal of Genetics and Cytology* **12**: 570-581.
An antibody to histones was tested against a number of tissues including the salivary gland chromosomes of *Chironomus tentans*. It reacted to most tissues tested with a decrease in intensity roughly proportional to the phylogenetic divergence of the tested species from the calf to which the antibody was developed. The results indicate that the basic nuclear histones have acquired very little variation over a long evolutionary period. (Partim)

Specialised subjects: Polytene chromosomes - phylogeny
Species: *Chironomus tentans*

Degelmann, A. & Hollenberg, C.P. 1981. A structural analysis of Balbiani ring DNA sequences in *Chironomus tentans*. *Chromosoma* **83**: 295-313.
A 150bp length of DNA was cloned from BR1 of *C. tentans*. This was shown to be part of a 240bp repeat unit of the BR1 gene. *In situ* hybridisation to the salivary gland chromosomes showed that the cloned sequence cross-hybridises to BR2 and, to a lesser extent, to BR6. A small fragment of BR2 DNA was also cloned, which suggests that this DNA is organised in a very similar manner to that of BR1. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Degelmann, A., Royer, H.-D. & Hollenberg, C.P. 1978. Organisation der ribosomalen RNS-Gene in *Chironomus tentans* und einiger verwandter Arten. *Zoologischer Anzeiger Supplement. Verhandlungen der deutsche Zoologische Gesellschaft, 1977*, **71**: 232. (Abstract)
An abstract of the work published more fully in Degelmann *et al*. (1979).

Specialised subjects: Nucleolus - structure
Species: *Chironomus tentans*

Degelmann, A., Royer, H.-D., & Hollenberg, C.P. 1979. The organization of the ribosomal RNA genes of *Chironomus tentans* and some closely related species. *Chromosoma* **71**: 263-281.
DNA from the rRNA genes of *C. tentans* was cloned. That this DNA was identical to the rDNA cistron was confirmed by *in situ* hybridisation to the salivary gland chromosomes. A photograph is provided to show that the hybridisation was to the nucleolar regions. (Partim)

Specialised subjects: Nucleolus - structure
Species: *Chironomus tentans*

Demin, S.Yu. 1986. Phenotypical variations of polytene chromosomes of the salivary glands of larval chironomids from natural populations of *Chironomus plumosus* and closely related species. *Evolyutsiya, vidoobrazovanie i sistematike khironomid, Novosibirsk,* pp.104-109. (In Russian)
This reference has not been seen, but it has been determined from other sources that refer to the work that it deals with inversion polymorphism.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus plumosus*

Demin, S.Yu. & Ilyinskaya, N.B. 1986. A spontaneous triploidy in *Chironomus plumosus* L. (Diptera, Chironomidae). *Tsitologiya* **28**: 119-123. (In Russian, English summary)
Two triploid individuals were found amongst 70 larvae of *C. plumosus* examined from two populations. The morphology of the polytene chromosomes of these larvae is described and analysed. Illustrated by photographs.

Specialised subjects: Polyploidy - spontaneous
Species: *Chironomus plumosus*

Derksen, J., Trendelenburg, M.F., Scheer, U & Franke, W.W. 1973. Spread chromosomal nucleoli of *Chironomus* salivary glands. *Experimental Cell Research* **80**: 476-479.
Salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] were spread for examination under the electron microscope. The putative nucleoli showed deoxyribonucleic protein axes associated with lateral fibrils. The size ranges of these two elements are given. The relative length of free axis on the lateral fibrils is less than that observed in the nucleoli of amphibian oocytes.

Specialised subjects: Nucleolus - structure
Species: *Chironomus thummi* [=*C. riparius*]

Derksen, J., Wieslander, L., van der Ploeg, M. & Daneholt, B. 1980. Identification of the Balbiani ring 2 chromomere and determination of the content and compaction of its DNA. *Chromosoma* **81**: 65-84.
BR2 of *Chironomus tentans* was shown to originate from band 3B10 of chromosome 4, both by cytological examination of salivary gland chromosomes with the puff developed, and by *in situ* hybridisation of labelled BR2 DNA to chromosomes in the Malpighian tubules where the puff is not developed. These regions are illustrated by photographs. It was calculated the this band contained 470kb of DNA, much more than required for between 1 and 4 75S RNA genes of 37kb. The nature of the excess DNA and the possible functional organization of the BR2 chromomere are discussed.

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Desai, L. & Tencer, R. 1968. Effects of histones and polylysine on the synthetic activity of the giant chromosomes of the salivary glands of dipteran larvae. *Experimental Cell Research* **52**: 185-197.
The polytene chromosomes of *Chironomus thummi* [=*C. riparius*] are illustrated under normal conditions and following the addition of histone or polylysine. The pattern of histone localisation closely follows the distribution of DNA in the chromosomes. The added materials are accumulated in the chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Devai, G., Miskolczi, M. & Wülker, W. 1989. Standardization of chromosome arms B, C and D in *Chironomus* (Diptera: Chironomidae). *Acta Biologica Debrecina Supplementum Oecologia Hungarica* **2**: 79-92.
Describe a standard map for chromosome arms B, C, and D of *C. piger* to complement Keyl's (1962a) standard map of arms A, E and G. The map of arm C is used to compare that of *C. piger* with those of three other species. However it appears that the identification of the bands in these other three species is not entirely correct (Wülker, *Ent. Scand.* **22**: 231-240, 1991). Illustrated by numerous photographs and by drawn maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus balatonicus*, *C. piger*, *C. plumosus*, *C.* spec. Apple Valley

Devai, G., Wülker, W. & Scholl, A. 1983. Revision der Gattung *Chironomus* Meigen (Diptera). IX. *C. balatonicus* sp. n. aus dem Flachsee Balaton (Ungarn). *Acta Zoologica Academiae Scientarum Hungaricae* **29**: 357-374.
Describe the polytene chromosomes and inversion polymorphism of *C. balatonicus* and its cytological relationship to *C. plumosus*. Although the two species occur sympatrically there is no cytological evidence of hybridisation. Illustrated by photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus, C. plumosus*

Diaz, M. Hierro, J. & de Diaz, G.D. 1971. Aminoacridine dyes and the secondary structure of DNA *in situ*. *Journal of Histochemistry and Cytochemistry* **19**: 761-765.
Used salivary gland chromosomes of a *Chironomus* species to evaluate a new method for demonstrating whether DNA is denatured or double stranded. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species,

Diez, J.L. 1973. Effect of Cordycepin (3'-desoxyadenosine) on polytene chromosomes of *Chironomus pallidivittatus* salivary glands. *Chromosoma* **42**: 345-358.
Incubation of the salivary glands of *C. pallidivittatus* in cordycepin leads to a reduction in size or to a collapse of the Balbiani rings. Despite the reduction in size, incorporation of ^{3}H-uridine still occurs in the Balbiani rings, puffs and the nucleolus. The effects are illustrated by photographs.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus pallidivittatus*

Diez, J.L. & Barettino, D. 1984. DNA-RNA hybrids and transcriptional activity in *Chironomus* polytene chromosomes. *Chromosoma* **90**: 103-110.
Detected DNA-RNA hybrids in polytene chromosomes by use of a specific probe. The hybrids were found to be located in transcriptionally active regions, except where the slide had been airdried, when they were apparently masked by protein. The DNA-RNA hybrids on such airdried slides could be unmasked by mild pronase digestion. Illustrated by many photographs.

Specialised subjects: Techniques; Puffs - RNA synthesis
Species: *Chironomus pallidivittatus, C. thummi* [=*C. riparius*]

Diez, J.L., Cortès, E., Merino, Y. & Santa-Cruz, M.C. 1990. Galactose-induced puffing changes in *Chironomus thummi* Balbiani rings and their dependence on protein synthesis. *Chromosoma* **99**: 61-70.
Compare the effects of galactose on the Balbiani rings of *C. thummi* with those reported on other species (see Beermann 1973). The main effects, a reduction in BR2 and an activation of BR1, were similar. However there was no obvious induction of other BRs as reported for the others species. Illustrated by photographs and graphs.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Diez, J.L. & de la Torre, C. 1979. ^{3}H-UTP incorporation in polytene chromosomes of *Chironomus* permeabilized cells. *Protoplasma* **101**: 81-88.
Transcriptional activity was demonstrated in fixed salivary gland chromosomes of *C. pallidivittatus*. ^{3}H-UTP was preferentially incorporated onto the nucleolus and BR2. Incorporation was inhibited by pretreatment with actinomycin D, whereas amanitin inhibited only the incorporation into the Balbiani rings. The results are illustrated photographically.

Specialised subjects: Puffs - Balbiani rings, gene activity; Nucleolus - gene activity
Species: *Chironomus pallidivittatus*

Diez, J.L., Santa-Cruz, M.C. & Aller, P. 1977. Effect of cyclohexamide on RNA synthesis in *Chironomus* polytene chromosomes. *Chromosoma* **61**: 369-379.
Treatment of the salivary glands of *C. pallidivittatus* with cycloheximide lead to changes in the morphology of the nucleolus, with the segregation of the fibrillar and granular regions. The treatments also lead to an increased uptake of ^{3}H-uridine by the chromosomes but a reduced incorporation into the nucleolus. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - gene activity

Species: *Chironomus pallidivittatus*

Diez, J.L., Santa-Cruz, M.C., Villanueva, A. & Aller, P. 1980. Dependence of Balbiani ring puffing on protein synthesis. *Chromosoma* **81**: 263-269.
When BR2 of *Chironomus thummi* [=*C. riparius*] is repressed by galactose pretreatment, it can be re-activated by treatment with protein synthesis inhibitors (illustrated photographically). Since such inhibitors have no apparent effect on larvae which have not had the galactose pretreatment, in which BR1 is repressed, it appears that the galactose may induce a represser-like factor, which is then inhibited by the protein synthesis inhibitors.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Diez, J.L. & Stockert, J.C. 1976. Formation of ribonucleoprotein "droplets" in *Chironomus* salivary gland nuclei. *First International Congress on Cell Biology, Boston, Massachusetts. Journal of Cell Biology* **70:** 124a (Abstract)
The occurrence of RNP droplets was studied in fixed salivary glands. The highest frequency of droplets occurred in late prepupae where they were either free in the cytoplasm or grouped around specific regions of the chromosome such as the Balbiani rings and puffs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus* species

Dignam, S.S., Yang, L., Lezzi, M. & Case, S.T. 1989. Identification of a developmentally regulated gene for a 140-kDa secretory protein in salivary glands of *Chironomus tentans* larvae. *Journal of Biological Chemistry* **264**: 9444-9452.
The cloned gene for the sp140 secretory protein is shown by *in situ* hybridisation to be located at I-17-B on the right arm of chromosome I, i.e. on arm F of *C. tentans*. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans*

Doyle, D.J. 1967*a*. *Sources of salivary gland secretion in the dipteran* Chironomus tentans. Doctor of Philosophy Thesis, The Johns Hopkins University, Baltimore, Maryland, U.S.A. 130pp.
The thesis work forms the basis of later publications, e.g. Doyle and Laufer (1968, 1969).

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Doyle, D. & Laufer, H. 1968. Analysis of secretory processes in dipteran salivary glands. *In Vitro* **3**: 93-103.
Note that the formation of the salivary secretion is correlated with the activity of puffs specific to the salivary gland chromosomes, notably the three Balbiani rings. These tissue specific puffs produce some of the proteins found in the salivary secretion, others being produced elsewhere and taken up into the salivary glands. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Doyle, D. & Laufer, H. 1969. Requirements of ribonucleic acid synthesis for the formation of salivary gland specific proteins in larval *Chironomus tentans*. *Experimental Cell Research* **57**: 205-210.
The synthesis of the tissue specific proteins by the puffs in the salivary gland chromosomes is shown to be by relatively stable RNA template, since extended inhibition of RNA synthesis produces no significant decrease in protein synthesis. The effect of actinomycin D in inhibiting RNA synthesis is shown by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Dubinin, N.P., Sokolov, N.N. & Tiniakov, G.G. 1936. Occurrence and distribution of chromosome aberrations in nature (Diptera). *Nature* **137**: 1035-1036.
Investigated 250 larvae from three populations of Chironomidae which showed 20%, 43% and 65% of individuals heterozygous for inversions. (Partim)

Specialised subjects: Inversions - polymorphy
Species: Chironomidae spp.

Dusenbery, D.B. & Uretz, R.B. 1972. The orientation of DNA within 80-Angstrom chromatin fibres. *Journal of Cell Biology* **52**: 639-647.
Squashed salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] were examined under polarised fluorescence microscopy. Individual fibres have an average thickness of 80Å and therefore it is concluded that the DNA lies nearly parallel to the axis of these fibres. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Dvorak, J., van Brink, J.M. & Kiauta, B. 1970. A note on the germ cell chromosomes of three allied species of the genus *Glyptotendipes* Kieffer, 1913 (Diptera, Nematocera: Chironomidae, Chironominae). *Genen en Phaenen* **14**: 5-8.
The mitotic and meiotic karyotypes of *G. barbipes*, *G. cauliginellus* and *G. gripekoveni* were examined and measured. The karyotype of *G. barbipes* was slightly different from the other two species in that chromosome 1 appears relatively shorter. This chromosome in *G. barbipes* also is polymorphic for size in this Strieperpolder, Netherlands population; no such polymorphism being noted in a German population by Wolf (1941). The chromosome numbering is the reverse of the more usual system in that chromosome 1 is the short acrocentric pair of chromosomes.

Specialised subjects: Karyotype study
Species: *Glyptotendipes barbipes, G. cauliginellus, G. gripekoveni*

Dyomin, S.Yu. & Ilyinskaya, N.B. 1988. Changes in the compactness of polytene chromosomes from different organs of *Chironomus plumosus* larvae. *Tsitologiya* **30**: 407-415. (In Russian, English summary)
Compactness of chromosome 3 in different tissues was studied in larvae collected at different seasons. Although the compactness varied with season of collection, all tissues within a larvae showed the same level of compactness. Illustrated by a map of the salivary gland chromosome and photographic maps for all tissues.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus plumosus*

Dyomin, S.Yu. & Ilyinskaya, N.B. 1989. Polytene chromosome compactness polymorphism in natural populations of four chironomid species. *Tsitologiya* **31**: 706-712. (In Russian, English summary)
Show that four other species show similar seasonal differences in the degree of compactness of the polytene to that previously reported for *Chironomus plumosus*. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Camptochironomus* [=*Chironomus*] *tentans*, *C. clarus*, *C. muratensis*, *Glyptotendipes paripes*

Dymshits, G.M., Rumyantseva, G.V., Frumgarts, L.A., Gruzdev, A.D., Zainiev, G.A., Shilova, I.E., Karpova, G.G. & Grineva, N.I. 1981. A method for obtaining and luminescent visualization of specific nicks in the DNA of polytene chromosomes in situ. *Tsitologiya* **23**: 31-37. (In Russian, English summary)
Presents a technique for visualising specific nicks in the DNA of polytene chromosomes when stained with acridine orange.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Dymshits, G.M., Rumyantseva, G.V., Frumgarts, L.A., Gruzdev, A.D., Zainiev, G.A., Shilova, I.E., Karpova, G.G. & Grineva, N.I. 1982. Vizualization of oligo-dT sequences in polytene chromosomes of *Chironomus thummi* by means of alkylating oligoadenylate derivatives. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 12.
An abstract of the technique described by Dymshits *et al*. (1981).

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Dyomin, S.Yu. & Schobanov, N.A. 1990. Karyotype of *Chironomus entis* Schobanov from the plumosus group (Diptera, Chironomidae) living in the European part of the Soviet Union. *Tsitologiya* **32**: 1046-1054. (In Russian, English summary)
Describe the polytene karyotype and the chromosomal polymorphism from six populations, providing a photographic map and photographs of heterozygous configurations. Note the similarity to the karyotype of *C. plumosus*, exemplified in the sharing of sequences for three chromosome arms.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Inversions - geographical distribution
Species: *Chironomus entis*

Edström, J.-E. 1964. Chromosomal RNA and other nuclear RNA fractions. *The Role of*

Chromosomes in Development. Symposia on Development and Growth **23**: 137-152.
The polytene chromosomes of *Chironomus tentans* contain much less RNA than DNA except in the vicinity of certain bands such as the Balbiani rings (BR). Not only that, but the base composition of the RNA from different chromosome segments varies, in particular that from the BRs has a high adenine content (Edström & Beermann 1962). Estimation of the amount of DNA in a band indicates that there is much more present in the BRs than needed to produce the RNA. The implications of this are discussed. The base composition of the nucleolar RNA produced by the two nucleoli of *C. tentans*, which are illustrated in a phase contrast photograph, were also compared and found not to differ significantly. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - Balbiani rings, Nucleolus - RNA synthesis
Species: *Chironomus tentans*

Edström, J.-E. 1965. The base composition of RNA from nucleoli formed at two different organizers in *Chironomus tentans*. *Biochemical and Biophysical Research Communications* **18**: 341-344.
Nucleolar RNA was extracted from the two nucleoli of *Chironomus tentans* and was analysed for base composition. The RNA had a high content of adenine and uracil but no detectable difference was detected between the RNA from the two nucleoli.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edström, J.-E. 1966. Composition of the nucleolus as a basis for views on its function. *International Symposium on the Nucleolus, its Structure and Function, Montevideo, Uruguay, 1965. National Cancer Institute Monographs* **23**: 223-233. (English and Spanish Summary)
Reviews work on nucleolar RNA from *Chironomus tentans*. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - RNA synthesis
Species: *Chironomus tentans*

Edström, J.-E. (published as Edstrom, J.E.) 1968. Characterization of RNA from isolated nuclear components of *Chironomus tentans*. *Thirteenth Biological Conference Oholo Meeting, Israel*: 21 (Abstract)
Nuclear preribosomal and ribosomal RNA is found exclusively in the nucleoli, and nucleoli of different genomic origin appear equivalent. The chromosomes synthesise heterogeneous sedimenting RNA of high molecular weight, a pattern seen also for the RNA of a single band. 4S RNA is produced by a large number of bands from all chromosomes. 5S RNA as well as a number of other fractions up to 16S are mainly localised in the nucleoli.

Specialised subjects: Polytene chromosomes, Nucleolus - gene activity
Species: *Chironomus tentans*

Edström, J.E. 1973. Polytene chromosomes. *Chromosome identification - technique and applications in biology and medicine. Nobel Symposia on Medicine and Natural Sciences* (1972) **23**: 271-275.
Reviews work relevant to the idea that the bands of the polytene chromosomes are equivalent to genes and concludes that they probably are, although they contain more DNA than is necessary for an average sized gene. Studies of gene activity in the Balbiani rings of *Chironomus* indicate that puffs are sites of gene activity, although not all active genes are visible as puffs. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes; Puffs - gene activity
Species: *Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Edström, J.-E. 1974. Polytene chromosomes in studies of gene expression. *In* Busch, H. (Ed.), *The Cell Nucleus,* Academic Press, New York, Volume II: 293-332.
Reviews all aspects of the use of polytene chromosomes for studies of gene expression, from the amount of DNA in the polytene bands to the formation of RNA by the chromosome and the effect of drugs on gene activity. Illustrated by photographs of *in situ* hybridisation of BR RNA, incorporation of ^{3}H-uridine into nucleoli and BRs, and an electron micrograph of a BR. (Partim)

Specialised subjects: Polytene chromosomes, Balbiani rings, gene activity
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Edström, J.-E. 1976. Meiotic versus somatic transcription with special reference to Diptera. *In* Allfrey, V.G. Bautz, E.K.F. McCarthy, B.J. Schimke, R.T. & Tissieres, A. (Eds.),

Organization and Expression of Chromosomes. Life Sciences Research Report **4**: 301-316.
The transcription occurring during meiotic prophase is compared to that which takes place in somatic cells. Although there are similarities, there are also clear differences. In particular it appears that different DNA is involved. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Meiosis - gene activity
Species: *Chironomus pallidivittatus*

Edström, J.-E. & Beermann, W. 1962. The base composition of nucleic acids in chromosomes, puffs, nucleoli and cytoplasm of *Chironomus* salivary gland cells. *Journal of Cell Biology* **14**: 371-380.
Analysis of the base composition of RNA from various components of isolated salivary gland chromosomes of *C. tentans* by microelectrophoresis, indicated that chromosomal, nucleolar and cytoplasmic RNAs differ significantly from each other. Nucleolar and cytoplasmic RNA are both rich in adenine and uracil. The RNA of chromosome I is significantly different from that of chromosome IV, and that from various parts of chromosome IV differs significantly. The results exclude the possibility that both strands of the chromosomal DNA are copied. Illustrates the whole chromosome complement, with a detailed photograph and drawn map of chromosome IV.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Edström, J.-E. & Daneholt, B. 1967. Sedimentation properties of the newly synthesised RNA from isolated nuclear components of *Chironomus tentans* salivary gland cells. *Journal of Molecular Biology* **28**: 331-343.
Labelled RNA from various components of the chromosome were subjected to sedimentation analysis. Nucleoli form a 38s component which is converted to on 30s and one 20s component, but do not form a 4s component as do the rest of the chromosomes. A polydisperse RNA in the range 10 to 90s is produced by the Balbiani ring. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Edström, J.-E., Daneholt, B., Egyházi, E., Lambert, B. & Ringborg, U. 1969. Formation and processing of ribonucleic acid in subnuclear components of *Chironomus tentans*. *Proceedings of the Biochemical Society. Biochemical Journal* **114**: 51p-52p. (Abstract)
Briefly reviews the structure of polytene chromosomes and their use for investigating the production and processing of ribosomal and other chromosomal RNAs.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Edström, J.-E., Egyházi, E., Daneholt, B., Lambert, B. & Ringborg, U. 1971. Localization of newly synthesized low molecular weight RNA in polytene chromosomes from *Chironomus tentans*. *Chromosoma* **35**: 431-442.
When salivary gland chromosomes are incubated with tritiated uridine *in vitro* the nucleoli, Balbiani rings and numerous chromosome bands are labelled. When incubated with DRB, which selectively inhibits labelling of high molecular weight RNA, the labelling pattern is somewhat different. The nucleoli are still labelled but only a restricted number of bands (DRB bands) are labelled. In chromosome I there are five DRB bands. It is concluded that the majority of such bands contain RNA with properties similar to transfer RNA. Includes several chromosome photographs and a drawn map of chromosome I.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Edström, J.-E., Ericson, E., Lindgren, S., Lönn, U. & Rydlander, L. 1977. Fate of Balbiani-ring RNA in vivo. *Cold Spring Harbor Symposia on Quantitative Biology, 1976,* **42**: 877-884.
Gives a brief description of the Balbiani rings of *Chironomus tentans*, before addressing the fate of the RNA produced by these puffs. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Edström, J.-E., Lindgren, S., Lönn, U. & Rydlander, L. 1977. Kinetics of RNA export from the Balbiani rings in vivo. *Proceedings of the Oxford Chromosome Conference. Chromosomes Today* **6**: 223-226.
The transcription time and half life of the RNA transcribed from BR1 and BR2 of *Chironomus tentans* was studied. The transcription time is around 20 minutes, after which it enters the nuclear sap where it spends an average of 60 min

before most or all of it is delivered to the cytoplasm. The half life in the cytoplasm is about 20 hours, despite previous reports of the stability of protein synthesis. The results are not necessarily contradictory although no detailed explanations are given. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edström, J.-E., Lindgren, S., Lönn, O. & Rydlander, L. 1978. Balbiani ring RNA content and half-life in nucleus and cytoplasm of *Chironomus tentans* salivary gland cells. *Chromosoma* **66**: 33-44.
The quantity of RNA in the Balbiani rings of *C. tentans* was found to be variable within and between individuals, presumably reflecting the relative activity of the BRs in a particular cell. The RNA content of non-BR puffs is 75% lower than that of the BRs. The half life of the RNA from BR1 was estimated to be about 65min. The results are consistent with the presence of from 25-30 transcription units in BR2. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edström, J.-E. & Rydlander, L. 1976. Identification of cytoplasmic RNA from individual Balbiani rings. *Biologisches Zentralblatt* **95**: 521-530. (English & German summaries)
Cytoplasmic RNA of giant size from the salivary gland cells of *Chironomus tentans* could be hybridized *in situ* to the Balbiani rings of the polytene chromosomes. Following electrophoresis components which hybridized to either BR1 or BR2 could be separated. When BR2 was caused to regress there was a corresponding decrease in the component which hybridized to this puff. When the size of BR1 was induced to increase, there was an increase in its hybridising RNA.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edström, J.-E., Rydlander, L. & Franke, C. 1980. Concomitant induction of a Balbiani ring and a giant secretory protein in *Chironomus* salivary glands. *Chromosoma* **81**: 115-124.
Galactose treatment of larvae of *C. pallidivittatus* changes the size relationships of BR1 and BR2, as well as inducing a new BR, BR6. Correlated changes in the secretory protein produced leads to the conclusion that BR1 codes for fraction 1a, BR2 for 1b, and BR6 for 1c of this protein.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus pallidivittatus*

Edström, J.-E. & Tanguay, R. 1974*a*. Chromosome products in *Chironomus tentans* salivary gland cells. *Cold Spring Harbor Symposia on Quantitative Biology, 1973*. **38**: 693-699.
Two populations of messenger-like (ml)RNA were identified in the cytoplasm of salivary gland cells. One had the properties of messenger RNA from other cell populations, while the other had a longer half-life and took longer to reach the cytoplasm. The latter mlRNA was shown to cross-hybridise with BR1 and BR2 when used in *in situ* hybridisation to polytene chromosomes. BR RNA moved with the same rate of migration as that from the cytoplasm on agar gels, indicating that it is not subject to major cleavage during export. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edström, J.-E. & Tanguay, R. 1974*b*. Cytoplasmic ribonucleic acids with messenger characteristics in salivary gland cells of *Chironomus tentans*. *Journal of Molecular Biology* **84**: 569-583.
A type of heterogeneous RNA in the cytoplasm, designated messenger-like RNA, probably originates from the Balbiani rings. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Edstrom, J.E. 1968. See under Edström, J.-E. 1968.

Engström, A. & Ruch, F. 1951. Distribution of mass in salivary gland chromosomes. *Proceedings of the National Academy of Sciences, U.S.A.* **37**: 459-461.
X-ray microradiographic studies of the salivary gland chromosomes of *Chironomus* species show that the dry weight per volume unit is 2 to 10 times higher in the bands than in the interband spaces. Illustrated by 2 microradiograms.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Egyházi, E. 1974*a*. A tentative initiation inhibitor of chromosomal heterogeneous RNA synthesis. *Journal of Molecular Biology* **84**: 173-183.
Salivary gland chromosomes 1 to 3 of *Chironomus tentans* were dissected and pooled after various treatments to investigate the effect of DRB in inhibiting initiation of HnRNA synthesis. When DRB was added for a short period after labelling, the synthesis of low molecular weight HnRNA was inhibited but that of high molecular weight RNA decreased only slightly or even increased. When added for prolonged periods, their was an overall and similar reduction in all size classes. It was inferred that DRB interfered with the initiation of chromosomal HnRNA synthesis. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Egyházi, E. 1974*b*. Actinomycin D and RNA transport. *Nature* **250**: 221-223.
The addition of actinomycin D to cultures of *Chironomus tentans* salivary gland chromosomes previously labelled with tritiated cytidine and tritiated uridine, results in a reduction of the chromosomal labelling by 50-60% without any significant increase in the labelling of nuclear sap or cytoplasmic RNA. It is concluded that the chromosomal RNA is nascent and finished RNA chains, all bound to the DNA template. The actinomycin D interferes with the release of this RNA from the template. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Egyházi, E. 1975*a*. Inhibition of Balbiani ring RNA synthesis at the initiation level. *Proceedings of the National Academy of Sciences, U.S.A.* **72**: 947-950.
DRB blocks the initiation of transcription in BR1 and BR2 of *Chironomus tentans* but does not affect elongation of growing chains. Using this in experiments enabled the estimation that RNA synthesis proceeds at about 25 nucleotides per second at 18^{o}C, in BR1 and 2. A photograph of chromosome 4 after incubation in DRB for 30 minutes and 40 minutes shows the reduction in size of the BRs after the additional incubation period. This indicates that the BRs shrink when RNA synthesis terminates.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Egyházi, E. 1975*b*. Processing of heterogeneous chromosomal RNA: studies with an initiation inhibitor. *Biochemistry of the Cell Nucleus. Mechanism and Regulation of Gene Expression. Proceedings of the Ninth Federation of European Biochemical Societies Meeting, Budapest, 1974,* **33**: 57-62.
The giant RNA transcripts of Balbiani rings 1 and 2 of *Chironomus tentans* were investigated following treatment with the initiation inhibitor DRB. This inhibitor does not interfere with RNA chains initiated before its addition and allows finished RNA chains to be detached from the chromosomal sites. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Egyházi, E. 1976*a*. Initiation inhibition and reinitiation of the synthesis of heterogeneous nuclear RNA in living cells. *Nature* **262**: 319-321.
The inhibition of initiation of HnRNA synthesis in chromosomes 1 to 3 of *Chironomus tentans* by DRB was investigated in explanted salivary glands. Thirty minutes incubation inhibited the synthesis of virtually all size classes of HnRNA. The DRB was then washed out and reinitiation of synthesis examined. If label was added 5 minutes after washing out, the synthesis of HnRNA of less than 38S was approximately normal but 75S-100S HnRNA was 70% lower than normal. About 30 minutes after washing out was required before reinitiation of this larger size class returned to normal.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Egyházi, E. 1976*b*. Quantitation of turnover and export to the cytoplasm of HnRNA transcribed in the Balbiani rings. *Cell* **7**: 507-515.
While salivary gland chromosomes 1 to 3 of *Chironomus tentans* produce the usual heterogeneous pattern of RNA sizes, chromosome 4 produces relatively more in the 75S range. This RNA is produced by Balbiani rings 1 and 2. It is released rapidly into the nulclear sap but then is apparently rapidly degraded. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans*

Egyházi, E., Daneholt, B., Edström, J.-E., Lambert, B. & Ringborg, U. 1970. Differential

inhibitory effect of a substituted benzimidazole on RNA labelling in polytene chromosomes. *Journal of Cell Biology* **47**: 516-520.
The effect of DRB on the labelling of RNA on salivary gland chromosomes of *Chironomus tentans* was investigated. It was shown that DRB selectively inhibited the labelling of chromosomal H RNA but only partially inhibits the labelling of low molecular weight RNA in the chromosomes and the nucleolus.
(Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - gene activity
Species: *Chironomus tentans*

Egyházi, E., D'Monte, B. & Edström, J.-E. 1972. Effects of alpha-amanitin on in vitro labelling of RNA from defined nuclear components in salivary gland cells from *Chironomus tentans*. *Journal of Cell Biology* **53**: 523-531.
Alpha-amanitin was found the affect the labelling pattern of the salivary gland chromosomes. While the nucleoli remained labelled, the rest of the chromosomes exhibited a diffuse labelling which was above background levels. This was due to an inhibition of the labelling of larger molecules of heterogeneous RNA. This is illustrated by two autoradiographs. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - gene activity
Species: *Chironomus tentans*

Egyházi, E., Thyberg, J., Pigon, A. & Johansson, O. 1986. Inactive chromatin in polytene chromosomes of *Chironomus tentans* partially shows a non-nucleosomal organization. *Chromosoma* **94**: 19-30.
Electron microscopic examination of fractionated chromatin from the salivary glands indicated a difference in the organisation of the active and inactive chromatin regions. Active chromatin displayed a nucleosomal configuration while inactive chromatin showed no such packaging, although all core histones were present. Illustrated by electronmicrographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Eigenbrod, J. 1978. Differences in the number of nucleolus organizers in *Chironomus tepperi* shown by in situ hybridization. *Chromosoma* **67**: 63-66.
Shows that the puff in 16b of the fourth chromosome of *C. tepperi* is a nucleolus, which is present in some animals but not in others. By the use of *in situ* hybridisation (illustrated.), it is shown that the latter animals actually lack the ribosomal cistrons.

Specialised subjects: Nucleolus - polymorphy
Species: *Chironomus tepperi*

Emmerich, H. & Berendes, H. D. 1971. Activiteit van het genoom. Regulatie door het insektenhormon ecdyson. *Vakblad voor Biologien* **51**(2): 30-36.
Discusses how ecdysone regulates puff formation in polytene chromosomes. Deals largely with *Drosophila* but does mention *Chironomus*. It is listed here mainly to clarify the situation arising from the fact that *Chironomus tentans* is used as a key descriptor in Biosis. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - ecdysone
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Erhard, H. 1910. Über den Aufbau der Speicheldrüsenkerne der *Chironomus*-larven. *Archiv für Mikroskopische Anatomie und Entwicklungsmechanik* **76**: 114-124.
Stained the salivary glands of a *Chironomus* species, perhaps *C. plumosus* from the drawings, with a number of stains to examine the different staining reactions of the nucleolus and the chromatic strands. Concluded the chromosome was made up of alternate discs of light and deeply staining material.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species [?=*plumosus*]

Ericsson, C., Goldknopf, I.L., Lezzi, M. & Daneholt, B. 1986. Low degree of ubiquitination of histone 2A in the dipteran *Chironomus tentans*. *Cell Differentiation* **19**: 263-269.
A low content of ubiquinated histone 2A was found in salivary gland nuclei of *C. tentans*. This is hypothesised to be due to the structure of the polytene chromosomes of *Chironomus*, in which the chromatin is organised into unusually large chromosomal entities. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Ericsson, C., Mehlin, H., Björkroth, B., Lamb, M.M. & Daneholt, B. 1989. The ultrastructure of

upstream and downstream regions of an active Balbiani ring gene. *Cell* **56**: 631-639.
Examine the upstream and downstream regions of the transcription loops of Balbiani ring genes by electron microscopy. The loop starts and ends in tightly packed chromatin with the two anchoring sites spacially separated. The upstream and downstream nontranscribed regions differ from each other in structure. Illustrated by electron micrographs.

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus tentans*

Fairlie, T.W. 1952. *Polymorphism in the salivary gland chromosomes of the midge,* Tendipes (Tendipes) decorus *Johannsen*. Doctor of Philosophy Thesis, University of Toronto, Canada. Subsequently published as Rothfels & Fairlie (1957).

Specialised subjects: Inversions - adaptive significance
Species: *Tendipes decorus* [=*Chironomus decorus* gp.(R&F)]

Faussek, W. 1912. The problem of the structure of the cell nucleus in the salivary glands of *Chironomus* larvae. *Trudy Imperatorskago S.-Peterburgskago obshchestva Estestvoispytatelei* **43**: 74-94 (In Russian)
Examines the structure of the chromosomes and nucleolus in the nuclei of the salivary gland cells of a *Chironomus* species, probably *C. plumosus*. In agreement with Balbiani (1881), he concludes that the cross striations are disks of chromatin. He notes the presence of similar structures in other glandular tissues, such as Malpighian tubules and intestinal epithelium, noting the salivary glands have the greatest development.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Faussek, W. 1913. Zur Frage über den Bau des Zellkernes in den Speicheldrüsen der Larve von *Chironomus*. *Archiv für mikroskopische Anatomie und Entwicklungsmechanik* **82**: 39-60.
A German translation of the Russian text (Faussek 1912) with the addition of a "Nachtrag" to incorporate the results of Alverdes (1912a).

Specialised subjects: Polytene chromosomes - structure
Species:.*Chironomus plumosus*

Feher, L.V. 1985. *Ecological-systematics studies of chironomids from reservoirs in Bratsk*. Candidates Thesis, Biological Sciences, Leningrad, Russia. 131pp.
This thesis has not been seen but a list of some species illustrated cytologically is given by Kiknadze *et al*. (ATLAS, Nauka, Novosibirsk, 1991). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus psittacinus, Sergentia* spp., *Polypedilum nubeculosum*

Ficq, A. & Pavan, C. 1957. Autoradiography of polytene chromosomes of *Rhyncosciara angelae* at different stages of larval development. *Nature* **180**: 983-984.
Using ^{14}-labelled precursors of RNA and proteins it was shown that the nucleoli and the pyroninophilic bands (coloured red by Unna staining and rich in RNA) of *Chironomus* have a much higher protein metabolism than those rich in DNA. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus* species

Filippova, M.A., Gunderina, L.I. & Kiknadze, I.I. 1987. Enzyme and chromosomal polymorphisms of sibling species *Chironomus balatonicus* and from west Siberia. *Isozyme Bulletin* **20**: 27.
The polytene karyotypes of *C. balatonicus* and *C. plumosus* from western Siberia were compared with those of Europe and found to be identical. However more chromosomal polymorphism, including a rare pericentric inversion, was found in the Siberian population of *C. balatonicus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes, Inversions
Species: *Chironomus balatonicus*, *C. plumosus*

Filippova, M.A. & Kiknadze, I.I. 1982. Activity of hydrolytic enzymes in *Chironomus thummi* salivary glands. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 15.
The increase in the activity of hydrolytic enzymes in the salivary glands of larvae during metamorphosis was associated with the appearance of the metamorphic puff set, possibly reflecting hormonal status.

Specialised subjects: Puffs - moulting

Species: *Chironomus thummi* [=C. riparius]

Filippova, M.A., Kiknadze, I.I. & Gunderina, L.I. 1989. Genetic variation and genetic differentiation of natural *Chironomus plumosus* and *Chironomus balatonicus* (Chironomidae: Diptera). *Genetika* **25**: 1757-1767. (Translated in *Soviet Genetics* **25**: 1158-1166)
The genetic differentiation studied in this paper is integrated with previous cytological analysis of Devai *et al*. 1983 to conclude that *C. plumosus* and *C. balatonicus* are sibling species. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomesSpecies: *Chironomus balatonicus, C. plumosus*

Firling, C.E. 1970. *Studies on the functional activity of polytene chromosomes of Chironomus tentans salivary glands maintained in prolonged organ culture*. Doctor of Philosophy Thesis, Southern Illinois University, U.S.A.. 82pp.
A medium based on the composition of the haemolymph was developed for *in vitro* culture of polytene chromosome containing tissues. Salivary gland chromosomes and nucleoli appeared normal after 4 days in this medium, After 3 days, 30% of glands showed the normal, asynchronous pattern of chromosomal DNA synthesis seen *in vivo*. RNA synthesis, ^{3}H-uridine incorporation and histone pattern were also similar to the normal patterns.

Specialised subjects: TechniquesPolytene chromosomes - general
Species: *Chironomus tentans*

Firling, C.E. & Kobilka, B.K. 1979. A medium for the maintenance of *Chironomus tentans* salivary glands *in vitro*. *Journal of Insect Physiology* **25**: 93-103.
Publication of the work in Firling (1970), with some additional data on the ability of ecdysterone to induce a puff at the IV-2B chromosomal locus. Illustrated by photographs.

Specialised subjects: TechniquesPolytene chromosomes - general
Species: *Chironomus tentans*

Fischer, H.A., Ahrens, P., Hahle, K. & Thiele, H. 1974. Polyamine als Stimulatoren von Genaktivitaten: Eine autoradiographische Studie an Riesenchromosomen von *Chironomus thummi*. *Histochemistry* **38**: 223-228. (English summary)
When inactive salivary gland chromosomes are incubated in polyamines they begin to incorporate uridine as RNA synthesis is reactivated. It is therefore suggested that polyamines affect gene activity in a similar manner to Mg^{++}. Illustrated by autoradiographs.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Fischer, J. 1969. Zur Fortpflanzungsbiologie von *Chironomus nuditarsis* Str. *Revue Suisse de Zoologie* **76**: 23-55.(English, French & German summary)
Inbreeding of *C. nuditarsis* in the laboratory regularly leads to inbreeding depression as a result of the presence of lethal factors. The lethal factors could be shown in association with the AB chromosome, in crosses utilising inversions of either arm. The inversions of arm A were shown to be sex-linked. A drawn map of the AB chromosome showing the limits of the inversions used, is given. (Partim)

Specialised subjects: Inversions - polymorphy, sex chromosomes
Species: *Chironomus nuditarsis*

Fischer, J. 1978. Zum Problem der Chromosomen-Evolution durch Translokationen bei *Chironomus* (Diptera). *Archiv für Genetik* **51**: 73-98. (English & German summary)
Four spontaneously occurring translocations of *C. nuditarsis* were investigated for there effects on viability and fertility. Heterozygotes appeared to suffer no reduction in viability but fertility was reduced by from 20% (in whole arm translocations) to 50% (in smaller translocations). This fertility loss was less than would be expected if separation of the homologues was random at meiosis. The reduction was due to the favouring of the alternate centromere arrangement at the first meiotic division. When individuals were heterozygous for multiple heterozygotes the reduction in fertility was greater than the product of the values for each of the heterozygotes concerned. The reduction occurred equally in both sexes. The reduction in fertility would account for the lack of translocation polymorphisms in natural populations of *Chironomus*. Heterozygous and some homozygous translocations are illustrated.

Specialised subjects: Reciprocal translocations - sterility
Species: *Chironomus nuditarsis*

Fischer, J. & Rosin, S. 1967. Bastarde zwischen *Chironomus plumosus* L. und *Chironomus nuditarsis* Str. *Siebenundzwanzigster*

Jahresbericht der Schweizerischen Gesellschaft für Vererbungsforschung, S.S.G. Archiv der Julius Klaus-Stiftung für Vererbungsforschung, Sozial-anthropologie and Rassenhygiene **42**: 30-42.
Laboratory hybrids were produced between *C. plumosus* females and *C. nuditarsis* males. Although the chromosome of the two species differ by only two short inversions, the polytene chromosomes of the hybrids were unpaired. However meiotic recombination can occur in the hybrids since recombinant chromosomes are seen in backcrosses of hybrids. Two cases of trisomy for chromosome 4 were observed in the backcrosses. (Partim)

Specialised subjects: Hybrids - asynapsis
Species: *Chironomus nuditarsis, C. plumosus*

Fischer, J. & Tichy, H. 1980. Uber eine Heterochromatin-Mutation aus einer Wild-population von *Chironomus nuditarsis*. 1. Zur Funktion des veranderten Genom-Abschnittes. *Genetica* **54**: 41-43.
A naturally occurring mutant of *C. nuditarsis* lacks the Balbiani ring at the distal end of the fourth chromosome, having instead a large chromatin mass. This mass appears to be genetically inactive. It is present also in the polytene chromosomes of the rectum and of the Malpighian tubules, and occurs in hybrids of *C. nuditarsis* and *C. plumosus*. These aspects are illustrated by photographs.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus nuditarsis*, *C. plumosus*

Fittkau, E.-J. 1961. Zur genwärtigen Situation der Chironomidenkunde. *Verhandlungen der internationalen Vereinigung für theoretische und angewandte Limnologie* **14**: 958-961.
In the discussion after the paper, Wülker raises the possibility of using the chromosomes to help in understanding the systematics of chironomids. (Partim)

Specialised subjects: Karyotype study
Species: *Chironomus* spp.,

Fittkau, E.-J., Reiss, F. & Hoffrichter, O. 1976. A bibliography of the Chironomidae. *Gunneria* **26**: 1-177.
References are given to 6400 publications prior to 1975, covering all fields in relation to the Chironomidae. A rough key is provided in which those relating to cytogenetics are included in the category of "Cytology".

Specialised subjects: General Chironomidae Cytogenetics
Species: All Chironomidae

Flemming, W. 1892. Über die Unsichtbarkeit lebender Kernstrukturen. *Anatomische Anzeiger* **7**: 758-764.
Reviews the studies of Balbiani (1881), Carnoy (1884) and Korschelt (1884) on the nucleus of the salivary glands of *Chironomus plumosus*, with the nucleoli and banded structures. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Fokina, N.A., Kerkis, A.Y. & Gruzdev, A.D. 1972. Contact of polytenic chromosomes with the nuclear membrane. *Tsitologiya* **14**:830-835. (In Russian, English summary)
The connection of the polytene chromosomes of late fourth instar larvae of *Chironomus thummi* [=*C. riparius*] to the nuclear membrane was studied by electron microscopy. Large bands and groups of bands can attach to the walls of nuclear membrane pores by means of fibres which ramify to form fibrils 100-150 A in diameter.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Francke, C. & Edström, J.-E. 1982. Visualization of a giant translation unit in *Chironomus*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 16.
An abstract of the results reported by Francke *et al*. (1982).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Francke, C., Edström, J.-E., McDowall, A.W. & Miller, O.L.,Jr. 1982. Electron microscopic visualization of a discrete class of giant translation units in salivary gland cells of *Chironomus tentans*. *European Molecular Biology Organization Journal* **1**: 59-62.
Giant polysomes producing nascent protein strands were isolated and visualised under electron microscopy. It is argued that these are the translation products of from the large Balbiani rings, BR1 and BR2. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Frank, R. 1961. Chromosomenpolymorphismus in einer Chironomidenpopulation bei Bern. *Archiv der Julius Klaus-Stiftung fur Vererbungsforschung, Sozialanthropologie und Rassenhygiene* **36**: 135-137.
Studied inversions in the left and right arms of chromosome 2 of *Chironomus nuditarsis*. The results indicated that the inversions fitted Hardy-Weinberg expectation and the sequences in the two arms were randomly combined.

Specialised subjects: Inversions - polymorphy
Species: *Chironomus nuditarsis*

Frank, R. 1970a. *Jahreszeitliche Anderungen der Haufigkeiten zweier Inversionen in einer naturlichen Population von* Chironomus nuditarsis Dissertation, Universität Bern, Switzerland.
This reference has not been seen but it is assumed that the contents are largely those of Frank (1970*b*).

Specialised subjects: Inversions - polymorphy
Species: *Chironomus nuditarsis*

Frank, R. 1970b. Jahrezeitliche Schwankungen und ortliche Unterschiede in den Frequenzen von zwei Inversionen in einer Wildpopulation von *Chironomus nuditarsis* Str. *Archiv der Julius Klaus-Stiftung fur Vererbungsforschung, Sozialanthropologie und Rassenhygiene* **45**: 30-43.
Reports more extensive studies of the inversions in arms A and B of *Chironomus nuditarsis*. The frequency of A2 varied from 10.5% to 34.4%, and the frequency of B2 from 18.6% to 41.2%. The inversions on each arm were randomly associated, although their frequency bore a constant relation to each other in all populations over the time of the study. The inversions show seasonal changes in frequency which are largely consistent between populations, although there can be a lag of up to a month.

Specialised subjects: Inversions - geographic patterns
Species: *Chironomus nuditarsis*

Freitas, F. de, Floeter-Winter, L.M. & Leoncini, O. 1985. Cytological and cytochemical characterization of the polytene chromosomes of *Chironomus sancticaroli* (Diptera: Chironomidae). *Revista Brasiliera de Genetica* **8**: 47-60. (English & Portuguese summary)
Describe and figure the polytene chromosomes of *C. zanthus* (as *C. sancticaroli*). The number and position of the nucleolar organisers is also defined. Illustrated by photographs and autoradiographs.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus sancticaroli* [=*C. xanthus*]

Frey, M., Koller, T. & Lezzi, M. 1976. Isolation and electron microscopic visualization of DNA extracted from bands of polytene chromosomes. *Abstracts of the Eighth Annual Report of the Union of Swiss Societies of Experimental Biology. Experientia* **32**: 793-794. (Abstract)
In order to examine the possibility that certain interspersed DNA sequences may be involved in the control of decondensation of certain polytene bands, DNA was cut from small segments of the chromosomes and examined under the electron microscope. DNA filaments up to 120 microns in length were obtained.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Frey, M., Koller, T. & Lezzi, M. 1982. Isolation of DNA from microsurgically excised bands of polytene chromosomes of *Chironomus*. *Chromosoma* **84**: 493-503.
Describe a technique for isolating the DNA from single bands of isolated polytene chromosomes of *C. tentans*. Shows that the amount of DNA from a double band is approximately twice that from a single band. Illustrated by photographs and an electronmicrograph. Drawn maps of chromosome IV and part of chromosome I are included.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus tentans*

Frolova, S.L. 1944. Study of fine chromosome structure under enzyme treatment. *Journal of Heredity* **35**: 235-246.
Studied the effect of nucleases and pepsin on the salivary gland chromosomes of *Drosophila robusta* and a *Chironomus* species. Considered the chromosomes to be composed of chromonemata successively twisted into pairs, with the space between the chromonemata filled with chromoplasm. The chromoplasm is considered to contain both ribonucleotides and protein. The ultimate chromosome threads were on the limits of optical resolution and considered to be genonemata.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Fujii, S. & Kimoto, Y. 1952. The structure of the salivary chromosomes (a preliminary note). *Japanese Journal of Genetics* **27**: 221. (In Japanese, English title) (Abstract)
Includes studies on the effect of various treatments on the polytene chromosomes of *Chironomus dorsalis* [probably *C. yoshimatsui*] and *C. plumosus*. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*], *C. plumosus*

Fujii, S. & Kimoto, Y. 1955. On the structure of the salivary gland chromosomes. I & II. *Zoological Magazine,* Tokyo 64: 28-32, 33-38. (In Japanese, English summary after II)
Includes an account of the structural development of the larval salivary gland chromosomes in *Chironomus dorsalis* [probably *C. yoshimatsui*] and a study of the effects of pH on the polytene chromosomes of *Spaniotoma* [=*Tokunagayusurika*] *akamusi*, as well as other Diptera. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*], *Spaniotoma* [=*Tokunagayusurika*] *akamusi*

Fujita, S. & Takamoto, K. 1963. Synthesis of messenger RNA on the polytene chromosomes of dipteran salivary glands. *Nature* **200**: 494-495.
Injected ^{3}H-uridine into full grown larvae of *Brillia* species and examined the chromosomes for RNA synthesis. While most activity was at puffs and the nucleolus organiser, there was a lot of activity in the interband regions immediately adjacent to the bands. This is illustrated by autoradiographs. It is concluded that RNA synthesis occurs on the chromosome but that the RNA rapidly breaks down as it moves from the nucleus to the cytoplasm. It is also concluded that the chromosome must be unravelled before synthesis occurs, but that this is not the only factor necessary, there must also be some form of regulator.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Brillia* species

Gall, J.G. 1987. Closing remarks. *In*: Hennig, W. (ed.), *Structure and Function of Eukaryotic Chromosomes. Results and Problems in Cell Differentiation* **14**: 315-319.
Reviews W. Beermann's contribution to present knowledge of chromosome structure, based on his studies of the polytene chromosomes of *Chironomus*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Galler, R., Riedel, N., Rydlander, L. & Edström, J.-E. 1984. Balbiani rings and their induction. *Chromosomes Today* **8**: 153-160.
Reviews the DNA structure and the polypeptide products of the Balbiani rings of *Chironomus pallidivittatus*. BR1 and BR2 regress under conditions which lower the levels of inorganic phosphate in the haemolymph, while under such conditions a new Balbiani ring, BR6 is induced. The product of BR6, in contrast to the other Balbiani rings, has a net negative charge. It is suggested that the switch is important in conserving phosphate when levels are low. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*

Gaudecker, B. von. 1967. RNA synthesis in the nucleolus of *Chironomus thummi* as studied by high resolution autoradiography. *Zeitschrift für Zellforschung und Mikroskopische Anatomie* **82**: 536-557.
RNA synthesis in the nucleolus of *C. thummi* [=*C. riparius*] was studied by making autoradiographs at increasing intervals after the injection of ^{3}H-uridine. The results indicated that the RNA is first synthesised on the chromosomal fibres extending into the nucleolus in the pars fibrosa. The RNA subsequently breaks down into two different components which combine with protein. The larger RNP component migrates to the pars granulosa, while the smaller component is found in the cytoplasm within 20 minutes. Also includes some information on the ultrastructure and labelling patterns of the Balbiani rings and other chromosomal segments. Well illustrated with autoradiographs.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Gavrila, L. 1983. Cytology of polytene chromosomes of *Chironomus*, *Mycetophila* and *Rhagoletis*. I. Suprachromosomal organization in polytene nuclei of *Chironomus* and *Mycetophila*. *Cytologia* **48**: 663-669.
Notes that the polytene chromosomes of a *Chironomus* species are joined together in an end to end arrangement, in accord with the hypothesis of Du Praw. However my observations indicate that this is not a general phenomenon in *Chironomus* species, rather it may be due to the unusual repeat content of the species he used (Keyl 1965a, b, 1966a) which his figures indicate to be *C. riparius*. Glazko & Zainiev (1985), who looked at spatial organisation of the chromosomes of another population of the same species, also give no indication of finding a similar arrangement. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species [=*C. riparius*]

Geikina, K.A. 1973. A cytochemical study of the acidic proteins of chironomid polytene chromosomes. *Latvija Padomju Socialistiskas Republikas Zinatnu Akademijas Vestis* **7**: 59-63. (In Russian, English summary)
The reactivity of the acid proteins of chromosomes depends on histones, as opposed to those of the nucleolus, Balbiani rings and cytoplasm, which are associated with RNA.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Glancy, E.A. 1940. Micromanipulative studies on the nuclear matrix of *Chironomus* salivary glands. *Biological Bulletin* **79**: 372-373. (Abstract)
Reports on the properties of the salivary gland chromosomes during micromanipulation. Records that the nucleolus and chromosomes persist as a compact mass. These studies were published in full under the name of D'Angelo (1946). (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp.

Glazko, T.T. & Zainev, G.A. 1985. The spatial organisation of polytene chromosomes in *Chironomus thummi* salivary gland nuclei. *Tsitologiya* **27**: 1111-1117. (In Russian, English summary)
Investigates the three-dimensional arrangement of the salivary gland chromosomes. Although no Rabl's organisation was found, there was support for the view that the three-dimensional architecture of the interphase nuclei has some tissue-specific traits. However their is no suggestion of an arrangement such as that described by Gavrila (1983).

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus thummi* [=*C. riparius*]

Glazko, T.T. & Zainev, G.A. 1986. Variation in the architecture of polytene nuclei in *Chironomus thummi* salivary gland cells after ultra-centrifugation. *Tsitologiya* **28**: 920-925. (In Russian, English summary)
The polytene nuclei of the salivary gland of the fourth instar are relatively resistant to centrifugation, although contacts of chromosomes with the nuclear envelope are often disrupted in the anterior lobe where the highest levels of polyteny are attained. Heating or cooling the larvae increases the formation of ectopic fibres and this effect is greatest in the autumn. The possible structural-functional significance of these associations is discussed.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus thummi* [=*C. riparius*]

Göltenboth, F. 1974*a*. Riesenchromosomen. I. Morphologie und Verhalten. *Mikrokosmos* **63**: 336-341.
Reviews the history of the study of polytene chromosomes, a method of making squash preparations, and the structure of the chromosomes. Illustrations include the whole salivary complement of *Chironomus thummi* [=*C. riparius*] and an electron micrograph of bands and interband regions.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Göltenboth, F. 1974*b*. Riesenchromosomen. II. Genaktivität und Puffs. *Mikrokosmos* **63**: 379-383.
Reviews the relationship between puffs on polytene chromosomes and gene activity. Illustrations include the whole salivary gland complement and fourth chromosome of *Chironomus thummi* [=*C. riparius*], with comparative autoradiographs showing incorporation of ^{3}H-thymidine or -uridine, and the

fourth chromosome of *C. tepperi* to illustrate the effect of actinomycin treatment.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tepperi*, *C. thummi thummi* [=*C. riparius*]

Göltenboth, F. 1975*a*. Riesenchromosomen. III. Strukturheterozygotie bei Bastarden von *Chironomus thummi*. *Mikrokosmos* **64**: 52-57.
Reviews the studies which have been carried out on the structural differences in the salivary gland chromosomes of *C. thummi* [=*C. riparius*] and *C. piger*, as revealed in hybrids between the two species. Well illustrated by photographs, autoradiographs and drawings, including a drawn map of chromosome 4 of *C. thummi* [=*C. riparius*].

Specialised subjects: Polytene chromosomes - structure; Hybridisation
Species: *Chironomus thummi thummi* [=*C. riparius*], *C. th. piger* [=*C. piger*]

Göltenboth, F. 1975*b*. *Experimentelle Chromosomenuntersuchungen. Biologische Arbeitsbücher* Vol. **14**, 76 pp. Quelle & Meyer, Heidelberg.
This reference has not been seen.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: Not known, probably *Chironomus thummi* [=*C. riparius*]

Göltenboth, F. 1978. *Chromosomenprakticum*. George Thieme Verlag, Stuttgart, 212pp.
Describes techniques for preparing polytene chromosomes from *Chironomus* larvae for studies of gene activity or chromosome mutations. Illustrated by photographs and autoradiographs. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Techniques; Polytene chromosomes, Puffs - gene activity
Species: *Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Goldschmidt, E. 1942*a*. *Cytological investigations of Chironomidae*. Ph.D. thesis, The Hebrew University, Jerusalem, Israel. 33 pp. (In Hebrew?)
This work has not been seen but it is assumed that the work forms the basis of Goldschmidt (1942*b*).

Specialised subjects: Polytene chromosomes - pairing; Hybrids - asynapsis
Species: *Chironomus thummi* gp.

Goldschmidt, E. 1942*b*. The pattern of salivary gland chromosomes in a hybrid in the genus *Chironomus*. *Journal of Heredity* **33**: 265-272.
Two strains of *Chironomus*, both conforming to the description of *C. thummi* were hybridised in the laboratory and the pattern of synapsis of the polytene chromosomes studied. Large areas of asynapsis were found, those at the ends of the chromosomes tending to be discontinuous and varying between nuclei. In larvae from backcrosses of the F_1 hybrids, the paired and unpaired chromosomes were roughly in Mendelian proportions and there were indications of crossing over in the hybrid males. Intermittent asynapsis was also found in the polytene chromosomes of the Malpighian tubules and the hindgut. The banding patterns of the unpaired central regions were compared, a drawn map for those of chromosome 3 being provided. They indicated no large chromosome aberrations, but it is very difficult to identify homology between the bands of the two strains. In addition, strain B has a bulb near the centre of each of the three long chromosomes, not present in strain A. This may represent the centromere. Photographs and drawings of hybrid chromosomes are presented. A complete drawn map of strain A, as well as additional photographs were deposited with the American Documentation Service (now in the Library of Congress). These photographs are rather poor and do not assist in an understanding of the paper.

Specialised subjects: Polytene chromosomes - pairing; Hybrids - asynapsis
Species: *Chironomus thummi* gp.

Goldschmidt, E. 1947. Studies on the synapsis in salivary chromosomes of hybrid *Chironomus* larvae. *Journal of Genetics* **48**: 194-205.
Hybrids of the two strains of *Chironomus* studied by Goldschmidt (1942*b*) were further studied to examine the effect of temperature of larval development and of age on the degree of asynapsis of the polytene chromosomes. Synapsis was found to be greatest in younger larvae and in larvae reared at moderate temperatures. In sectioned material the non-synapsed portions tended to be widely separated, suggesting that they were repelling each other. Two line drawings of chromosomes are included, but no photographs.

Specialised subjects: Polytene chromosomes - pairing; Hybrids - asynapsis
Species: *Chironomus thummi* gp.

Gopalan, H.N.B. 1973*a*. Cordycepin inhibits induction of puffs by ions in *Chironomus* salivary gland chromosomes. *Experientia* **29**: 724-726. (German summary)
Studies indicate that in intact salivary gland cells of *C. thummi* [=*C. riparius*], organic or inorganic ions can only induce puffs under conditions which permit RNA synthesis. In the presence of cordycepin, the induction of puffs, normally induced by ions, is inhibited. However 15-20% of cells show resistance to cordycepin, indicating the heterogeneity of the cell population in the salivary glands.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Gopalan H.N.B. 1973*b*. Amino acid induced changes of puffing patterns in *Chironomus* salivary gland chromosomes. *Chromosoma* **44**: 25-32.
All naturally occurring amino acids except tyrosine were tested for their effect on puffing in the polytene chromosomes of *C. thummi* [=*C. riparius*]. Only tryptophan and phenylalanine proved effective, each inducing puffs at the same seven loci. The induction is energy dependent and requires cations in the incubation medium and concomitant RNA synthesis. Four photographs and an autoradiograph are provided.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Gopalan, H.N.B. 1976. Amino acid mediated decondensation of nucleoproteins in isolated polytene chromosomes of *Chironomus*. *First International Congress on Cell Biology, Boston, Massachusetts. Journal of Cell Biology* **70**: 418a. (Abstract)
Amino acids are able to affect the condensation state of isolated salivary gland chromosomes in a manner similar to the changes occurring in puff formation. It is concluded that puffing patterns can be attributed to a direct action of amino acids.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Grebenyuk, L.P., Kiknadze, I.I. & Belyanina, S.I. 1989. A new species of the genus *Chironomus* (Diptera, Chironomidae) from fresh water reservoirs of the U.S.S.R. *Zoologicheskii Zhurnal* **68**: 76-82. (In Russian, Russian and English summary)
Describe the polytene chromosomes of the new species *C. pankratovae*. The species has the pseudothummi-complex arm combination and is cytologically distinct from other described species. Illustrated by a photograph of the chromosomes, with arms A, E and F labelled according to the pattern of Keyl (1962). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus pankratovae*

Green, M.M. 1987. Introduction. *In*: Hennig, W. (ed.), *The Structure and Function of Eukaryotic Chromosomes. Results and Problems in Cell Differentiation* **14**: 1-4.
Discusses W. Beermann's attitude to research and how this lead to the quality of his studies on the polytene chromosomes of *Chironomus*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus pallidivittatus, C. tentans*

Grinchuk, T.M. 1978. A study of karyofund of *Glyptotendipes barbipes* (Staeger) (Chironoma Diptera) from subsaline lagoon of the Black Sea aquatorium. *Abstracts of the XIV International Congress of Genetics, Moscow,* Part **1**: 257.
Although *G. barbipes* is normally highly polymorphic, a population from a subsaline lagoon of the Black Sea Aquatorium showed very little polymorphism. Only 5 larvae, out of 44 studied, were heterozygous for one of 2 paracentric inversions. It is suggested that this may be the result of specialisation of this population to unusual conditions.

Specialised subjects: Inversions - geographical distribution
Species: *Glyptotendipes barbipes*

Grinchuk, T.M. 1979. Karyological study of two species of chironomid (Diptera, Chironomidae) in brackish estuaries, pp.44-46. *In* Chubareva, L.A. (ed.), *Karyosystematics of the Invertebrate Animals*. 130pp. Zoologicheskii Institut Academiia Nauk, S.S.S.R., Leningrad. (In Russian)
Describes and figures the polytene chromosomes of two species of Chironomini.

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus salinarius*, *Glyptotendipes barbipes*

Grinchuk, T.M. 1984. The karyological variability in *Chironomus salinarius* (Chironomidae, Diptera) inhabiting different ecological niches. *Tsitologiya* **26**: 751-754. (In Russian, English summary)
Populations from higher salinities were found to have a higher frequency of heterozygous inversions than those in lower salinities. It is suggested that the inversions may help in adaptation to higher salinity. Illustrated by photographs.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus salinarius*

Grinchuk, T.M. & Michailova, P.V. 1979. The karyotypic variation of *Glyptotendipes barbipes* (Diptera, Chironomidae) from various localities. *Tsitologiya* **21**: 959-964.(In Russian, English summary)
Comparison of the cytology of salt and fresh water populations of *G. barbipes* indicates that while they have a common origin, there is racial differentiation in the two different habitats.

Specialised subjects: Inversions - geographical distribution
Species: *Glyptotendipes barbipes*

Grond, C., Saiga, H. & Edström, J.-E. 1987. The sp-I genes in the Balbiani rings of *Chironomus* salivary glands. *In* Hennig, W. (ed.), *Structure and function of eukaryotic chromosomes*. *Results and Problems in Cell Differentiation* **14**: 69-80.
Briefly discusses the Balbiani rings of *C. pallidivittatus* and provides photographs to show the four BRs normally developed and following exposure to glycerol medium. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus pallidivittatus*

Gross, J.D. 1957. Incorporation of phosphorus-32 into salivary-type chromosomes which exhibit puffs. *Nature* **180**: 440.
Larvae of *Metriocnemus hygropetricus* were grown on medium containing ^{32}P for periods of 2-24 hours, before autoradiographs were made of the salivary gland cells. The radioactivity of the puffs or Balbiani rings was very much higher than that of the rest of the chromosomes, which show incorporation very little above background. This activity is correlated with the pyronin staining of the puffs and the disappearance of the staining following ribonuclease digestion. However ribonucleic acid content of the puffs and the rest of the chromosomes was not compared.

Specialised subjects: Puffs - RNA synthesis
Species: *Metriocnemus hygropetricus*

Grossbach, U. 1968. Cell differentiation in the salivary glands of *Camptochironomus tentans* and *C. pallidivittatus*. *Proceedings of the Second International Symposium on Chironomidae, Helsinki, 1967. Annales Zoologici Fennici* **5**: 37-40.
Certain cells of the salivary glands of *C. pallidivittatus* produced a granular secretion. In this region a Balbiani ring is present which is not developed in other cells. By crossing with *C. tentans* to produce hybrid individuals with various numbers of *C. pallidivittatus* fourth chromosomes, the amount of granular secretion did not correlate with the number of chromosomes present, indicating that regulation is independent of the number of information units present. The number of polypeptide chains present in the salivary secretion, however, exceed the number of different Balbiani rings present in the genome, suggesting that more than one cistron may be present in each Balbiani ring.

Specialised subjects: Puffs - Balbiani rings, gene regulation
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans*

Grossbach, U. 1969. Chromosomen-Aktivität und biochemische Zell- differenzierung in den Speicheldrüsen von *Camptochironomus*. *Chromosoma* **28**: 136-187. (English summaries)
Because they produce different salivary gland protein components, the two related species *C. pallidivittatus* and *C. tentans* were used to determine whether the genes controlling synthesis of these proteins are located in the chromomeres which are specifically puffed in this tissue. In hybrids of the species, protein 6 was only produced when a group of cells on chromosome 4 of *C. pallidivittatus* was present, while protein 7 was produced, again by chromosome 4 of *C. pallidivittatus*, from a puff only present in a small lobe of the gland. The results strongly suggest a correlation between the presence of certain Balbiani rings and the synthesis of specific protein components. Drawn maps of chromosome 4 of both species are provided, as well as photographs of a number of variants of Balbiani ring formation.

Specialised subjects: Puffs - Balbiani rings, protein synthesis
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans*

Grossbach, U. 1971. Chromosomen-Struktur und Zell-Funktion. *Mitteilungen der Max-Planck-Gesellschaft zur Forderung der Wissenschaften* **2**: 93-108.
Reviews the structure of polytene chromosomes and the evidence that specific puffs are the sites of production of specific proteins. Illustrations include photographs of chromosome 4 of *Chironomus pallidivittatus* and a reproduction of Balbiani's (1881) figure of the salivary gland nucleus.

Specialised subjects: Puffs - gene activity
Species: *Chironomus pallidivittatus*, *C. plumosus*, *C. tentans*

Grossbach, U. 1974. Chromosome puffs and gene expression in polytene cells. *Cold Spring Harbor Symposia on Quantitative Biology, 1973,* **38**: 619-627.
Explores the relationship between the polypeptides produced in the salivary glands of *Chironomus pallidivittatus* and *C. tentans*, and the puffs visible in the salivary gland chromosomes by using crosses between the two species. Some of the polypeptides can be correlated with the presence of specific Balbiani rings on chromosome 4 of one or other species. Direct evidence of this correlation was obtained by specific repression of certain chromomeres and demonstrating a reduction in the production of the related polypeptide. A relationship is also demonstrated between the size of the Balbiani ring and the amount of product produced. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*, *C. tentans*

Grossbach, U. 1975. Korrelationen zwischen Chromosomen-Aktivität und Genexpression in differenzierten Zellen. *Regulationsmechanismen der Genaktivität und Replikation bei Riesenchromosomen. Nachrichten Akademie der Wissenschaften in Göttingen. Mathematisch-physikalische Klasse*: 176-179.
Reviews the studies which have indicated that their is a correlation between puffing in polytene chromosomes and specific gene activity, particularly the studies of Balbiani ring development and production of particular polypeptides in *Chironomus pallidivittatus* (Grossbach 1968,1969). (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Acricotopus lucens, Chironomus pallidivittatus*

Grossbach, U. 1977. The salivary gland of *Chironomus* (Diptera): a model system for the study of cell differentiation. *Biochemical differentiation in insect glands. Results and Problems in Cell Differentiation* **8**: 147-196.
Reviews the taxonomy of the subgenus *Camptochironomus* and the development and structure of the salivary glands and the polytene chromosomes of these insects. The polytene complement of *C. tentans* is figured. Then reviews the proteins produced in the salivary glands and the relationship between the production of these proteins and puffs on the chromosomes. Well illustrated with photographs and drawings (including drawn maps of chromosome 4 from both *C. tentans* and *C. pallidivittatus*). 147 references. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - gene activity
Species: *Chironomus pallidivittatus, C. tentans*

Grossbach, U. 1982. Giant chromosome nuclei from *Chironomus* (Diptera) in amphibian oocytes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 20.
An abstract of the work largely reported by Grossbach & Streichehan (1981).

Specialised subjects: Polytene chromosomes, Puffs, Nucleolus - transplantation
Species: *Chironomus pallidivittatus*

Grossbach, U. & Streichhan, I. 1981. Transplantation of insect giant chromosome nuclei into amphibian oocytes. *Chromosoma* **82**: 189-196.
Salivary gland nuclei of *Chironomus pallidivittatus* were transplanted into oocytes of *Xenopus laevis* and cultured for 18 hours. The nuclei and the polytene chromosomes enlarged considerably during this time. The banding pattern of the chromosomes was maintained and the nucleoli and Balbiani rings remained obvious, suggesting the latter remained active despite being in an entirely different cell type.

Specialised subjects: Polytene chromosomes, Puffs, Nucleolus - transplantation

Species: *Chironomus pallidivittatus*

Gruzdev, A.D. 1972. Effect of temperature on sizes of isolated polytene chromosomes. *Tsitologiya & Genetika* **6**(2): 167-172. (In Russian, English summary)
When isolated salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] were subjected to heat treatment, denaturation occurred in two stages. At about 45-55^{o}C contraction of the chromosomes occurred by an as yet unclarified mechanism. The second stage occurs at about 80-90^{o}C, but depends upon the salt concentration in the solution. When the concentration is below 0.2M NaCl, there is a further contraction which may be induced by DNA melting. When the concentration of NaCl is greater, the chromosomes swell up (to a definite limit), increasing with the rise in ionic strength of the solution. It is suggested that this may be due to the relaxation of histone bonds.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Gruzdev, A.D. & Belaya, A.N. 1968*a*. The influence of the concentration of hydrogen, ions, toxicity and ionic strength of solutions on the size of polytene chromosomes. *Tsitologiya* **10**: 297-305. (In Russian, English summary)
The effects of sugars, NaCl, hydrogen ions and versene concentrations on isolated polytene chromosomes of *Chironomus dorsalis* [=*C. riparius*] were studied. It was shown that all have an effect on the chromosomes, causing them to swell or contract and, in the case of versene, to dissolve.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Gruzdev, A.D. & Belaya, A.N. 1968*b*. On the linkages in polytene chromosomes. *Tsitologiya* **10**: 995-1001. (In Russian, English summary)
By studying the effects of hydrophobic agents and disulphide bond rupturing substances on *Chironomus dorsalis* [=*C. riparius*], it was determined that hydrophobic interactions played no part in intrachromosomal bonds, while disulphide bonds were clearly demonstrated.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Gruzdev, A.D. & Belaya, A.N. 1973. On the role of bivalent metal ions in the structure of polytene chromosomes. *Tsitologiya* **15**: 383-390. (In Russian, English summary)
The effect of the ionic strength of NaCl solutions on the diameter of the polytene chromosomes was studied in *Chironomus dorsalis* [=*C. riparius*]. The results suggest that metal ions are involved in intrachromosomal bonds, which could be reversibly broken under the treatment conditions. The NaCl also affected lysine-rich histone - DNP bonds. The metal ions and histones are suggested to stabilise the structure of the chromosomal fibre.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Gruzdev, A.D. & Kiknadze, I.I. 1970. The connection of polytene chromosomes with the nuclear membrane. *Tsitologiya* **12**: 919-921. (In Russian, English summary)
In stained but unsquashed salivary glands of *Chironomus dorsalis* [=*C. riparius*], the telomeres appear spread on the nuclear membrane, as are many of the bands if space arrangements permit. However in the fourth chromosome only the telomere touches the nuclear membrane and may be able to easily slide along its surface.

Specialised subjects: Polytene chromosomes - telomeres
Species: *Chironomus dorsalis* [=*C. riparius*]

Gruzdev, A.D. & Kishchenko, G.P. 1975. Packing of DNA in disks of polytene chromosomes. *Doklady Akademiia Nauk, S.S.S.R.* **222**: 217-219. (In Russian) [English translation in *Doklady Biological Sciences* **222**: 177-179.]
The number of packing levels of DNA in the bands of polytene chromosomes of *Chironomus thummi* [=*C. riparius*] was determined by stretching chromosomes stained with acridine orange and recording the change in intensity of fluorescence. It is suggested that the DNA is packed in a second-order helix with central symmetry in each chromomere. Stretching of the chromosome leads to irreversible changes in the structure.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Gruzdev, A.D. & Kishchenko, G.P. 1978*a*. Packing of DNA in the fibrils of DNP of polytene chromosomes. *Biofizika* **23**: 1000-1004. (In

Russian) [English translation in *Biophysics* **23**: 1014-1019 (1979)]
Isolated polytene chromosomes of *Chironomus thummi* [=*C. riparius*], stained with acridine orange were stretched in a micromanipulator. The changes in fluorescence suggest that: 1) for low degrees of stretching (3-4 fold) practically complete orientation of the fibrils of DNP is achieved without disturbance of the integrity of the chromomeres contained in them; 2) the intranuclear-somal DNA in native fibrils of DNP is superspiralised and is inclined at an angle of 30^{o} to the axis of the fibril.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Gruzdev, A.D. & Kishchenko, G.P. 1978*b*. Fluorescence polarization of stretched polytene chromosomes stained with acridine orange. *Biophysics of Structure and Mechanism* **4**: 97-110.
Fluorescence polarisation of acridine orange binding to DNA was used to study the packing of DNA in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*]. The results suggest that polytene chromosome bands have at least three levels of packing: a 100 Å fibre, a 250 A{)o coil and a chromomere. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Gruzdev, A.D. & Reznik, N.A. 1981. Evidence for the uninemy of eukaryote chromatids. *Chromosoma* **82**: 1-8.
The alternative theories of uninemy or binemy of chromosome structure were tested by comparing the ratio of elongation of the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] to the ratio of the DNA length of the haploid chromosome set to the length of the polytene chromosome set. The values obtained were approximately equal, favouring the interpretation that the chromosomes are unineme with a single DNA molecule (or of a chain of linked DNA molecules) from one telomere to the other. Other experiments indicated that the DNA molecules in the polytene chromosomes are double stranded and supercoiled up until the time they rupture due to stretching.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Gruzdev, A.D., Zainev, G.A. & Reznik, N.A. 1975. Stretched polytene chromosome as a model for studying the functional organisation of eukaryotic chromosomes. *Tsitologiya* **17**: 718-720. (In Russian, English summary)
Proposes three methods of stretching polytene chromosomes which may be used in attempts to more accurately localise functional loci on cytological maps.

Specialised subjects: Techniques; Polytene chromosomes - bands and genes
Species: *Chironomus* spp.

Guareschi, C. 1938. Il nucleo delle ghiandole salivari delle larve di *Chironomus plumosus* studiato in campo oscuro, a luce polarizzata e con la reazione di Feulgen. *Atti Accademia nazionale dei Lincei Rendiconti* **6s**: 297-302.
Investigated the polytene chromosomes of the salivary gland using dark field, polarised light and Feulgen staining, to indicate that corresponding bands were observed. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Guareschi, C. 1939*a*. Ricerche comparative sulla struttura nucleare delle ghiandole salivari dei Ditteri. *Bolletino di Zoologia* **10**: 27-32.
Includes observations on the salivary gland chromosomes of *Chironomus plumosus* larvae and makes some comparisons to those in the salivary glands of other Diptera. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Guareschi, C. 1939*b*. La morfologia della cromatina delle ghiandole salivari di *Chironomus plumosus* in rapporto ad esperienze chimico-fisiche. *Bolletino di Zoologia* **10**: 103-114.
Reports changes in the appearance of the chromatin in the nuclei of salivary gland cells under different physiological conditions with bright- or dark-field microscopy. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Guareschi, C. 1939*c*. Sul valore delle immagini strutturali dei nuclei delle ghiandole labiali di *Chironomus* e l'influenza dell'ambiente. *Bolletino di Societa Italiana di Biologia Sperimentale* **14**: 653- 655.

Reports on the effects of different fluids, particularly hypotonic solutions, on the visibility of the chromosomes. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Guareschi, C. 1940. L'azione dei diversi cationi in rapporto alla gelificatiozione del gomitolo cromatinico delle ghiandole labiali di *Chironomus plumosus*. *Bolletino di Societa Italiana di Biologia Sperimentale* **15**: 674-675.
Reports the effects of various cations on the appearance of the chromatin in the nuclei of the salivary gland cells.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Guareschi, C. 1941. Condizioni ambientali e struttura delle ghiandole labiali di *Chironomus plumosus*. *La Ricerca Scientifica* **12**: 169-177.
Larvae of *C. plumosus* from different habitats or maintained in the laboratory under different salinities have labial glands with cytoplasm of contrasting gelatinous or clear appearance. Photographs of the glands *in vivo* show the nuclei, with polytene chromosomes and nucleoli visible in some, and chromocentre. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Gunderina, L.I. & Sherudilo, A.I. 1983. DNA replication cycle during chromosome polytenisation in the salivary glands of *Chironomus thummi*. I. ^{3}H-thymidine incorporation into polytene chromosomes related to the developmental phase of larvae throughout the IV instar. *Tsitologiya* **25**: 527-533. (In Russian, English summary)
Investigates the course of DNA synthesis in the salivary gland chromosomes and shows that the length of the S-period differs with the degree of polytenisation. Illustrated by autoradiographs.

Specialised subjects: Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Gunderina, L.I., Sherudilo, A.I. & Mitina, R.L. 1982. Expression of the proliferative function in *Chironomus thummi* salivary glands. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 22. (In Russian)
An abstract of the work published by Gunderina & Sherudilo (1983).

Specialised subjects: Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Gunderina, L.I., Sherudilo. A.I. & Mitina, R.L. 1984a. DNA replication cycle during chromosome polytenisation in the salivary glands of *Chironomus thummi*. II. Cytophotometric and autoradiographic analyses of the course of DNA synthesis in the single cells of the salivary gland. *Tsitologiya* **26**: 794-801. (In Russian, English summary)
The salivary gland can be divided into 5 lobes in which the cells show different levels of polytenisation. Within a lobe the cells are at the same ploidy level. Cells at different levels of ploidy begin DNA synthesis at different times.

Specialised subjects: Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Gunderina, L.I., Sherudilo, A.I. & Mitina, R.D. 1984b. DNA replication cycle during chromosome polytenisation in the salivary glands of *Chironomus thummi*. III. The duration of DNA synthesis period. *Tsitologiya* **26**: 927-935. (In Russian, English summary)
The duration of DNA synthesis was measured for cells of 2^{10}c and 2^{11}c, and it was found that the duration of S-phase increased by 1.3 times.

Specialised subjects: Chromosomal replication - DNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Gurdon, J.B. & Graham, C.F. 1967. Nuclear changes during cell differentiation. *Science Progress* **55**: 259-277.
Reviews the regulation of gene activity during cell differentiation. In the course of this review mention is made of polytene chromosomes. In particular that the RNA synthesised on different puffs is not the same. Basal cells of the salivary gland of *Chironomus pallidivittatus* have a terminal puff on chromosome 4 in these cells which is not present in *C. tentans*. The presence of this puff coincides with the presence of granules in the basal cells of *C. pallidivittatus* only. The puffing pattern of the polytene chromosomes also differs in different tissues. Some puffs are present only at certain developmental stages, but there are

some puffs that are only present in some larvae and appear unrelated to any developmental event. The latter are thought to represent genes of general metabolic importance, while the former are genes involved in specific developmental events. Certain puffs are induced by hormones such as ecdysone, and remain puffed only as long as the concentration of ecdysone exceeds a certain level. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - gene activity
Species: *Chironomus pallidivittatus*, *C. tentans*

Haapala, O. 1984. Chromosome structure and DNA sequence organization. *The Nucleus* **27**: 1-6.
Quotes Keyl's (1975) data on the amount of DNA in chromosome loops and interchromomeric regions in the spermatocyte lampbrush chromosomes of *Chironomus pallidivittatus*. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus pallidivittatus*

Hägele, K. 1970. DNS-Replikationsmuster der Speicheldrüsen-Chromosomen von Chironomiden. *Chromosoma* **31**: 91-138. (English summary)
By means of autoradiographic studies on the polytene chromosomes of *Chironomus* species, it is determined that the DNA replication periods are not the same for all bands. The asynchrony is greatest in the heterochromatin of *C. melanotus*. Differences in the amount of DNA do not affect the onset of replication but bands with high DNA content replicate for a longer time, except for some exceptional regions where bands of low DNA content are synthesising DNA for the whole replication cycle. Some of the DNA synthesised in these regions must disappear immediately from the chromosome. The labelling pattern of the *C. thummi* [=*C. riparius*] chromosomes in a *C. thummi* x *C. piger* hybrid differs from that of the parental species. Illustrated by numerous autoradiographs and includes a complete drawn map of the chromosomes of *C. thummi*.

Specialised subjects: Polytene chromosomes - replication
Species: *Chironomus annularius*, *C. melanotus, C. plumosus, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1971. Strukturverändernde Wirkung von FUdR auf polytäne Chromosomen und Beziehungen zwischen Replikationsdauer und Bruchhäufigkeit von Querscheiben. *Chromosoma* **33**: 297-318. (English summary)
Following treatment with FUdR, constrictions and partial breaks were found in the polytene chromosomes of *Chironomus thummi* [=*C. riparius*]. The breaks occurred predominantly in the bands with the highest DNA content and in those which were late replicating, indicating the bands with the largest replicons.

Specialised subjects: Polytene chromosomes - structure, chromosome breakage studies
Species: *Chironomus thummi* [=*C. riparius*]

Hägele, K. 1972. Querscheibenspezifische Unterschiede in der ^{3}H-Thymidin-Markierung während der Larvenentwicklung von *Chironomus thummi piger*. *Chromosoma* **39**: 63-82. (English summary)
Region A2j-A3(d) on chromosome II of *C. thummi piger* [=*C. piger*] replicates for much longer than bands which contain even up to 3.8 times more DNA. The difference in replication occurs in both young larvae and in prepupae. However no extra DNA accumulates in the region and so DNA must immediately be lost from the chromosome, as is indicated by the loss of label when larvae treated with ^{3}H-uridine at the early stage are allowed to develop in water free of the isotope. No such loss occurs from other regions of the chromosomes.

Specialised subjects: Polytene chromosomes - chromosomal replication
Species: *Chironomus thummi piger* [=*C. piger*]

Hägele, K. 1975*a*. *Chironomus*. *Handbook of Genetics* **3**: 296-278.
Reviews the biology and the cytology of the polytene chromosomes of the two best studied *Chironomus* species, *C. tentans* and *C. thummi* [=*C. riparius*].

Specialised subjects: Polytene chromosomes - karyotype
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Hägele, K. 1975*b*. Die Auswirkung der Dosis- und Positionsveränderungen von Genomanteilen auf das Replikationsmuster. *Regulationsmechanismen der Genaktivität und Replikation bei Riesenchromosomen. Nachrichten der Akademie der Wissenschaft in Göttingen. Mathematisch-Physikalishe Klasse*: 195-198.
Investigated the effect of dose and position effect on replication patterns in the polytene chromosomes of hybrids of *Chironomus thummi*

[=*C. riparius*] and *C. piger*. The replication pattern was found to vary depending whether the chromosomes were homozygous for material from *C. thummi* or heterozygous. In particular, it appeared that chromosome 2 may regulate DNA synthesis of chromosome 4.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1976. Prolongation of replication time after doublings of the DNA content of polytene chromosome bands of *Chironomus*. *Chromosoma* **55**: 253-258.
DNA replication was investigated in the asynapsed homologous chromosome regions in hybrids of *C. thummi* [=*C. riparius*] and *C. piger*. The bands of *C. thummi* which had a doubling of DNA content over that in *C. piger* showed a doubling in replication time. In bands with higher multiples of DNA, the replication time increased linearly but by a smaller factor than the increase in DNA content.

Specialised subjects: Polytene chromosomes - chromosomal replication
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1977*a*. Differential staining of polytene chromosome bands in *Chironomus* by Giemsa banding methods. *Chromosoma* **59**: 207-216.
Describes two Giemsa staining methods, C-banding and a variant called BR banding. The former stains only the centromeres and some telomeres of *Chironomus* salivary gland chromosomes, while the latter also stains the duplicated bands in *C. thummi* [=*C. riparius*].

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus luridus*, *C. melanotus*, *C. plumosus*, *C. tepperi*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1977*b*. N-banding in polytene chromosomes of *Chironomus* and *Drosophila*. *Chromosoma* **63**: 79-88.
After N-banding, the pattern obtained in the salivary chromosomes of *Chironomus* species corresponded to the polytene puffing pattern, with the size and staining intensity of the bands reflecting the size of the puffs. There was no evidence of banding in heterochromatin or that the banding was restricted to nucleolar organisers. This differs from the situation in *Drosophila*. It is concluded that N-banding stains a non-histone protein which is accumulated in genetically active chromosome regions and some types of heterochromatin which are not found in *Chironomus*. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus melanotus*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1980. Studies on polytene chromosomes of *Smittia parthenogenetica* (Chironomidae, Diptera). I. Characterization of a chromosome insertion derived from a germ-line limited chromosome. *Chromosoma* **76**: 47-55.
Investigates the nature of a segment of germ-line limited chromosome inserted into polytene chromosome II. It is concluded that the segment is heterochromatic but comprises two different heterochromatin types.

Specialised subjects: Polytene chromosomes - structure
Species: *Smittia parthenogenetica*

Hägele, K. 1984. Different hybrid effects in reciprocal crosses between *Chironomus thummi thummi* and *C. th. piger* including spontaneous chromosome aberrations and sterility. *Genetica* **63**: 105-111.
Hybrids from the cross of *C. thummi* male by *C. piger* female show the development of chromosomal aberrations which arise during embryonic development. Chromosome breaks occur preferentially at specific regions in all four chromosome pairs, and in the chromosomes from both parental species. Some chromosome mutations appear to cause lethality or malformations. Illustrated by photographs. (Partim)

Specialised subjects: Hybrids - chromosome aberrations, inviability
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. 1985. Identification of a polytene chromosome band containing a male sex determiner of *Chironomus thummi thummi*. *Chromosoma* **91**: 167-171.
Genetic crosses between *C. thummi* males and *C. piger* females, followed by backcrosses were used to show a sex specific difference in polytene chromosome pairing behaviour in region D3d-g of chromosome III. Selective staining showed the presence of a heterochromatic, AT-rich band in the *C. thummi* homologue which was not present in

female hybrids, nor in the *C. piger* homologue. It is concluded that this is the male sex determiner of the *C. thummi* stock. Illustrated by photographs.

Specialised subjects: Sex chromosomes - differential segment; Hybrids - backcrosses
Species: *Chironomus thummi piger* [=*C. piger*], *C. thummi thummi* [=*C. riparius*]

Hägele, K. 1986. Localization of a male sex determining chromosome region in *Chironomus thummi piger*. *Genetica* **70**: 187-190.
By using the reciprocal hybridisation cross to that in Hägele (1985), it is concluded that the male sex determiner of *C. piger* is at D3d-g of chromosome III, as it is in *C. thummi* [=*C. riparius*]. Since there was no selective staining of bands in the regions, the conclusion was based on sex specific pairing differences in the polytene chromosomes. Illustrated by photographs.

Specialised subjects: Sex chromosomes - differential segment; Hybrids - backcrosses
Species: *Chironomus thummi piger* [=*C. piger*], *C. thummi thummi* [=*C. riparius*]

Hägele, K. & Oschmann, B. 1989. Non-reciprocal gonadal dysgenesis in hybrids of the chironomid midge *Chironomus thummi* II. Gonadal-dysgenesis inducing chromosomes. *Genetica* **78**: 185-193.
Backcrosses were performed to determine which of the *Chironomus piger* chromosomes are responsible for the temperature sensitive, non-reciprocal gonadal dysgenesis observed in hybrids of a *C. thummi* female by a *C. piger* male. Analysis of the results indicated that chromosome I had the greatest effect, with chromosome III able to exert some effect if chromosome I was also present. Illustrated by photographs of some backcross salivary gland chromosome complements.

Specialised subjects: Hybrids - sterility
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. & Oschman, B. 1987. Non-reciprocal gonadal dysgenesis in hybrids of the chironomid midge *Chironomus thummi* III. Germ line specific abnormalities. *Chromosoma* **96**: 50-54.
Continue the analysis of the causes of sterility in the dysgenic cross of *C. thummi* [=*C. riparius*] males by *C. piger* females. Found that about 60% of males showed allocyclic behaviour in the spermatogonia and spermatocyte I nuclei, leading to disintegration of the chromosomes in severe cases. In individuals without the allocycly, chromosome and chromatid aberrations are frequent and chiasma frequency is decreased more than 12-fold. Illustrated by photographs.

Specialised subjects: Hybrids - sterility
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K. & Speier, H. 1985. Selection of *thummi* specific chromosome regions in the progeny of *Chironomus thummi thummi* X *Chironomus thummi piger* hybrids after long term culturing as a consequence of gonadal sterility. *Heredity* **54**: 159-163.
After 2 years of culturing it was found that a stock derived from the cross of *C. thummi* male by *C. piger* female had accumulated five times more *thummi* chromosome regions than the homologous *piger* regions. This was found to be due to the chromosomal and cytoplasmic egg constitution of the hybrid females leading to gonadal sterility. Illustrated by a photograph of the salivary gland chromosomes of a hybrid. (Partim)

Specialised subjects: Hybrids - sterility
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hägele, K.& Speier, H. 1988. C-band differentiation between chromosomes of two subspecies of the chironomid midge *Chironomus thummi*. *Experientia* **44**: 260-261.
Compare the amount of C-banded heterochromatin in the metaphase and polytene chromosomes of *C. thummi* [=*C. riparius*] and *C. piger*. In accord with previous observations, *C. thummi* has more pericentric heterochromatin than *C. piger*. However, the proportion of pericentric heterochromatin appears to be much greater in the metaphase chromosomes than in the polytene chromosomes. This is interpreted as not being due to underreplication, but simply due to the more compact nature of the heterochromatin in the metaphase chromosomes. Illustrated by photographs.

Specialised subjects: Heterochromatin
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hajdu, L.J. 1983. A chromosome inversion pathway for some *Chironomus* species and two new techniques for analyzing similarity functions. *In* Felsenstein, J. (ed.), *Numerical Taxonomy*. *NATO Advanced Study Institute, Series G, Ecological Sciences* **1**: 532-535.
Uses computer analyses to derive trees of the

relationships between *Chironomus* species on the basis of the banding pattern of arm A.

Specialised subjects: Techniques; Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus*, *C. annularius*, *C. cingulatus*, *C. commutatus*, *C. crassicaudatus*, *C. dorsalis*, *C. halophilus* [=*C. aprilinus*], *C. holomelas*, *C. luridus*, *C. melanescens*, *C. melanotus*, *C. nuditarsis*, *C. obtusidens*, *C. piger*, *C. plumosus*, *C. pseudothummi*, *C. riparius*, *C. uliginosus*, *C.* unnamed [=*C. balatonicus*]

Halyard, R.A. 1967. *A cytogenetic analysis of* Tendipes crassicaudatus. M.S. thesis, Emory University, Georgia, U.S.A.
This work has not been seen.

Specialised subjects: Polytene chromosomes
Species: *Tendipes* [=*Chironomus*] *crassicaudatus*

Hameister, H. 1977. RNA synthesis in isolated polytene nuclei from *Chironomus tentans*. *Chromosoma* **62**: 217-242.
Assesses the effect of salt concentration on the chromosome structure and RNA synthesis of isolated salivary gland nuclei. A salt concentration of 0.15M monovalent cations is designated as standard salt medium (SSM) as the visible chromosome structure is best preserved. At lower or higher concentrations the bands decondense and visible chromosome structure is lost. At low salt concentrations RNA synthesis is depressed compared with SSM, where autoradiography indicated most activity is in the nucleoli and the Balbiani rings. At high salt concentration RNA synthesis is stimulated at many sites on the chromosome; more than at any normal developmental stage.

Specialised subjects: Polytene chromosomes - structure, gene activity
Species: *Chironomus tentans*

Hameister, H. & Pelling, C. 1975. Zur Rolle der RNA-Polymerasen während verschiedener Genaktivierungszustände. *Regulationsmechanismen der Genaktivität und Replikation bei Riesenchromosomen. Nachrichten der Akademie der Wissenschaften in Götingen. Mathematisch-Physikalishe Klasse*: 172-175.
The role of RNA polymerase in gene activation in polytene chromosomes was investigated by studying the kinetics of RNA synthesis under conditions of differing temperature or salt concentration. Conclude that there are two activity phases, a pre-active and an active phase, with differing relationships to RNA polymerase activity.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Hankeln, T. 1985. *Untersuchung der Intergrationsstellen mobiler, repetitiver genetischer Elemente im Genom von* Chironomus thummi thummi. Diplomarbeit Thesis, Lehrstuhl für Genetik, Ruhr-Universität, Bochum, Germany.
In situ hybridisation was attempted as part of an analysis of a clone containing a mobile genetic element. The clone hybridised to a number of chromosomal sites. The results are not illustrated. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi thummi* [=*C. riparius*]

Hankeln, T., Keyl, H.-G. & Schmidt, E.R. 1989. DNA-probes for the investigation of chromosome evolution in *Chironomus*. Part II: repetitive sequences. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 219-227.
Demonstrate the usefulness of DNA-probes for repetitive DNA families as a means of identifying *Chironomus* species. The probes are used for *in situ* hybridisation to the polytene chromosomes and the species may be identified by the number and distribution of hybridisation sites. Illustrated by a schematic representation of the results. (Partim)

Specialised subjects: Techniques; Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. luridus, C. melanotus, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hankeln, T., Rozynek, P. & Schmidt, E.R. 1988. The nucleotide sequence and in situ localization of a gene for a dimeric haemoglobin from the midge *Chironomus thummi piger*. *Gene* **64**: 297-304.
A clone containing DNA for the gene specifying a member of the HbVIIB family of dimeric haemoglobins from *C. piger* was in situ hybridised to the polytene chromosomes and found to bind to band F2b2 on arm D. A clone of the *C. thummi* [=*C. riparius*] monomeric haemoglobin HbIV in situ hybridised to band A1c1 on arm E and there was no cross hybridisation between the two regions. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi piger* [=*C. piger*]

Hankeln, T. & Schmidt, E.R. 1987. Cotransposition of a highly repetitive DNA element with flanking sequences in the genome of the midge *Chironomus thummi*. *Journal of Molecular Evolution* **26**: 311-319.
A subclone with low copy-number sequences, derived from one end of a clone of the 'Cla' repetitive element, was in situ hybridised to polytene chromosomes of *C. thummi* and *C. piger*. A hybridisation band was seen at C2g on chromosome I in both species, while in *C. piger* additional bands of hybridisation were seen near the centromere of chromosome I, as well as a band at the centromeres of chromosomes II and III. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hardy, P.A. 1978. Die RNS-Produkte verschiedener Balbiani-Ringe aus *Chironomus tentans*. *Verhandlungen der deutsche Zoologische Gesellschaft* **71**: 241. (Abstract)
The RNA products of the Balbiani rings of *C. tentans* were characterised. The results are given in Hardy & Pelling (1980*a*).

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Hardy, P.A. 1979. In-vitro-Translation von Balbiani-Ring-RNA von *Chironomus tentans*. *Hoppe-Seyler's Zeitschrift für Physiologische Chemie* **360**: 278-279. (Abstract)
The products of in-vitro-translation of the Balbiani rings of *C. tentans* were characterised. The results are given in Hardy & Pelling (1980*a*).

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Hardy, P.A. 1980. *The salivary glands of* Chironomus tentans: *characterization of the major secretory products and their messenger RNAs*. Dissertation, Universität Tübingen, Germany.
Thesis not seen but assumed to largely contain the data published by Hardy & Pelling (1980*a & b*).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Hardy, P.A. & Pelling, C. 1980*a*. Cell-free synthesis and immunological characterization of salivary proteins from *Chironomus tentans*. *Chromosoma* **81**: 403-417.
The salivary proteins of the larvae of *C. tentans* were characterised. The largest component, with molecular weights of between 820,000 and 700,000 Daltons, are from the RNA transcribed from the two Balbiani rings. In the in-vitro-translation system proteins of around 300,000 Daltons are produced, which are interpreted to be incomplete translation products of the BR RNA. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Hardy, P.A. & Pelling, C. 1980*b*. In vitro translation of Balbiani ring RNA from *Chironomus tentans*, pp.3-8. *In* Murray, D.A. (ed.), *Chironomidae. Ecology, Systematics, Cytology and Physiology*. Permagon Press, Oxford.
RNA from the salivary glands of *C. tentans* was translated in a cell free system. The products of the largest RNA components were shown to be immunologically related to the salivary constituents. Provides support for the contention that these products are coded for by the Balbiani rings on chromosome IV. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Harris, H. 1965. The ribonucleic acids in the nucleus and cytoplasm of animal cells. *Endeavour* **24**: 50-56.
Reviews the nature and function of RNA in the nucleus and cytoplasm. Discusses some of the evidence from *Chironomus* and includes photographs, including an autoradiograph, of the polytene chromosomes of *C. tentans*. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Hashimoto, H. 1976. Non-biting midges of marine habitats (Diptera: Chironomidae), pp. 377-414. *In* Cheng, L.(ed.), *Marine Insects*. North Holland/ American Elsevier, New York.
Gives the chromosome numbers and mentions the cytological relationships of *Telmatogeton* and *Paraclunio* species. Chromosome numbers in

Hawaiian *Telmatogeton* range from n=4 to n=7, but the marine and freshwater species are of common descent. *Paraclunio trilobatus* and *P. alaskensis* both have n=5 but, while the former is similar to the *Telmatogeton* standard, the latter appears quite different. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Paraclunio alaskensis, P. trilobatus, Telmatogeton japonicus, T. pacificus, T. torrenticola*

Hasper, M. 1911. Zur Entwicklung der Geschlechtsorgane von *Chironomus*. *Zoologische Jahrbücher* **31**: 543-612.
Describes the embryology of two chironomids tentatively identified as *C.* [=*Microtendipes*] *confinis* and *C. riparius*. Amongst the numerous illustrations are some which show mitotic figures. (Partim)

Specialised subjects: Mitosis
Species: *Chironomus* [=*Microtendipes*] *confinis, C. thummi* [=*C. riparius*]

Hauck, A. 1978. Riesenchromosomen. *Mikrokosmos* **67**: 312-315.
A brief review of the history of the discovery of polytene chromosomes in *Chironomus* and of the nature of these chromosomes. Methods for preparing salivary gland chromosomes are given, with photographs, appearing to be of *C. plumosus* and *C. thummi* [=*C. riparius*], to show the main features.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus plumosus*, *C. thummi* [=*C. riparius*]

Hauser, M. 1966. Riesenchromosomen in Quetschpräparat. *Mikrokosmos* **55**: 33-36.
A brief review of the preparation of polytene chromosome squash preparations, the structure of polytene chromosomes and the features which may be observed in squash preparations.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* spp.

Heitz, E. 1935. Chromosomenstruktur und Gene. *Zeitschrift fur induktive Abstammungs- und Vererbungslehre* **70**: 402-447.
In a comprehensive review of chromosomes, chironomids are used as examples for some aspects of the structure of polytene chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp., *C. thummi* [=*C. riparius*], *Cryptochironomus defectus*, *Prodiamesa olivacea*

Heitz, E. 1955. Über die Struktur der Chromosomen und Chloroplasten. *Deutsche Akademic der Nafurforscher (Leopoldina). Nova Acta Leopoldina* (N.S.) **17**: 517-540.
A further comprehensive review of chromosome structure in which chironomids are used to illustrate the fibrillar nature of polytene chromosomes and the nature of Balbiani rings. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Acricotopus lucidus* [=A. *lucens*], *Chironomus tentans, Trichocladius* [=*Halocladius*] *vitripennis*

Hennig, W. 1966. Chromosomenforschung und Genphysiologie. *Umschau in Wissenschaft und Technik* **13**: 435-437.
A brief review of polytene chromosomes and the studies carried out with *Chironomus tentans* to show the relationship between puffing and gene activity. The karyotype, both polytene and mitotic, of *C. tentans* is illustrated along with an autoradiograph to show sites of RNA production.

Specialised subjects: Polytene chromosomes, Puffs - gene activity
Species: *Chironomus tentans*

Hennig, W. 1974. Giant chromosomes. *In* Busch, H. (ed.), *The Cell Nucleus,* Volume **II**: 333-369. Academic Press, New York.
Reviews fully the nature of polytene chromosomes, their structure, replication, and use in studies of gene activity. Some photographs to illustrate replication patterns, nucleoli and Balbiani rings. (Partim)

Specialised subjects: Polytene chromosomes - structure, gene activity
Species: *Chironomus pallidivittatus, C. tentans, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Hertner, T.K. 1983. *Biochemische und molekularbiologische Untersuchungen über Genexpression und Genstruktur bei der*

Zuckmücke Chironomus tentans. Doktors der Naturwissenschaften, Eidgenössischen Technischen Hochschule, Zürich, Switzerland. (In German, English summary)
Reports the results of *in situ* hybridisation studies of two clones described in Hertner *et al*.(1986). Not illustrated. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans*

Hertner, T., Hertner-Meyer, B., Sogo, J.M., Schläpfer, G., Jäckle, H., Edström, J.-E. & Lezzi, M. 1986. Microcloning of a long segment of a gene from the primary ecdysterone-controlled puff region I-18c of *Chironomus tentans*: molecular characterization and effect of hormone on its transcription. *Developmental Biology* **113**: 29-39.
Two adjacent clones containing sequences from the ecdysterone-inducible puff I-18c of *C. tentans* were obtained by microcloning from the polytene chromosomes. Their identity was confirmed by *in-situ* hybridisation back to the salivary gland chromosomes, where it was observed that a single band of hybridisation was present at the site of origin of the I-18c puff. When the novel *in-situ* hybridisation technique for demonstrating nascent RNA was used, it could be shown that the gene was being transcribed whenever the puff was active. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - RNA synthesis; Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans*

Herwerden, M.A.van. 1910*a*. Über die Kernstruktur in den Speicheldrüsen der *Chironomus*-Larve. *Anatomischer Anzeiger* **36**: 193-207.
Studied the nucleus and the nucleoli in the salivary gland cells of living and fixed larvae, providing drawings to support the view that the banding of the chromosomes was a spiral of chromatin around an inner axis. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Herwerden, M.A.van. 1910*b*. De bouw der Kernen in de speekselkieren der *Chironomus*larve. *Utrecht Onderzoekingen Physiologisch Laboratorium* (*Series* 5) **11**: 40-60.
A Dutch version of Herwerden (1910*a*).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Herwerden, M.A.van. 1911*a*. Über den Kernfaden und den Nucleolus in den Speicheldrüsenkernen der *Chironomus*larve. *Anatomischer Anzeiger* **38**: 387-393.
Uses a variety of stains and digestive treatments on the salivary gland nuclei in an attempt to disprove the idea of Erhard (1911) that the chromosome is made up of alternating discs of lightly and darkly staining material. Again concludes that the chromosomes contain a spiral of chromatic material. Acid digestion removes most of the staining from the nucleolus, while it becomes vacuolated following treatment with NaCl.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus* species

Herwerden, M.A.van. 1911*b*. Kerndraad en Nucleolus in de speekselkernen der *Chironomus*larve. *Utrecht Onderzoekingen Physiologisch Laboratorium* (*Series* 5) **12**: 1-10.
A Dutch version of Herwerden (1911*a*).

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus* species

Herwerden, M.A.van. 1913. [De structuur van de kern in de spekselklieren der *Chironomus*larve.] *Tijdschrift der Nederlandse Dierkundige Vereniging*, 1910. **12**: v-vi.
Report of a seminar covering the work published in Herwerden (1910*a*).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Hilburn, L.R. 1974. *Studies concerned with cytogenetic and morphometric variation in* Glyptotendipes barbipes *(Staeger) and* Chironomus stigmaterus *Say (Diptera: Chironomidae)*. M.Sc. thesis, Texas Tech University, Texas, U.S.A. 76pp.
The cytogenetic aspects of the work on *Glyptotendipes barbipes* have been published by Hilburn & Atchley (1976) and on *Chironomus stigmaterus* were incorporated into Hilburn (1979). (Partim)

Specialised subjects: Inversions - geographical distribution

Species: *Chironomus stigmaterus*, *Glyptotendipes barbipes*

Hilburn, L.R. 1979*a*. *Population genetics of* Chironomus stigmaterus *Say (Diptera: Chironomidae): cytogenetic and enzyme variability in populations of the south western United States*. Ph.D. thesis, Texas Tech University, Texas, U.S.A. 66pp.
The cytogenetic aspects of this thesis were incorporated into Hilburn (1979). (Partim)

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus stigmaterus*

Hilburn, L.R. 1979*b*. Population genetics of *Chironomus stigmaterus* Say (Diptera: Chironomidae) I. Cytogenetic variability in populations of the south-western United States. *Heredity* **43**: 219-228.
Populations from Texas and New Mexico are chromosomally polymorphic and show genetic divergence from the virtually monomorphic populations of California. Chromosome maps are provided and the break points of 28 rearrangements defined. Only ten of these were polymorphisms, the others being recorded as single heterozygotes. It is suggested that two subspecies exist which are partially reproductively isolated.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus stigmaterus*

Hilburn, L.R. & Atchley, W.R. 1976. Studies on inversion polymorphism in *Glyptotendipes barbipes* (Staeger) (Diptera: Chironomidae). *Journal of the Kansas Entomological Society* **49**: 419-428.
Eight samples from five localities in Texas and New Mexico were examined to study inter- and intra- population variability of the inversion polymorphisms.

Specialised subjects: Inversions - geographical distribution
Species: *Glyptotendipes barbipes*

Hirvenoja, M. 1973. Revision der Gattung *Cricotopus* van der Wulp und ihrer Verwandten (Diptera, Chironomidae). *Annales Zoologici Fennici* **10**: 1-363. (English summary)
Notes that Beermann (1952) described the polytene chromosomes of *Halocladius varians* under the name *Trichocladius vitripennis*. However the material studied by Beermann had n=3, which Michailova (1975) found to be typical of *H. vitripennis*(Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Halocladius varians* [=*H. vitripennis*]

Hoffmann, P. 1980. Darstellung der Riesenchromosomen bei tiefgefrorenen *Chironomus*-larven. *Mikrokosmos* **69**: 163-165.
Describes a simple technique for preparing salivary gland chromosomes from deep-frozen larvae. Includes a photograph of chromosomes prepared in this way.

Specialised subjects: Techniques; Polytene chromosomes - general
Species: *Chironomus* species

Hoffrichter, O. 1971*a*. Karyotaxonomic study on genera related to *Chironomus* (Diptera). *Proceedings of the 13th International Congress of Entomology. Moscow, 1968,* **1**: 141-142. (Abstract)
Uses examples from *Glyptotendipes* and *Chironomus* to illustrate the differences between the systematics of larvae and adults. Lists at least six types of data, including cytotaxonomy, necessary for distinguishing intraspecific variations from interspecific differences.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus piger*, *C. plumosus*, *C. thummi* [=*C. riparius*], *Glyptotendipes* spp.

Hoffrichter, O. 1971*b*. Problems of karyosystematic studies in Chironomidae. *Third International Symposium of Chironomid Research, Moscow, 1968. Limnologica* **8**: 221-224. (Russian summary)
Reviews some of the problems encountered in karyosystematic studies of Chironomidae and applies them to the subgenus *Phytotendipes* of *Glyptotendipes*. Four populations studied, one from North America (possibly *G. lobiferus*), all had four polytene chromosomes, but the cytological relationships did not agree with the taxonomy proposed on the basis of the larval morphology. The results are compared to those of some *Chironomus* species.

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus piger*, *C. thummi* [=*C. riparius*], *C. plumosus*, *Glyptotendipes* (*Phytotendipes*)spp. [?incl. *G. lobiferus*]

Hoffrichter, O. 1977. *Studien zur Morphologie und Karyosystematik der Gattung* Glyptotendipes *(Chironomidae, Diptera)*. Inaugural-Dissertation, Freiburg Universität, Germany. 199pp.
Reviews the morphology and taxonomy of the genus before providing standard maps of the polytene chromosomes of the genus *Glyptotendipes*. The chromosomes of five species are related to this standard map. Four of these species have n=4, while *G. meridionalis* has n=2. Inversion polymorphism and the phylogenetic relationships of the species are investigated. B chromosomes were found in 66% of individuals of *G. paripes* in a population in Freiburg.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Glyptotendipes barbipes*, *G. gripekoveni*, *G. lobiferus*, *G. meridionalis*, *G. pallens*, *G. paripes*

Hoffrichter, O. & Reiss, F. 1981. Supplement 1 to "A bibliography of the Chironomidae." *Gunneria* **37**: 1-68.
Provide an additional 1700 references, mostly subsequent to those covered in Fittkau *et al*. (1976). Again they cover all fields in relation to the Chironomidae, with rough key in which those relating to cytogenetics are included in the category of "Cytology".

Specialised subjects: General Chironomidae Cytogenetics
Species: All Chironomidae

Holderegger, C. 1973. Scanning electron microscopy of isolated *Chironomus* salivary gland chromosomes. *Abstracts of the Fifth Annual Report of the Union of Swiss Societies of Experimental Biologie, Basel*. *Experientia* **29**: 227-774.
Under the SEM the body of the chromosome resembles a sponge of various pore sizes. Fibrils are packed more densely in bands than in interbands. The nucleolus appears as a compact body, while the Balbiani rings contain radially arranged fibrils which are often covered with spherical particles. Many of these features are illustrated in Holderegger (1974).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species[?=*C. tentans*]

Holderegger, C. 1974. Isolated giant chromosomes, pp.1-16. *In* Hayat, M.A. (ed.), *Principles and Techniques of Scanning Electron Microscopy*, 3. Van Nostrand Reinhold Co., New York.
A detailed outline of the procedures and controls for preparing isolated salivary gland chromosomes for examination under SEM. Illustrated by photographs of whole mounts and sections to show particularly the structure of the Balbiani rings.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Holderegger, C.U. 1975. *Darstellung isolierter Speicheldrüsenchromosomen von* Chironomus thummi *im Scanning-Elektronen-mikroskop. Elektronenmikroskopische Untersuchungen zur Ultrastruktur von ioneninduzierten Dekondensationen isolierter Speicheldrüsenchromosomen von* Chironomus thummi. Dissertation, Technische Hochschule, Zürich, Switzerland. 65 pp.
This reference has not been seen. It is assumed that some of the contents will have been included in Holderegger (1974).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Holderegger, C. & Lezzi, M. 1972. Juvenile hormone-induced puff formation in chromosomes of Malpighian tubules of *Chironomus tentans* pharate adults. *Journal of Insect Physiology* **18**: 2237-2250.
Topical application of juvenile hormone to pharate adults of *C. tentans* induces the puff I-19-A in the Malpighian tubule chromosomes. This puff corresponds to the site of a juvenile hormone-inducible puff in the salivary gland chromosomes. The higher the dose of juvenile hormone given, the more quickly the puff disappears. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Hollenberg, C.P. 1976. Proportionate representation of rDNA and Balbiani ring DNA in polytene chromosomes of *Chironomus tentans*. *Chromosoma* **57**: 185-197.
By use of *in situ* hybridisation and estimation of saturation hybridisation levels, it was determined that during polytenisation of the salivary gland

chromosomes in *C. tentans* the genes for rRNA, BR1 and BR2 are duplicated to the same extent as the bulk of the genome. Illustrated by a number of autoradiographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Hoyer-Fender, S. & Grossbach, U. 1988. Histone H1 heterogeneity in the midge *Chironomus thummi*. Structural comparison of the H1 variants in an organism where their intrachromosomal localization is possible. *European Journal of Biochemistry* **176**: 139-152.
Seven subfractions of histone H1 were identified in *C. thummi* [=*C. riparius*]. Several different variants are known to be present in salivary gland chromosomes and further studies are envisaged to clarify the nature and distribution of the subtypes. (Partim)

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus thummi* [=*C. riparius*]

Hsu, T.C. & Liu, T.T. 1948. Microgeographic analysis of chromosomal variation in a Chinese species of *Chironomus* (Diptera). *Evolution* **2**: 49-57.
Three neighbouring populations of a *Chironomus* species were analysed for chromosomal rearrangements. Six polymorphisms were present in all populations, four simple and one tandem paracentric inversions, and a "bulb"-like puff. All polymorphisms appeared to be in equilibrium and all were randomly combined with respect to each other. However relative frequencies in the three populations were different, indicating some degree of isolation although they were only a few miles apart. A drawn map is provided for portion of chromosome 2, as well as drawings of the heterozygous configurations.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus* species

Ilyinskaya, N.B. 1977. A case of somatic mosaicism of heterozygous paracentric inversion of chromosome II in *Chironomus plumosus*. *Tsitologiya* **19**: 45-49. (In Russian, English summary)
One larva of *C. plumosus* was found to be mosaic for the presence of a large paracentric inversion in chromosome II. Over two thirds of the cells were heterozygous for the inversion, which occurs in 58% of the population, while the remaining cells were homozygous but showed minor disturbance of the banding pattern but did not involve the telomere. It is assumed the second cell line is the result of somatic mutation.

Specialised subjects: Natural mosaics
Species: *Chironomus plumosus*

Ilyinskaya, N.B. 1980. Functional organization of polytene chromosomes in relation to karyosystematic problems. *New data on karyosystematics of Diptera. Proceeding of the Zoological Institute, Academy of Sciences, U.S.S.R.* **95**: 14-22. (In Russian, English summary)
Reviews many studies of salivary gland chromosomes concerning polymorphism due to environmental effects and band variations due to differing functional conditions. Notes that these sources of variation must be taken into account in karyosystematic studies. Extensive bibliography.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus*, *C. thummi* [=*C. riparius*]

Ilyinskaya, N.B. 1981. The effect of maintenance temperature of hibernating larvae (*Chironomus plumosus* L.) on the morphology of polytene chromosomes. *Tsitologiya* **23**: 264-269. (In Russian, English summary)
Hibernating larvae brought into the laboratory maintained the chromosome length and banding pattern of hibernating larvae (see Ilyinskaya & Maximova 1976) if kept at low temperature. If the larvae were placed at room temperature, the chromosomes shorten and many bands fuse but the time taken for these changes to occur depends on the time during hibernation when the larvae were collected. Those collected in March, which have the longest chromosomes, take the longest for the changes to begin, with changes being observed after 150 minutes compared with 15-30 minutes in larvae collected in December. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. 1982. Phenotypic variability of polytene chromosomes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 22.
Reviews the sources of variability in the morphology of the polytene chromosomes of *Chironomus plumosus*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Ilyinskaya, N.B. 1984. Characteristics of polytene chromosomes with different compactization degrees in larvae of *Chironomus plumosus* from a natural population. *Tsitologiya* **26**: 543-551. (In Russian, English summary)
It was found that fourth instar larvae of *C. plumosus* [=*C. muratensis*]could be divided into five groups on the basis of the puffing pattern and degree of compactness of their polytene chromosomes. These groupings were not related to the level of polyteny. Within each group there was a linear correlation between length and width of the chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. 1986. Phenotypical variation of polytene chromosomes and questions about the karyosystematics of chironomids. *Evolytsiya, vidoobrazovanie i systematika khironomid*, Novosibirsk, pp.97-103. (In Russian)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus*

Ilyinskaya, N.B. 1988. The effect of environmental temperature on the polytene chromosome morphology in *Chironomus plumosus* examined in different seasons. *Tsitologiya* **30**: 205-210. (In Russian, English summary)
The degree of compactness of the polytene chromosomes of a population of *C. plumosus* [=*C. muratensis*]was found to depend on the temperature of the habitat during winter, spring and summer, but not in autumn.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. 1990. The correlated changes in the compactness of polytene chromosomes and their arms in salivary gland cells of the chironomid larvae during acclimation to various temperatures. *Tsitologiya* **32**: 993-1001. (In Russian, English summary)
Used a Compactness Index to assess the change in dimensions of the polytene chromosomes of *Chironomus plumosus* [=*C. muratensis*] during acclimation to different temperatures in the laboratory. The possible significance of the changes is discussed. Illustrated by graphs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. & Demin, S. Yu. 1987. Morphology of polytene chromosomes of *Chironomus plumosus* larvae under acclimation to various temperatures in natural environment. *Tsitologiya* **29**: 86-93. (In Russian, English summary)
The degree of compaction of the polytene chromosomes in two populations of *C. plumosus* [=*C. muratensis*] reflected the temperature regimes in each habitat. There was the same general trend to a decrease in length as temperature increased from 4^{o}C to about 21^{o}C, but the shape of the temperature curves was different in each lake. Anoxia lead to more variability of the chromosome lengths within a gland and also to a slight alteration in the shape of the curve. No heat shock puff was observed in any of the larvae examined.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. & Martynova, M.G. 1978. Incorporation of ^{3}H-thymidine into the polytene chromosomes of salivary glands of hibernating larvae of *Chironomus plumosus*. *Tsitologiya* **20**: 522-526. (In Russian, English summary)
Hibernating larvae were collected in October and December and studied for evidence of DNA synthesis as indicated by the uptake of ^{3}H-thymidine. The results indicate that DNA synthesis continues in hibernating larvae.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus plumosus* [=*C. muratensis*]

Ilyinskaya, N.B. & Maximova, F.L. 1974. Features of functional organisation of the polytene chromosomes of Chironomidae during hibernation. *Materialy VIIth Syezda Vsesoyuznoe Entomologieskoe Obshchestro* **1**: 170. (In Russian)
An abstract of the work published by Ilyinskaya & Maximova (1976, 1978).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Maximova, F.L. 1976. Changes in polytene chromosomes of salivary glands of *Chironomus plumosus* larvae in different seasons. *Tsitologiya* **18**: 847-851. (In Russian, English summary)
A preliminary report of the work published in more detail by Ilyinskaya & Maximova (1978), indicating that seasonal variation occurs in the structure of the polytene chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Maximova, F.L. 1978. Changes in the banding pattern and number of salivary gland polytene chromosomes of *Chironomus plumosus* in different seasons. *Tsitologiya* **20**: 291-297. (In Russian, English summary)
The English translation of the title of this paper is misleading since it refers to changes in the number of bands in the polytene chromosomes, not to changes in the number of chromosomes. The number of bands recognisable in the polytene chromosomes was found to change in a seasonal manner. The highest number of bands was recorded in winter, the lowest in autumn. The reduction in band number was due to the fusion of several bands into one big block, while in winter a number of additional interband regions could be distinguished. These changes are not related to puffing but depend on the environment.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Maximova, F.L. 1985. Compactization of *Chironomus plumosus* polytene chromosomes in different seasons and on different stages of the 4th larval instar. *Tsitologiya* **27**: 163-170. (In Russian, English summary)
Larvae from a natural population were characterised for the degree of compactness of the polytene chromosomes and stage during the fourth instar during each month of the year. The was a correlation between compactness and season but the only strong relationship between chromosome morphotype and instar stage occurred in the summer and autumn.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Nilova, V.K. 1989. Electron microscopic study of myocytes with polytene chromosomes of *Chironomus plumosus* larvae. *Tsitologiya* **31**: 1193-1199. (In Russian, English summary)
Some myocytes adjacent to salivary glands contain, as well as myofibres, polytene chromosomes of classic morphology including puff structures. Illustrated by three plates of electron micrographs.

Specialised subjects: Polytene chromosomes - tissue distribution
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Petrova, N.B. 1985. B-chromosomes of *Chironomus plumosus* (Diptera, Chironomidae). *Genetika* **21**: 1671-1679. (In Russian) [Translated in *Soviet Genetics* **21**: 1314-1321]
B chromosomes are reported from four populations of *C. plumosus*. In three of them the frequency is low but in the Yaroslav population the frequency is 20.8%. The B chromosomes show high levels of association with chromosomes IV, suggesting that they are derived from this chromosome. A case of mosaicism is reported for the first time in *C. plumosus*, where the number of B chromosomes varied from 1 to 15 in the same gland. B chromosomes are found in both sexes and do not affect the rate of development or the external morphology of the larvae. Illustrated by photographs.

Specialised subjects: Supernumerary chromosomes - population studies
Species: *Chironomus plumosus*

Ilyinskaya, N.B., Petrova, N.A. & Demin, S.Yu. 1988. Seasonal dynamics of chromosomal polymorphism in the midge *Chironomus plumosus* L. (Diptera, Chironomidae). *Genetika* **24**: 1393-1401. (In Russian) [Translated in *Soviet Genetics* **24**: 967-974 (1989)]
Examined the inversion polymorphism in the populations of two adjacent lakes in the Valdai Heights region. Of the 12 inversions present, 7 were found in both lakes, with IB-2 the most consistently present and showing seasonal changes in frequency. Individuals with B chromosomes were found in both lakes; the frequency of these did not vary with the season. Illustrated by photographs.

Specialised subjects: Inversions - flexible polymorphy; Supernumerary chromosomes - population studies
Species: *Chironomus plumosus*

Ilyinskaya, N.B. & Seliivanova, G.V. 1982. The structure of polytene chromosomes at various stages of endoreduplication. I. The DNA content and nuclear structure of salivary glands in the IV instar larvae of *Chironomus plumosus*. *Tsitologiya* **24**: 144-154. (In Russian, English summary)
Salivary gland nuclei at the end of the third and fourth instars contain nuclei with three classes of ploidy (2^7c-2^9c in 3rd, 2^9c-2^{11}c in 4th). The density of arrangement of the chromosomes is independent of the actual ploidy level and changes during the course of development. However the density of the chromosomes is greatest when the ploidy level is a multiple of the diploid value and less when it is greater than a multiple of the diploid value, suggesting that the different degrees of density represent different stages of the cell cycle. Illustrated by histograms and photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus* [=*C. muratensis*]

Ineichen, H. 1978. Photoperiodische Kontrolle der Entwicklung von *Chironomus tentans* und entwicklungsspezifisch Puff-Veränderungen (in vivo und in vitro). *Revue Suisse de Zoologie* **85**: 807-809. (English summary)
Photoperiod controls the course of development of the fourth larval instar of *C. tentans*. A short day treatment leads to dormancy (oligopause) for more than 150 days. During dormancy the puffs, which are normally developed in the salivary gland chromosomes, are not developed. In particular the ecdysone-inducible regions are unpuffed, while BR2 and a juvenile-hormone-inducible puff continue to be expressed. Incorporation of ^{3}H-uridine is reduced in the dormant larvae, and the changes in the pattern of incorporation are different. No illustrations.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Israelewski, N. & Schmidt, E.R. 1982. Spacer size heterogeneity in ribosomal DNA of *Chironomus thummi* is due to a 120bp repeat homologous to a predominantly centromeric repeated sequence. *Nucleic Acids Research* **10**: 7689-7700.
A 120bp *Cla*I element, present in varying numbers within the non-transcribed spacer of the *C. thummi* [=*C. riparius*] rRNA gene, hybridises in situ to the nucleolus and the centromere of chromosome IV, while in *C. piger* there is hybridisation only to the centromere of chromosome IV. This element is not present in the basic repeat element of the *C. tepperi* nucleolus, the structure of which is similar in the main nucleolus of chromosome I and the polymorphic nucleolus of chromosome IV. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation, Nucleolus - structure
Species: *Chironomus tepperi*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Istomina, A.G. & Kiknadze, I.I. 1987. Electron microscopy of Balbiani rings and nucleoli of *Chironomus* species of the *plumosus* group. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 93-101.
Examined the ultrastructure of the BRs and nucleoli in thin sections of salivary gland cells from natural populations of five sibling species of the *C. plumosus* group. These were mostly in arm G, although an additional, partly developed BR was present in region B16 of arm B. The ultrastructural organisation was similar in all species, and similar to that in previous studies of laboratory populations, although the actual positions of the BRs varied due to inversions. In *C. agilis* there were two nucleoli in arm G due to a complex rearrangement which separated the nucleolar organiser. Illustrated by electron micrographs.

Specialised subjects: Nucleolus - ultrastructure; Puffs - Balbiani rings, ultrastructure
Species: *Chironomus agilis, C. balatonicus, C. borokensis, C. muratensis, C. plumosus*

Istomina, A.G., Kiknadze, I.I. & Khristolyubova, N.B. 1983. The ultrastructure of tissue-specific Balbiani ring 3 in *Chironomus thummi*. *Tsitologiya* **25**:1037-1041. (In Russian, English summary)
Investigate the ultrastructure of BR3, which is only expressed in the cells of the special lobe of the salivary gland. The general structure is similar to that of other BRs but the average size of the RNP-granules is smaller. It is suggested that this reflects the smaller size of the transcript from BR3. Illustrated by electron micrographs.

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Istomina, A.G., Perov, N.A. & Kiknadze, I.I. 1982. The ultrastructure of the Balbiani rings in *Chironomus thummi*. *Abstracts of the International Symposium on the Organization and*

Expression of Tissue Specific Genes, *Novosibirsk*: 24.
Report on the ultrastructure of the three active Balbiani rings of *C. thummi* [=*C. riparius*], which is basically similar in having loop-like structures with numerous fibrils and granules of ribonuclear protein.

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Jacob, J. 1966. Intranucleolar deoxyribonucleic acid components in insect cells as revealed by electron microscopy. *Nature* **211**: 36-38.
Presents electron microscopic evidence that chromatin-like material, containing DNA is present inside the nucleolus of a *Smittia* species, probably *S. parthenogenetica*. Illustrated by electronmicrographs.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Smittia* species [?=*S. parthenogenetica*]

Jacob, J. 1967. An electron microscope autoradiographic study of the site of initial synthesis of RNA in the nucleolus of *Smittia*. *Experimental Cell Research* **48**: 276-282.
Uses electron microscope analysis of autoradiographs of salivary gland chromosomes of a *Smittia* species, probably *S. parthenogenetica*, to study the initiation of RNA synthesis in the nucleolus. The results are consistent with the interpretation that the synthesis is primed by the intranucleolar DNA dispersed in the inner part of the nucleolus. The nucleolus appears to consist of an inner and an outer entity with different functions. Well illustrated by electron micrographs or autoradiographs.

Specialised subjects: Nucleolus - gene activity
Species: *Smittia* species [?=*S. parthenogenetica*]

Jacob, J. & Danieli, G.A. 1970. Replication of intranucleolar DNA in *Smittia* (Diptera, Chironomidae). *Experientia* **26**: 1390-1393. (Italian summary)
Autoradiographic studies of replication of the salivary gland chromosomes of a *Smittia* species show four patterns of replication as in other studies. This is illustrated by five autoradiographs. The intranucleolar DNA however appears to replicate independently of the chromosomal DNA. It is not certain whether this is due to asynchronous replication or to amplification of the ribosomal DNA within the nucleolus.

Specialised subjects: Nucleolus - replication
Species: *Smittia* species [?=*S. parthenogenetica*]

Jacob, J. & Sirlin, J.L. 1962. The incorporation of pseudouridine into nucleolar transfer RNA. *Journal of the Zoological Society of India* **14**: 1-3.
Tritiated pseudouridine was used to demonstrate that the nucleolus was probably involved in the metabolism of tRNA. (Partim)

Specialised subjects: Nucleolus - tRNA metabolism
Species: *Smittia* species [?=*S. parthenogenetica*]

Jacob, J. & Sirlin, J.L. 1964*a*. Electron microscope autoradiography of the nucleolus of insect salivary gland cells. *Nature* **202**: 622-623.
A preliminary account of the use of electron microscope autoradiographs to investigate activity in the nucleolus of a *Smittia* species, probably *S. parthenogenetica*. Illustrated with three photographs, it is concluded that the nucleolar organiser does not contribute to any observable extent to the synthesis of nucleolar RNA.

Specialised subjects: Nucleolus - gene activity
Species: *Smittia* species [?=*S. parthenogenetica*]

Jacob, J. & Sirlin, J.L. 1964*b*. Electron microscope studies on salivary gland cells. 4. The nucleus of *Smittia parthenogenetica* (Chironomidae) with special reference to the nucleolus and the effects of actinomycin thereon. *Journal of Ultrastructure Research* **11**: 315-328.
The salivary gland chromosomes of *S. parthenogenetica* were sectioned and examined under the electron microscope. The ultrastructure of the chromosomes was essentially as in other, previously studied, organisms and so most work concentrated on the structure and chromosomal attachment of the nucleolus. The chromatin of the nucleolus organiser was similar to that of other bands. The structure of the nucleolus if polarised towards its point of attachment to the organiser. The nucleolar material is granular, mainly 100-150 Å, but with some larger particles particularly towards the periphery where they are closely packed. Treatment with actinomycin results in reduction and eventual disappearance of the nucleoli, which completely lose their attachment to the chromosomes. Well illustrated with photographs and with a summary diagram of the organisation of the nucleolus.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Smittia parthenogenetica*

Jacob, J. & Sirlin, J.L. 1964*c*. Synthesis of RNA in vitro stimulated in dipteran salivary glands by 1,1,3-tricyano-2-amino-1-propene. *Science* **144**: 1011-1012.
When larval salivary glands of *Smittia parthenogenetica* were incubated in 1,1,3-tricyano-2-amino-1-propene (tricyamp) there was a marked increase in the incorporation of uridine into the chromosomes and especially the nucleoli. This is illustrated by photographs. It is suggested that the incorporation is into RNA. Tricyamp is able to overcome the inhibitory effect of actinomycin D.

Specialised subjects: Polytene chromosomes -, Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Jäckle, H., de Almeida, J.C. & Edström, J.-E. 1982. Molecular cloning and structure of BR2 specific sequences in *Chironomus pallidivittatus*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 26.
Note that the clones obtained hybridised only to the BR2 region of *C. pallidivittatus* and did not hybridise to any region of the chromosomes of *C. thummi* [=*C. riparius*]. (Partim)

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus pallidivittatus, C. thummi* [=*C. riparius*]

John, B. & Lewis, K.R. 1965. The meiotic system. *Protoplasmatologia* **VI F1**: 1-335.
In a general review of meiosis it is noted that *Metriocnemus cavicola* [*M. martinii*] has an achiasmatic meiosis. When recombination occurs within the inversion loop of an inversion heterozygote of *Chironomus tentans* the resulting bridge may not break, leading to a double sperm. In the discussion of meiotic differences between sexes it is noted that *Sciara*, *Miastor*, and the Orthocladiinae have a differential chromosome elimination in the soma but, while it is also differential between the sexes in the first two, in Orthocladiinae the soma of males and females has the same constitution. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Meiosis
Species: *Chironomus tentans*, *Metriocnemus cavicola* [=*M. martinii*], Orthocladiinae spp.,

John, B. & Lewis, K.R. 1968. The chromosome complement. *Protoplasmatologia* **VI A**: 1-206.
In a general review of the chromosomes of plants and animals, some observations are included on the polytene chromosomes of Chironomidae. The relative lengths and effect of increasing rounds of polytenisation are compared between the chromosomes of the salivary gland, mid-gut and Malpighian tubules of *Chironomus tentans*. Salivary gland chromosomes are illustrated by the complement of *Glyptotendipes barbipes*. There are also notes on puff activity and on the different DNA contents of the bands of *C. thummi* [=*C. riparius*] and *C. piger*. The anomalous chromosome cycle of the Orthocladiinae is compared to those of Sciaridae and Cecidomyiidae. In the area of evolutionary changes, the clustering of inversion breakpoints in *Tendipes* [=*Chironomus*] *decorus* is noted, as are the translocation groups of the genus *Chironomus*. The different arm combinations of *C. uliginosus*, *C. obtusidens* and *C. commutatus* are illustrated. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure, interspecific rearrangements; Germ-line limited chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus commutatus, C. obtusidens, C. tentans*, *C. thummi piger* [=*C. piger*,], *C. th. thummi* [=*C. riparius*], *C. uliginosus, Clunio marinus*, *Eucricotopus atritarsis* [=*Cricotopus ornatus*], *E.* [=*Cricotopus*] *sylvestris, Limnophyes* species, *Metriocnemus cavicola* [=*M. martinii*], *M. inopinatus*, *M. hygropetricus*, *M.* species, *Psectrocladius obvius*, *P. platypus*, *P. remotus* [=*P. sordidellus*], *P.* species, *Tendipes decorus* [=*Chironomus decorus* gp.(R&F)], *Trichocladius* [=*Halocladius*] *vitripennis*

John, B. & Lewis, K.R. 1969. The chromosome cycle. *Protoplasmatologia* **VI B**: 1-125.
Use various *Chironomus* species as examples in a general discussion of polytene chromosomes. Includes a figure of a fluorescently stained chromosome of *C. tentans* to indicate that DNA is present in the interband regions a swell as in the bands. This is confirmed by DNase digest of interbands. In hybrids of *C. thummi* and *C. piger* there is relatively more DNA in the bands of *C. thummi*-derived chromosomes, the amount varying by factors of 2, 4, 8, or 16. When autoradiographs are made of polytene chromosomes, either a few bands or all parts of the chromosomes are labelled. These are just the extremes of a single total replication cycle. The nucleolus forms a

prominent part of the nuclear RNA. In *C. tentans* the two nucleoli produce similar RNAs, with the same base composition to that found in the cytoplasm. RNA is found in puffs, particularly the Balbiani rings where there is 400 times more than the average for the bands of chromosome 1, but different chromosome regions produce RNA of different base composition. In *C. tentans* the amount of DNA is a function of chromosome length, the average amount per band being similar in different chromosomes. It is calculated that the chromomeres contain about 100,000 base pairs. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*], *C. piger*

Kalisch, W.-E. 1982. EM chromosome mapping using surface spread polytene chromosomes. *Genetica* **60**: 21-24.
Compares electron micrographs and light micrographs of surface spread polytene chromosomes to show that more bands are recognisable than with standard squash preparations. Illustrated by photographs and redrawn partial chromosome maps.

Specialised subjects: Techniques; Polytene chromosomes - maps
Species: *Chironomus tepperi*

Kalisch, W.-E. & Hägele, K. 1981. Surface spreading of polytene chromosomes. *European Journal of Cell Biology* **23**: 317-320.
The surface spreading technique described enlarges the cross diameter of *Chironomus* salivary gland chromosomes up to 6.3 times (ave. about three times) and their length up to 3.5 times compared with conventional squash preparations. Pilocarpine pretreatment of the larvae enhances the results. Some bands do not spread as well as others. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - number of bands
Species: *Chironomus tepperi*, *C. thummi thummi* [=*C. riparius*]

Kalisch, W.-E. & Hägele, K. 1982. A new spreading technique for polytene chromosomes and its efficiency for autoradiography including in situ hybridization, pp.1-10. *In* S. Lakovaara (ed.), *Advances in Genetics, Development, and Evolution of Drosophila*, Plenum Publishing Corporation.
Further details on the technique given in Kalisch & Hägele (1981), with examples of its successful use for autoradiography on the salivary gland chromosomes of *Chironomus* species. Illustrated by photographs. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - maps, bands and genes, in situ hybridisation
Species: *Chironomus tepperi*, *Chironomus thummi* [=*C. riparius*]

Kalisch, W.-E. & Whitmore, T. 1983. Differences in the number of polytene chromosome bands as studied by electron microscopy. *Cytobios* **37**: 37-43.
Regions 1A and 1B of arm B of *Chironomus tepperi* were examined under the scanning electron microscope following two different pretreatments to the spreading technique (Kalisch & Hägele, 1981, 1982). Following pretreatment in Ringer's solution a 70% increase, and following pretreatment without Ringer's solution, a 220% increase in the number of bands recorded by Martin (1974) was observed. Illustrated by photographs and drawn maps of the region.

Specialised subjects: Techniques; Polytene chromosomes - maps
Species: *Chironomus tepperi*

Kalisch, W.-E., Whitmore, T. & Reiling, H. 1984. Computerized EM maps of surface spread polytene chromosomes. 1. Digitizing and plotting of banding patterns. *Cytobios* **41**: 47-62.
Provides a computer program to plot chromosome maps of polytene chromosomes that have been surface spread and examined under a scanning electron microscope. Examples are shown from the left arm of chromosome I and the right arm of chromosome III of *Chironomus thummi* [=*C. riparius*]. Illustrated by photographs and drawn or plotted maps. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - maps
Species: *Chironomus thummi thummi* [=*C. riparius*]

Kalnins, V.I. 1965. Fine structure of salivary gland chromosomes of chironomids. Abstracts of the Tenth Annual Meeting of the Canadian Society of Genetics. *Canadian Journal of Genetics and Cytology* **7**: 354.
Abstract report of the work presented in Kalnins et al. (1964*c*).

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus* spp., *Glyptotendipes* spp.

Kalnins, V.I., Stich, H.F. & Bencosme, S.A. 1964*a*. Fine structure of salivary gland chromosomes. *75th Annual Session of the American Association of Anatomists. Anatomical Records* **148**: 297. (Abstract)
Abstract report of the work published in Kalnins et al. (1964*b* & *c*). The species used are unspecified but are probably *Chironomus* and *Glyptotendipes* species.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp., *Glyptotendipes* spp.

Kalnins, V.I., Stich, H.F. & Bencosme, S.A. 1964*b*. Fine structure of the nucleolar organizer of salivary gland chromosomes of chironomids. *Journal of Ultrastructure Research* **11**: 282-291.
The region of the polytene chromosome associated with the nucleolus was studied under the electron microscope. This region was characterized by coils of 100Å fibres, pars amorpha and nucleolonema. These structures extend into the nucleolus proper and it is suggested that only the coils of fibres represent the nucleolus organiser. Illustrated by four plates of electron micrographs.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus cingulatus*

Kalnins, V.I., Stich, H.F. & Benscome, S.A. 1964*c*. Fine structures of nucleoli and RNA-containing chromosome regions of salivary gland chromosomes of chironomids and their interrelationship. *Canadian Journal of Zoology* **42**: 1147-1155.
The previous studies of the ultrastructure of the nucleolus (Kalnins, Stich & Benscome 1964*b*) are extended to other parts of the chromosome containing RNA. Although these exhibit a great variety of structures under light microscopy, they are shown to comprise only a few basic units, the pars amorpha and nucleolonema (previously described) and the characteristic Balbiani ring granules. The Balbiani ring granules are attached to 100Å fibres in the Balbiani rings. They are not present in nucleoli of micronucleoli. Illustrated by numerous electronmicrographs.

Specialised subjects: Polytene chromosomes, Nucleolus, Puffs - Balbiani rings, structure
Species: *Chironomus militaris* [=*C. decorus* gp.], *C. plumosus*, *Glyptotendipes barbipes*, *G. lobiferus*

Kao, W.-Y. & Case, S.T. 1983. Structural similarities among secretion polypeptides in salivary glands of *Chironomus tentans*. Abstracts of the twenty third Annual Meeting, American Society for Cell Biology, San Antonio, Texas. *Journal of Cell Biology* **97**: 441a.
Conclude that secretion polypeptides may be encoded by a multigene family such as those found in Balbiani rings of polytene chromosomes. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Karlson, P. 1965. [Introduction to the discussion papers.] *Table ronde sur les manifestations hormonales liées aux mécanismes génétiques. Archives d'Anatomie Microscopique et de Morphologie Experimentale* **54**: 643.
Notes that the interaction of a hormone with the genetic material was first demonstrated by Clever & Karlson (1960) in *Chironomus tentans*.

Specialised subjects: Puffs - ecdysone
Species: *Chironomus tentans*

Karlson, P. 1967. The effects of ecdysone on giant chromosomes, RNA metabolism and enzyme induction. *Endocrine genetics. Proceedings of a Symposium at the University of Cambridge,* 1966. *Memoirs of the Society for Endocrinology* **15**: 67-76.
Briefly reviews some experiments on the effects of ecdysone on puffs in the polytene chromosomes of *Chironomus tentans*, and *C. thummi* [=*C. riparius*] before detailing studies on *Calliphora*. (Partim)

Specialised subjects: Polytene chromosomes, gene activity
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Karlson, P. & Löffler, U. 1962. Isolierung von Speicheldrüsen-Chromosomen durch differentielle Zentrifugation. *Hoppe-Seylers's Zeitschrift für Physiologishe Chemie* **327**: 286-288. (German & English summaries)
Describe a technique for the isolation of salivary gland chromosomes using differential centrifugation, with an illustration of stained chromosomes prepared by this technique.

Specialised subjects: Techniques; Polytene chromosomes - isolation
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Kato, K.-I. 1977. Alcian blue staining of chromosomes in insect salivary glands. *Memoirs of the Osaka Kyoiku University*, *Series III*, **26**: 91-94.
Alcian blue staining of the salivary gland chromosomes of a *Smittia* species under a variety of treatments suggests that the stain may be staining deoxyribonucleic acid and/or complexed substances, including polysaccharides, which are produced as a result of the metabolic activity of the chromosomes. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Smittia* species

Kerkis, I.E., Filippova, M.A., Shobanov, N.A., Gunderina, L.I. & Kiknadze, I.I. 1988. Karyological and genetico-biochemical characteristics of *Chironomus borokensis* sp. n. from the plumosus group (Diptera, Chironomidae). *Tsitologiya* **30**: 1364-1372. (In Russian, English summary)
The new species *C. borokensis* is described on the basis of the salivary gland chromosomes and enzyme polymorphisms. The species is closely related to *C. plumosus*, having the same chromosome number and arm combination but differing in the sequences of arms B and F. It has considerable centromeric heterochromatin and is highly polymorphic. Photographic chromosome maps are provided. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus borokensis*

Kerkis, I.E., Kiknadze, I.I., Filippova, M. & Gunderina. L. 1989. Cytogenetic differentiation of the *Chironomus* species of the plumosus group. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 103-114.
Bring together a cytological comparison of the polytene chromosome banding patterns of eight previously described and one new species closely related to *C. plumosus*. Photographic maps are provided for each species, based on the map of Maximova (1976), which Petrova *et al.* (*Cytobios* **70**: 185-189, 1992) claim is not actually *C. plumosus*. As well as a phylogenetic comparison of the relationship of the sequences in each chromosome is given. Unfortunately in the printing the contents of pages 105 and 106 have been inserted in the reverse order.

Specialised subjects Cytotaxonomy - polytene chromosomes
Species: *Chironomus agilis, C. balatonicus, C. bonus, C. borokensis, C. entis, C. muratensis, C. nudiventris, C. plumosus, C.* sp.n. 1

Kerkis, I.E., Kiknadze, I.I. & Istomina, A.G. 1989. A comparative karyotype analysis of three *Chironomus* sibling species of the *plumosus* group (Diptera, Chironomidae). *Tsitologiya* **31**: 713-720. (In Russian, English summary)
Describe the karyotypes of three more species in the *C. plumosus* group and provide photographic maps comparing the polytene chromosomes to those of *C. plumosus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus agilis*, *C. bonus, C. entis*

Kerkis, I.E., Kiknadze, I.I. & Shilova, A.I. 1985. Karyological characteristics of *Lipiniella arenicola* Shilova (Diptera, Chironomidae). *Tsitologiya* **27**: 1410-1413. (In Russian, English summary)
Describe the salivary gland chromosomes of *Lipiniella araenicola* and provide photographic maps. The species has 2n=6, with three long acrocentric polytene elements joined in a chromocentre. Nucleoli are present in both chromosomes I and II, while 55% of larvae are heterozygous for a small inversion in chromosome III. Seasonal variation in polytene chromosome morphology was noted.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Lipiniella araenicola*

Keyl, H.-G. 1957. Untersuchungen am Karyotypus von *Chironomus thummi*. I. Karte der Speicheldrüsen-chromosomen von *Chironomus thummi thummi* und die cytologische Differenzierung der subspecies *C. th. thummi* und *C. th. piger*. *Chromosoma* **8**: 739-756.
Provides a drawn chromosome map of *C. th. thummi* [=*C. riparius*] and compares the karyotype of this species and the closely related *C. th. piger* [=*C. piger*]. There are no inversion differences between the two species (and inversions in natural populations are rare), instead they differ by an increased thickness of many bands in *C. thummi* compared with those in *C. piger*. These are illustrated by drawings and photographs.

Specialised subjects: Karyotype - evolution
Species: *Chironomus thummi piger* [=*C. piger*,], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1958. Untersuchungen am Karyotypus von *Chironomus thummi*. II. Strukturveränderungen an den Speicheldrüsenchromosomen nach Röntgen-bestrahlung von Embryonen und Larven. *Chromosoma* **9**: 441-483.
At four stages during embryogenesis and 150 stages during larval development, *C. thummi* [=*C. riparius*] was irradiated by X-rays and the polytene chromosomes of the mature larvae examined. In the embryo and at many other stages only partial chromosome breaks were observed. Photographs of many aberrations are provided and the explanation of partial breaks is well illustrated by diagrams. The implications of the results for an understanding of the structure of polytene chromosomes are discussed.

Specialised subjects: Polytene chromosomes - structure; Mutagenesis - ionising radiation
Species: *C. thummi thummi* [=*C. riparius*]

Keyl, H.-G. 1960*a*. Die cytologische Diagnostik der Chironomiden. II. Diagnosen der Geschwisterarten *Chironomus acidophilus* n.sp. und *C. uliginosus* n.sp. Bestimmungsmerkmale von *C. commutatus* Str. u. *C. obtusidens* Goethg. *Archiv für Hydrobiologie* **57**: 187-195. (German & English summary)
Describes two new species on the basis of cytological characters and extends the cytological key of Keyl & Keyl (1959) to include these two species, as well as *C. commutatus* and *C. obtusidens*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus acidophilus, C. commutatus, C. obtusidens, C. uliginosus*

Keyl, H.-G. 1960*b*. Chromosomenumbau und Evolution in der Gattung *Chironomus*. *Zoologischer Anzeiger Supplement*. *Verhandlungen der deutsche Zoologische Gesellschaft* **24**: 280-283.
Changes between species of chironomids may be in the form of whole arm translocations or of linear rearrangements. This is explained by examples from the genus *Chironomus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Karyotype - evolution
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans, Chironomus anthracinus, C. commutatus, C. melanotus, C. parathummi, C. pseudothummi, C. thummi piger* [=C. *piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1960*c*. Erhöhung der chromosomalen Replikationsrate durch Mikrosporidieninfektion in Speicheldrüsenzellen von *Chironomus*. *Die Naturwissenschaften* **47**: 212-213.
In *Chironomus anthracinus* larvae infected with a microsporidian parasite, the salivary gland chromosomes become abnormally highly polytenized and the cells hypertrophied. These effects are illustrated by photographs.

Specialised subjects: Polytene chromosomes - parasite effects
Species: *Chironomus anthracinus*

Keyl, H.-G. 1961*a*. Die cytologische Diagnostik der Chironomiden III. Diagnose von *Chironomus parathummi* n.sp. und Ergänzungen zur Bestimmungs-tabelle. *Archiv für Hydrobiologie* **58**: 1-6.
Describes *C. parathummi* on the basis of cytological characters and completes the cytological key (Keyl & Keyl 1959, Keyl 1960*a*) by the addition of this species, as well as *C. melanotus*, *C. aberratus* and *C. nuditarsis*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus, C. melanotus, C. nuditarsis, C. parathummi*

Keyl, H.-G. 1961*b*. Chromosomenevolution bei *Chironomus*. I. Struktur-abwandlungen an Speicheldrüsen-Chromosomen. *Chromosoma* **12**: 26-47.
Describes the structural modifications which occur as species characteristics in the European representatives of the genus *Chironomus*. These include alterations of the proportions of the various chromosomes, heterochromatinisation of the centromeric regions and differential expression of intercalary structures. Many photographs of the detail of specific chromosome regions.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Karyotype - evolution
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans, Chironomus aberratus, C. acidophilus, C. anthracinus, C. cingulatus, C. commutatus, C. crassimanus, C. dorsalis,*

C. holomelas, C. melanotus, C. obtusidens, *C. parathummi, C. plumosus, C. pseudothummi, C. striatus, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *C. uliginosus*

Keyl, H.-G. 1962. Chromosomenevolution bei *Chironomus*. II. Chromosomenumbauten und phylogenetische Beziehungen der Arten. *Chromosoma* **13**: 464-514.
Twenty European species of *Chironomus* could be grouped into four complexes differing by whole arm translocations. Within these groups the species differed from one another mainly by paracentric inversions. Using the relationships between the chromosomal rearrangements of arms A, E and F, the phylogenetic relationships were reconstructed. In two other studied species, *C. striatus* and *C. salinarius*, the relationships of the banding patterns to those of other species were not sufficiently clear for detailed comparisons to be made. In addition the relationship between arm F of *Camptochironomus* [=*Chironomus*] *tentans* and that of *C. piger* is given.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Karyotype - evolution
Species: *Camptochironomus* [=*Chironomus*] *tentans, Chironomus aberratus*, *C. acidophilus, C. annularius, C. anthracinus, C. cingulatus, C. commutatus, C. crassimanus, C. dorsalis, C. halophilus* [=*C. aprilinus*], *C. holomelas, C. luridus, C. melanescens, C. melanotus, C. nuditarsis, C. obtusidens*, *C. parathummi, C. plumosus, C. pseudothummi, C. salinarius, C. striatus, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *C. uliginosus*

Keyl, H.-G. 1963*a*. Crossing over bei Bastarden von *Chironomus thummi piger* x *Chironomus thummi thummi*. *Chromosoma* **13**: 588-599.
Hybrids of *C. th. piger* [=*C. piger*] x *C. th. thummi* [=*C. riparius*] were backcrossed to *C. piger* and the frequency of crossing over in structurally identical and structurally different sections of the chromosomes was determined. Crossing over was much higher in the structurally identical regions and was also higher in females than in males. Photographs of examples of the recombinant karyotypes in the backcrosses are provided.

Specialised subjects: Hybridisation - crossing over, sex differences
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1963*b*. DNS-Konstanz in Heterochromatin von *Glyptotendipes*. *Experimental Cell Research* **30**: 245-247.
The centromeric heterochromatin of chromosome arm IIL of *G. barbipes* can appear as a Balbiani ring or as a heterochromatic block, leading Stich & Naylor (1958*a* & *b*) to conclude that the amount of DNA varied with temperature. This study, employing a distal region of the arm as a control, shows that the relative amount of DNA is constant with the different appearance of the heterochromatin depending on the stage of replication of the polytene chromosomes. Illustrated by photographs of the different appearances of the heterochromatin and of the distal segment used for comparisons.

Specialised subjects: Heterochromatin - polytene chromosomes
Species: *Glyptotendipes barbipes*

Keyl, H.-G. 1964*a*. Veränderungen des DNS-Verteilungsverhältnisses in Speicheldrüsen-Chromosomen während der Replikation. *Verhandlungen der deutsche Zoologischen Gesellschaft in München* **1963**: 78-84.
Evaluation of the effects of a microsporidian infection on the larval salivary gland chromosomes of *Chironomus anthracinus* in an attempt to understand the differential DNA content of heterochromatic and euchromatic bands. Illustrated by photographs of comparative chromosomal sections from infected and uninfected larvae.

Specialised subjects: Polytene chromosomes - chromosomal replication
Species: *Chironomus anthracinus*, *C. thummi thummi* [=*C. riparius*]

Keyl, H.-G. 1964*b*. Verdopplung des DNS-Gehalts kleiner Chromosomenabschnitte als Faktor der Evolution. *Die Naturwissenschaften* **51**: 46-47.
Measurements of the DNA content of certain homologous bands in the chromosomes derived from different parents in the hybrid of *Chironomus thummi* [=*C. riparius*] x *C. piger*, indicated that the *C. thummi* bands had 2, 4, or up to 16 times the DNA of the equivalent band in *C. piger*. Similarly a heterozygous band in the centromere region of the CD chromosome of *C. plumosus* contained about 8 times the DNA of its homologue. It is suggested that the increase in DNA arises from a doubling of the original band during replication, and that this doubling process may be repeated several times.

Specialised subjects: Polytene chromosomes - bands, DNA content
Species: *Chironomus plumosus*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1965*a*. Duplikationen von Untereinheiten der chromosomalen DNS während der Evolution von *Chironomus thummi*. *Chromosoma* **17**: 139-180. (German & English summary)
A more detailed account of the differences in DNA content of homologous bands presented by Keyl (1964*b*). Illustrated by photographs and drawings of various chromosome regions, as well as by diagrams of the proposed mechanism of DNA increase.

Specialised subjects: Polytene chromosomes - bands, DNA content
Species: *Chironomus plumosus*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1965*b*. A demonstrable local and geometric increase in the chromosomal DNA of *Chironomus*. *Experentia* **21**: 191-193. (German summary)
A short, English version of the work presented in Keyl (1964*b*, 1965*a*). Illustrated by a drawing of one chromosome region and a diagram of the proposed mechanism of DNA increase.

Specialised subjects: Polytene chromosomes - bands, DNA content
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1966*a*. Increase of DNA in chromosomes. *Chromosomes Today* **1**: 99-101.
A further account of the relationships of the DNA content of homologous bands in *Chironomus thummi* [=*C. riparius*] and *C. piger*, as in Keyl 1964*b*, 1965*a* & *b*).

Specialised subjects: Polytene chromosomes - bands, DNA content
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. 1966*b*. Lokale DNS-Replikationen in Riesenchromosomen, pp.54-69. *In* Sitte, P., *Probleme der biologistehen Reduplication. 3rd wissenschaftliche Konferenz der Gesellschaft Deutscher Naturforscher und Arzte Semmering bei Wien*, 1965. *Springer-Verlag, Berlin*. 412pp. (English summary)
Presents data on the reduplication of DNA in the centromere regions of *Glyptotendipes barbipes*, in specific bands of *Chironomus thummi* [=*C. riparius*], and in *C. anthracinus* following microsporidian infection. The data are used to propose an hypothesis on the construction of such local replication units, previously reported in Sciaridae.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus anthracinus*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Keyl, H.-G. 1966*c*. Cytophotometry with giant chromosomes. *Zeiss Information* **61**: 96-99. (also in German)
Describes the use of quantitative cytophotometry to measure the DNA content of individual bands of polytene chromosomes and its applications in studying DNA replication and evolution.

Specialised subjects: Techniques; Polytene chromosomes - bands, DNA content
Species: *Chironomus anthracinus*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*],

Keyl, H.-G. 1967. Beziehungen zwischen Grösse und DNS-Gehalt mitotischer Chromosomen bei *Chironomus*. *Zoologischer Anzeiger Supplement. Verhandlungen der deutsche Zoologische Gesellschaft* **30**: 402-407.
Uses cytophotometry to investigate the claim of Besserer (1957), that mitotic cells with large chromosomes contain more DNA than cells with small chromosomes. The results indicate that such a claim is not warranted. Illustrated by photographs of the two types of mitotic cells, histograms of the DNA content, and a graph of the relationship between cell area and DNA content.

Specialised subjects: Chromosome structure, Mitosis
Species: *Chironomus tentans*

Keyl, H.-G. 1968. Messungen über DNS-Verteilung in Chromosomen mit dem Universal-Mikro-Spektralphotometer. *Umschau in Wissenschaft und Technik* **68**: 82-83.
Describes the method used for measuring the differences in DNA content of polytene bands and gives examples of the results, including photographs, to show the difference in a heterozygous centromeric band of *Chironomus obtusidens*.

Specialised subjects: Techniques; Polytene chromosomes - bands, DNA content
Species: *Chironomus obtusidens*

Keyl, H.-G. 1975. Lampbrush chromosomes in spermatocytes of *Chironomus*. *Chromosoma* **51**: 75-91.
Describes the lampbrush chromosomes present in pachytene and diplotene stages of the primary spermatocytes of *C. pallidivittatus*. The structure of the chromosomes is detailed and compared to that of the polytene chromosomes.

Specialised subjects: Techniques; General Dipteran Cytogenetics; Lampbrush chromosomes - structure
Species: *Chironomus pallidivittatus*

Keyl, H.-G. 1978. Die fibrilläre Organisation der Chromosomen. *Verhandlungen der deutsche Zoologische Gesellschaft* **71**: 59-67. (English summary)
Uses spread mitotic and meiotic chromosomes to investigate the occurrence of fibrillar loops. At the pachytene of meiosis the chromosomes have a lampbrush structure while in interkinesis and in spermatids there is a secondary loop structure with transcripts attached. Illustrated by photographs, including electronmicrographs, and diagrams.

Specialised subjects: Chromosome structure; Lampbrush chromosomes
Species: *Chironomus pallidivittatus, C. tepperi, C. thummi* [=*C. riparius*];

Keyl, H.-G. & Hägele, K. 1966. Heterochromatin-Proliferation an den Speicheldrüsen-Chromosomen von *Chironomus melanotus*. *Chromosoma* **19**: 223-230. (English summary)
In larvae of *C. melanotus* with an extended larval life, a proliferation and ejection of heterochromatic material occurs from the centromeres. It is also shown that in normal larvae, the percentage heterochromatin in the salivary gland nuclei at the same stage of development is variable, suggesting that replication of heterochromatin is less rigidly controlled than that of euchromatin. Illustrated by photographs of the heterochromatin ejections.

Specialised subjects: Polytene chromosomes, Heterochromatin - replication
Species: *Chironomus melanotus*

Keyl, H.-G. & Hägele, K. 1971. B-Chromosomen bei *Chironomus*. *Chromosoma* **35**: 403-417. (English summary)
Some populations of *C. plumosus* and *C. melanotus* contain a supernumerary chromosome, present in both germ-line and somatic cells. However the B-chromosome is not found in all nuclei of testis or soma, and the number present varies between cells of an individual. The B-chromosome of both species represent centromeric fragments of chromosome IV. Illustrated by photographs of the B-chromosomes in meiotic and polytene cells.

Specialised subjects: Supernumerary chromosomes - tissue differences
Species: *Chironomus melanotus*, *C. plumosus*

Keyl, H.-G. & Keyl, I. 1959. Die cytologische Diagnostik der Chironomiden. I. Bestimmungstabelle für die Gattung *Chironomus* auf Grund der Speicheldrüsenchromosomen. *Archiv für Hydrobiologie* **56**: 43-57.
Provides an identification key to 13 European species of *Chironomus* based on the characters of the salivary gland chromosomes. Provides photographic plates of the whole complement of each species as well as drawings of specific regions.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. anthracinus*, *C. cingulatus*, *C. crassimanus*, *C. dorsalis, C. halophilus* [=*C. aprilinus*], *C. luridus*, *C. plumosus, C. pseudothummi, C. salinarius*, *C. striatus, C. thummi piger* [=*C. piger*,], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. & Pelling, C. 1963. Differentielle DNS-Replikation in den Speicheldrüsen-Chromosomen von *Chironomus thummi*. *Chromosoma* **14**: 347-359.
Studied the incorporation of radio-labelled thymidine into the salivary gland chromosomes of hybrids between *C. thummi* [=*C. riparius*] and *C. piger*. The incorporation was into heterochromatic bands and these were shown to be more common in *C. thummi* than in *C. piger*. Illustrated by photographs and autoradiographs of hybrid chromosomes.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. & Strenzke, K. 1956. Taxonomie und Cytologie von zwei subspezies der Art

Chironomus thummi. *Zeitschrift für Naturforschung* **11b**: 727-735.
Describes the morphological differences between *C. thummi* [=*C. riparius*] and *C. piger*, which are referred to as subspecies although most workers now consider them to be distinct species (see e.g. Lindeberg 1967). The chromosomal comparisons are made between the salivary gland chromosomes of hybrids, which are illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Keyl, H.-G. & Werth, G. 1959.
Strukturveränderungen an Chromosomen durch Malachitgrün. *Die Naturwissenschaften* **46**: 453-454.
Describes and illustrates with photographs, the production of partial chromosome breaks in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] larvae grown in water containing malachite green.

Specialised subjects: Polytene chromosomes, Mutagenesis - chemical
Species: *Chironomus thummi thummi* [=*C. riparius*]

Kiknadze, I.I. 1961. On the interaction between the nucleolus and chromosomes. *Tsitologiya* **3**: 3-19. (In Russian)
Reviews the data on the relationship between the chromosome and the nucleolus in a variety of organisms. (Partim)

Specialised subjects: Nucleolus
Species: *Acricotopus lucidus* [=*A. lucens*]

Kiknadze, I.I. 1965*a*. Functional changes of giant chromosomes under conditions of inhibited RNA synthesis. *Tsitologiya* **7**: 311-318. (In Russian, English summary)
Studies effect of actinomycin C on puffing pattern of salivary gland chromosomes of *Chironomus dorsalis* [=*C. riparius*]. Illustrated by photographs and a large drawn map of the polytene chromosomes.

Specialised subjects: Polytene chromosomes - RNA synthesis, Puffs - RNA synthesis
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1965*b*. The structural and cytochemical characteristics of chromosome puffs. *Genetic Variation in Somatic Cells. Symposium on the Mutational Process, Prague*: 177-181.
Reviews the structure of various types of active loci in polytene chromosomes, illustrating the difference between a puff, a Balbiani ring, and a nucleolus by reference to *Chironomus dorsalis* [=*C. riparius*]. Illustrated by photographs and drawings. (Partim)

Specialised subjects: Puffs - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1965*c*. Analysis of puffs on the evidence of experimental reactions. pp. 78-99. *In* Kletochnaya differentsirovka i inductsionnye mekchanizmy. Izdatelstvo Nauka, Moskva. (In Russian).
Intermoult larvae of *Chironomus dorsalis* [=*C. riparius*] were chosen for study because of the stability of the puffing pattern. Incubation of the larvae in thioacetimide leads to regression of BR1 and activation of BR2. Low temperature causes regression of both Balbiani rings.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1966. Functional changes of chromosomes. *Rukovodstvo po Tsitologii* **2**: 329-346. (In Russian)
Reviews studies on puffing and other functional changes in polytene chromosomes, largely using examples from *Chironomus*. Includes some original illustrations, such as a chart of the developmental changes in puff size in *C. dorsalis* [=*C. riparius*], and others taken from published works. (Partim)

Specialised subjects: Puffs - developmental sequence, heterochromatin
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus dorsalis* [=*C. riparius*], *C. tentans*

Kiknadze, I.I. 1967*a*. The structure of nucleolar organizer in *Chironomus dorsalis*. *Tsitologiya* **9**: 901-911. (In Russian, English summary)
Studies the structure and replication of the nucleolus-forming zone in *C. dorsalis* [=*C. riparius*]. Identifies the nucleolus organizer to one of three bands in region 2b of the fourth chromosome. Illustrated by detailed drawings and photographs.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1967*b*. *Functional organisation of chromosomes*. Doctoral thesis, Akademiia Nauk, Siberskogo Otdelenya, Novosibirsk, S.S.S.R. (In Russian)
Although not seen, it is assumed that this thesis will basically contain the work published in the preceding papers.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1970. Cytogenetic aspects of ontogenesis: the transcriptional activity of the chromosomes in cell differentiation. *Ontogenez* **1**: 17-27. (In Russian) [English translation in *Soviet Journal of Developmental Biology* **1**: 11-19]
Reviews investigations of the functional organization of polytene chromosomes which accounts for the local activity of genes in the course of cell differentiation. Emphasises the role of the chromomere, possible cytological mechanisms controlling the number of RNA matrices synthesised, and the association between puffs and biochemical processes occurring in the cytoplasm. (Partim)

Specialised subjects: Puffs - structure, RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Kiknadze, I.I. 1971*a*. Polytene chromosomes as a model of an interphase chromosome. *Tsitologiya* **13**: 716-732. (In Russian, English summary)
Considers an hypothesis on the structural and functional organization of the polytene chromosomes. The ultrastructure of the bands is analysed and the genetic evidence for the localisation of structural genes in the bands described. Illustrated by photographs and electron micrographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Kiknadze, I.I. 1971*b*. Functional organization of chromosomes. *Uspekhi sovremennoi genetiki* **3**: 175-205. (In Russian)
Reviews the functional organisation of polytene chromosomes, largely based on her own work with *Chironomus dorsalis* [=*C. riparius*]. Deals with development of puffs and their structure. Illustrated by drawings, photographs and autoradiographs. (Partim)

Specialised subjects: Puffs - structure
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. 1971*c*. Chromosome function in chironomid ontogenesis. *Proceedings of the 13th International Congress of Entomology, Moscow, 1968*, **1**: 341-342. (Abstract)(In Russian)
A generalised abstract on gene activity in polytene chromosomes during development in chironomids. No species named but probably based on the author's studies of *Chironomus thummi* [=*C. riparius*].

Specialised subjects: Puffs - developmental sequence
Species: ?*Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. 1972. *The functional organization of the chromosome*. 212 pp. *Nauka*, Leningrad. (In Russian)
Reviews the structure and function of chromosomes. Much of the work is based on information gained from studies of polytene chromosomes, particularly of *Chironomus dorsalis* [=*C. riparius*]. Illustrated by numerous photographs and drawings. Over 1000 references. (Partim)

Specialised subjects: Chromosome structure, Polytene chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus dorsalis* [=*C. riparius*], *C. tentans*

Kiknadze, I.I. 1976. A comparative study on the polytene chromosome puffing of *Chironomus thummi* salivary glands during larval development and metamorphosis. I. Puffing in chromosome IV. *Tsitologiya* **18**: 1322-1329. (In Russian, English summary)
Studies the developmental changes in the puffing pattern and Balbiani ring activity of the fourth chromosome of *C. thummi* [=*C. riparius*] during the third and fourth larval instars.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. 1978. Comparative characteristics of puffing pattern in salivary gland chromosomes during larval development and metamorphosis. II. Puffing pattern in chromosomes I, II and III. *Tsitologiya* **20**: 514-521. (In Russian, English summary)
Studies the developmental changes in the puffing pattern of the three large polytene chromosomes of *Chironomus thummi* [=*C. riparius*] during the third

and fourth larval instars and during metamorphosis. Puffing pattern does not change significantly during the intermoult periods, but does change during the moults and particularly during metamorphosis.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. 1985*a* Organisation and expression of genes coding tissue-specific secretory proteins of the salivary glands of Chironomidae. Molecular cytological organization of Balbiani ring and the genes localised in them, pp.115-126, 205, 224-228. *In* Salganik, R.I. (ed.), *Organisation and expression of genes of tissue-specific functions in Diptera*. 237pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
Summarises results which establish the location of the genes within the Balbiani rings of *Chironomus thummi* [=*C. riparius*]. Separate illustrations at p. 205 and 224-228. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. 1985*b* Organisation and expression of genes coding tissue-specific secretory proteins of the salivary glands of Chironomidae. Ontogenetic changes in the activity of Balbiani ring genes and their hormonal regulation, pp.131-138, 205-206, 226, 233-237. *In* Salganik, R.I. (ed.), *Organisation and expression of genes of tissue-specific functions in Diptera*. 237pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
Reviews the data on the developmental changes in activity of the Balbiani ring genes of *Chironomus thummi* [=*C. riparius*]. Separate illustrations at pp. 205-206, 226 and 233. (Partim)

Specialised subjects: Puffs - Balbiani rings, tissue specificity
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. 1987*a*. Constructive contribution of D.K. Belyaev to the development of ideas about the functional organization of the chromosome. *Genetika* **23**: 956-961. (In Russian) [Translated in *Soviet Genetics* **23**: 654-659.]
Reviews the development of the work on the functional organization of the polytene chromosomes of chironomids in the Institute of Cytology and Genetics, Siberian Branch, Academy of Sciences of the USSR and the contribution of D.K. Belyaev to this work.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus balatonicus, C. melanescens, C. muratensis, C. nudiventris, C. obtusidens, C. plumosus, C. pseudothummi, C. thummi* [=*C. riparius*]

Kiknadze, I.I. 1987*b*. Chromosomal polymorphism in natural populations of the *plumosus* species-group of West Siberia (Diptera: Chironomidae). *Entomologica Scandinavica Supplement* **29**: 113-121.
Compares the banding patterns and inversion frequencies for the members of the plumosus group between western Siberia and western Europe. The banding patterns are identical but the inversion frequencies differ, with both *Chironomus plumosus* and *C. nudiventris* being more polymorphic in Siberia. Photographic chromosome maps, relative to that of Maximova (1976) which mapped all arms, are provided for *C. plumosus*, *C. balatonicus*, *C. muratensis*, and *C. nudiventris*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus, C. muratensis, C. nudiventris, C.plumosus,*

Kiknadze, I.I. & Belyaeva, E.S. 1967. Nucleolus the principles of its formation and its genetic significance. *Genetika* **3**(8): 149-161. (In Russian) [English translation in *Soviet Genetics* **3**(8): 96-105.]
Review the data available on the formation and role of the nucleolus, based mostly on the salivary gland chromosomes of chironomids. A model of nucleolus formation is given. Illustrated by photographs and drawings.

Specialised subjects: Nucleolus - formation
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus dorsalis* [=*C. riparius*], *C. tentans*

Kiknadze, I.I. & Belyaeva, E.S. 1968. The organization of nucleolus as a specialized puff. *Proceedings of the 12th International Congress of Genetics* **1**: 193. (Abstract)
Describes the changes which occur in a large heterochromatic block, which is one of the two bands forming the nucleolus organizer in *Chironomus dorsalis* [=*C. riparius*], with alterations in nucleolus activity.

Specialised subjects: Nucleolus - gene activity

Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I., Blinov, A.G. & Kolesnikov, N.N. 1989. Molecular-cytological organization of the genome of chironomids. *In Structural-Functional Organization of the Genome*. Nauka, Siberian Division, Novosibirsk, pp.4-58. (In Russian)
This article has not been seen, but will deal with chromosome structure and use of molecular probes to identify homologous structures such as Balbiani rings and transposable elements.

Specialised subjects: Polytene chromosomes - structure
Species: Chironomidae spp., (incl. *Chironomus thummi* [=*C. riparius*])

Kiknadze, I.I. & Filatova, I.T. 1960. Functional variations of RNA contents in nuclei of *Chironomus dorsalis* salivary glands prior to metamorphosis. *Isvestiya Siberskogo Otdelenya Akademiia Nauk, S.S.S.R.* (*Biologii*) **12**: 131-134. (In Russian).
Discuss the relationship between RNA and the state of development of the puffs, nucleolus and Balbiani rings of *Chironomus dorsalis* [=*C. riparius*]. Illustrated by photographs, drawings and a graph.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I. & Filatova, I.T. 1963. Changes in the RNA of giant chromosomes of *Chironomus dorsalis* during metamorphosis and under experimental conditions. *Doklady Academiya Nauk S.S.S.R.* **152**: 450-453. (In Russian) [English translation in *Doklady Biological Sciences* **152**: 1276-1279.]
Show that during development certain bands of the salivary gland chromosomes undergo regular changes in the amount of RNA synthesised. RNA synthesis was further studied by using thioacetamide to remove the effect of inhibitors of RNA synthesis. Illustrated by photographs and drawings.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus dorsalis* [=*C. riparius*]

Kiknadze, I.I., Filippova, M.A., Gunderina, L.I. & Kerkis, I.E. 1987. Karyological and biochemical analysis of species of the *plumosus* group (Diptera, Chironomidae), pp.126-128. *In* Narchuk, E.P. (ed.), *Diptera and their importance for animal husbandry and agriculture*. 158pp. Nauka, Zoological Institute, Leningrad. (In Russian)
This article has not been seen but deals with the recognition of species in the *Chironomus plumosus*-group by differences in the banding pattern of the polytene chromosomes. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus*-group [probably includes *C. agilis, C. balatonicus, C. muratensis, C. plumosus*]

Kiknadze, I.I., Grebenyuk, L.P., Filippova, M.A. & Kerkis, I.E. 1988. Karyological analysis of species of the pseudothummi-complex from water bodies of the U.S.S.R. *Biologiya Vnutrennikh Vod Informationnyi Byulletin* **79**: 56-59. (in Russian)
Briefly describe the band sequences of the polytene chromosomes of eight *Chironomus* species belonging to the pseudothummi-complex, including two undescribed species. Emphasis on arms A, E, F and G. No illustrations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aprilinus, C. dorsalis, C. luridus, C. melanescens, C. pseudothummi, C. uliginosus, C.* sp.n. N1, *C.* sp.n. N2

Kiknadze, I.I. & Gruzdev, A.D. 1970. Change in chromosome length related to polyteny in the chironomid salivary glands. *Tsitologiya* **12**: 953-960. (In Russian, English summary)
Shows there are three classes with respect to degree of polyteny in larvae of *Chironomus dorsalis* [=*C. riparius*]. Also shows a direct relation between a change in diameter of the polytene chromosomes and the increase in the length. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. riparius*], *Cryptochironomus defectus* gp.

Kiknadze, I.I., Gunderina, L.I., Filippova, M.A. & Seraya, E.I. 1988. Chromosomal polymorphism in natural and laboratory populations of *Chironomus thummi thummi*. *Genetika* **24**: 1795-1805. (In Russian, English summary) [Translated in *Soviet Genetics* **24**: 1251-1259 (1989)]
Describe and illustrate a variety of chromosomal polymorphisms and rearrangements in two natural

and two laboratory populations. This is in contrast to previous reports of this species as cytologically monomorphic (e.g. Keyl 1962). Most rearrangements are at low frequency, but band or puff heterozygosity can be at high frequency. Puffing of band II-C1j is correlated to the presence of a mobile element.

Specialised subjects: Inversions, Translocations, Puffs, Bands - heteromorphy
Species: *Chironomus thummi thummi* [=*C. riparius*]

Kiknadze, I.I. Gunderina, L.I. & Valeyeva, F.S. 1983. Morphology of heterochromatic centromere regions of polytene chromosomes of *Chironomus thummi* and its changes under RNA synthesis inhibition. *Tsitologiya* **25**: 1159-1165. (In Russian, English summary)
Describe three types of band pattern in the centromere region of *C. thummi* [=*C. riparius*] and note changes in the proportion of these when RNA synthesis is inhibited. After prolonged inhibition of RNA synthesis pseudo-puffs are formed from the A-T rich satellite containing bands. In hybrids of *C. thummi* and *C. piger*, the pseudo-puffs are formed only in the centromeres of the chromosomes derived from *C. thummi*.

Specialised subjects: Polytene chromosomes - structure, Heterochromatin
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Kiknadze, I.I., Istomina, A.G., Siirin, M.T. & Sebeleva, T.E. 1990. The karyotype and Balbiani ring system of *Fleuria lacustris* (Diptera, Chironomidae). *Tsitologiya* **32**: 371-377. (In Russian, English summary)
Describe the polytene chromosomes and mitotic chromosomes, and provide a photographic map of the salivary gland chromosomes. An extra Balbiani ring is developed in four cells of the special lobe of the salivary gland. The relationship of this BR to the special secretion of this lobe, and its ecological significance is discussed. Illustrated by photographs.

Special subjects: Cytotaxonomy - polytene chromosomes, Puffs - Balbiani rings, tissue specificitySpecies: *Fleuria lacustris*

Kiknadze, I.I. & Kerkis, I.F. 1984. Karyotypical characteristics of *Chironomus* f.l. reductus with 2n=6 from the Ob Reservoir. *Tsitologiya* **26**: 735-739. (In Russian, English summary)
Describe and provide photographic chromosome maps for a *Chironomus plumosus*-like larva with only 3 pairs of chromosomes due to a tandem fusion of arms G and E. The banding pattern is compared with that of *C. plumosus* and a high level of inversion polymorphism in all arms noted. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* f.l. reductus [=*C. nudiventris*]

Kiknadze, I.I. & Kerkis, I.E. 1986. Comparative analysis of the polytene chromosome banding patterns in sibling-species *Chironomus balatonicus* and *C. muratensis*. *Tsitologiya* **28**: 430-436. (In Russian, English summary)
Provide photographic chromosome maps of Siberian specimens of *C. balatonicus* and *C. muratensis*, based on the *C. plumosus* map of Maximova (1976), and compare them to the European populations. The populations differ by homozygosity for some paracentric inversions and by heterozygosity for pericentric inversions in the centromeric regions of chromosomes I and II.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus*, *C. muratensis*

Kiknadze, I.I., Kerkis, I.E. & Filippova, M.A. 1986. Comparative analysis of banding pattern and chromosomal polymorphism in sibling species of the plumosus group from Western Siberia, pp.50-64. *In* Kolesnikov, N.N. & Istomina, A.G. (eds.), *Evolution, species formation and systematics of chironomids*. 158pp. Nauka, Siberian Division, Novosibirsk, (In Russian)
Compares the banding patterns of *Chironomus plumosus*, *C. nudiventris, C. balatonicus*, and *C. muratensis*. Illustrated.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus, C. muratensis*, *C. nudiventris*, *C. plumosus*

Kiknadze, I.I., Kerkis, I.E. & Filippova, M.A. 1987. Chromosomal polymorphism in Siberian natural populations of *Chironomus plumosus* L. *Zoologicheskii Zhurnal* **66**: 877-882. (In Russian, English summary)
Examined chromosomal polymorphism in five geographically distinct Siberian populations of *C. plumosus*. They recorded 13 paracentric and one pericentric inversions, as well as noting B-chromosomes in most populations. Conclude that there are no major differences between the Siberian populations and previously described

European populations in any of the karyotypic features examined. Illustrated by a photographic map based on that of Maximova (1976) but also giving the band sequences of arms A, E and F according to the scheme of Keyl (1962). Also photographs of alternative banding sequences.

Specialised subjects: Inversions - polymorphySpecies: *Chironomus plumosus,*

Kiknadze, I.I., Kerkis, I.E. & Nazarova, N.L. 1990. Chromosomal polymorphism of natural populations of *Glyptotendipes paripes* Edw. (Diptera, Chironomidae). *Tsitologiya* **32**: 161-170. (In Russian, English summary)
Studied chromosomal polymorphism in four geographically distant populations. Inversion polymorphism was found only in chromosome I, with two sequences in arm A, and three in arm B. A new chromosome map of *G. paripes* is proposed and illustrated by photographs.

Specialised subjects: Inversions - geographical distribution, Polytene chromosomes - mapsSpecies: *Glyptotendipes paripes*

Kiknadze, I.I., Kerkis, I.E. & Ruzanova, A.I. 1987. Chromosomal polymorphism of *Chironomus nudiventris* Ryser, Scholl, Wülker (Diptera, Chironomidae). *Tsitologiya* **29**: 1161-1167. (In Russian, English summary)
Compare the chromosomal polymorphism of European and Siberian populations, noting that there are some changes in the dominant sequences, and describing some new sequences from Siberia. *C. nudiventris* has high chromosomal polymorphism and polymorphism for a B-chromosome. Illustrated by photographic maps and photographs of the heterozygous configurations.

Specialised subjects: Inversions - geographical distribution, Polytene chromosomes - maps
Species: *Chironomus nudiventris*

Kiknadze, I.I., Kerkis, I.E. & Shilova, A.I. 1989. Karyological and morphological descriptions of the larvae of *Lipiniella moderata* Kalugina. *Tsitologiya* **31**: 576-581. (In Russian, English summary)
Describe the mitotic and salivary gland chromosomes of *Lipiniella moderata* (2n=4), providing photographic maps. These are compared with those of *L. araenicola* (2n=6), which are also included. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Lipiniella araenicola*, *L. moderata*

Kiknadze, I.I., Kerkis, I.E., Shilova, A.I. & Filippova, M. 1989. A review of the species of the genus *Lipiniella* Shilova (Diptera). I. *L. arenicola* Shil. and *L. moderata* Kalug. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 115-128.
The cytological component of this paper is essentially a repeat of that in Kiknadze *et al*. (1989). Photographic chromosome maps and photographs of the mitotic or meiotic chromosomes are included. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Lipiniella araenicola*, *L. moderata*

Kiknadze, I.I., Kolesnikov, N.N., Panova, T.M., Gaydamakova, E.K., Blinov, A.G. & Filippova, M.A. 1987. Mobile genetic elements of the Chironomidae genome. I. Location of the pCthC1.2HR clone in polytene chromosomes of the subspecies *Chironomus thummi thummi* Kieffer, *C. t. piger* Strenzke and their hybrids. *Genetika* **23**: 1366-1376. (In Russian) [Translated in *Soviet Genetics* **23**: 954-962.]
Use *in situ* hybridisation to the salivary gland chromosomes to show that there are more than 90 hybridisation sites for the mobile element clone pCthC1.2HR in the genomes of *C. th. thummi* [=*C. riparius*] and *C. th. piger* [=*C. piger*]. The main site of hybridisation is the Balbiani ring BRa. There are only about half the number of hybridisation sites in *C. piger*, some of which are specific for that species. Hybrids may show sites not present in either parent. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Kiknadze, I.I., Lopatin, O.E. & Kolesnikov, N.N. 1975. VI. Chironomids - *Chironomus thummi* (Laboratory culture),pp.95-127. *In* Detlaff, T.A. & Vassetzky, S.G. (eds.), *Laboratornye Ob'ekty dlya Biologi Razvitiya,* Problemy Biologii Razvitiya, Akademia Nauk SSSR, Moscow. (In Russian) [English translation in *Animal Species for Developmental Studies. Volume I. Invertebrates*. Consultants Bureau, N.Y., pp.133-178 (1990)]
Describes the life history, rearing techniques and cytology of *C. thummi* [=*C. riparius*]. The meiotic, mitotic and polytene chromosomes are illustrated, including a photographic map of the salivary gland chromosomes. This map differs in

some details from that of Keyl (1957). The English translation has been updated to some extent by the inclusion of some later references. (Partim)

Specialised subjects: Karyotype - polytene chromosomes, Mitosis, Meiosis
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. & Panova, T.M. 1972. On puff heteromorphism in *Chironomus thummi*. *Tsitologiya* **14**: 1084-1091. (In Russian, English summary)
Describe a polymorphism for the presence or absence of a puff in region 4-Dc of *C. thummi* [=*C. riparius*]. Illustrated by photographs and autoradiographs, including photographs of the other chromosomes.

Specialised subjects: Puffs - heteromorphy
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Panova, T.M. & Agapova, O.A. 1982. Repeated regression and recovery of the Balbiani rings and nucleolus in *Chironomus thummi* salivary glands during development. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 29.
Report that the transcriptional activity of the Balbiani rings regresses during larval moults, when the puffs themselves regress. Activity begins again soon after the moult is completed.

Specialised subjects: Puffs - Balbiani rings, Nucleolus - gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Panova, T.M. & Agapova, D.A. 1984. Effect of ecdysone on the activity of the Balbiani rings and the ultrastructure of the salivary gland cells with *Chironomus thummi*. *Tsitologiya* **26**: 285-291. (In Russian, English summary)
Injection of ecdysone into the haemolymph of last instar larvae of *C. thummi* [=*C. riparius*] led to changes in the puffing pattern of the Balbiani rings and to changes in the ultrastructure of the cytoplasm identical to that observed during normal development. In addition to changes in the activity of the Balbiani rings, a set of metamorphosic puffs appeared. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Panova, T.M. & Novak, V.V. 1973. Endocrine glands of *Chironomus thummi* Kief. during larval development and pupation. *Abstracts of the Seventh Conference of European Comparative Endocrinologists, Budapest:* 228.
Each corpora cardiaca of the larva of *C. thummi* [=*C. riparius*] is in contact with a giant binuclear cell containing rather large polytene chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - tissue distribution
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Panova, T.M. & Novak, V.Y.A. 1975. The endocrine glands of *Chironomus thummi* Kieff. in larval development and metamorphosis. *Ontogenez* **6**: 11-19. (In Russian) [Translated in *Soviet Journal of Developmental Biology* **6**: 8-16.]
Note the formation of polytene chromosomes during the growth of some endocrine glands of *C. thummi* [=*C. riparius*]. The peritracheal gland grows mainly by polytenisation of the cells, increasing the amount of DNA over ten-fold. In the corpora cardiaca two polytene cells are intimately connected to the glands. Illustrated by a photograph. (Partim)

Specialised subjects: Polytene chromosomes - tissue distribution
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Panova, T.M. & Zakharenko, L.P. 1981. The comparative characteristics of puffing pattern in the salivary gland chromosomes during larval development and metamorphosis. III. Transcriptional activity of the nucleolus and the Balbiani rings. *Tsitologiya* **23**: 531-538. (In Russian, English summary)
Investigate the transcriptional activity of the nucleolus and the Balbiani rings during the last larval instar and the preceding larval moult and subsequent metamorphosic moult. The functional changes in the nucleolus and the Balbiani rings were closely related. RNA synthesis decreases and almost ceases during the moults. Illustrated by a number of autoradiographs.

Specialised subjects: Puffs - Balbiani rings, Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I. & Perov, N.A. 1980. Electron-microscopical linkage of the salivary gland polytene chromosomes of *Chironomus thummi* K. *New data on karyosystematics of Diptera. Trudy Zoologicheskii Institut Academiia Nauk, S.S.S.R.* **95**: 23-30. (In Russian, English summary)
Illustrate the comparison of chromosome maps based on electron micrographs and those based on

standard light micrographs. The study of chromosomes under the electron microscope can assist in determining the functional state of loci.

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Perov, N.A. & Chentsov, Y.S. 1976. Electron microscopic studies on the polytene chromosomes of *Chironomus thummi* salivary glands. I. Ultrastructural mapping. *Chromosoma* **55**: 91-103.
Ultrathin sections of unsquashed salivary gland chromosomes of *C. thummi* [=*C. riparius*] were used for ultrastructural mapping of the chromosomes, although only the map of arm 3L is given in this paper. Comparison is made to the light microscope maps with respect to number of bands and band thickness and shape. Puffed bands contained many granules, which enabled them to be distinguished from interbands which contained only fibrils or a few granules. Illustrated by electronmicrographs and drawings.

Specialised subjects: Polytene chromosomes - bands and interbands
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Perov, N.A. & Chentsov, Y.S. 1977. Electron microscope studies of the puff formation in *Chironomus thummi* salivary gland polytene chromosomes. *Tsitologiya* **19**: 259-262. (In Russian, English summary)
Describe the process of puff formation as seen under the electron microscope. Band decondensation does not initially involve the whole band, rather compact chromatin alternates with decondensed chromatin. Puff fibrils and granules appear very rapidly. Illustrated by electron- micrographs.

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Razmakhnin, E.P., Zakharenko, L.P., Shilova, I.E., Panova, T.M., Zainev, G.A. & Mertvetsov, N.P. 1983. Molecular-cytological organization of Balbiani ring 1 (BRc) in *Chironomus thummi*. *Doklady Akademiia Nauk S.S.S.R.* **269**: 954-957. (In Russian) [Translated in *Doklady Biological Sciences* **269**: 111-114.]
Make cytological comparison of the bands in the region of BR1 from polytene chromosomes from different tissues, different life history stages, and following different treatments including *in-situ* hybridisation of iodine-labelled 75S-RNA. Conclude the region is large (17 bands) and all of it is capable of transcribing 75S-RNA. Illustrated by photographs and a drawn map of the region of chromosome IV.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Valeeva, F.S. & Perov, N.A. 1982. Chromatin segregation in the polytene chromosomes of *Chironomus thummi* under the effect of prolonged RNA synthesis inhibition. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 30.
After prolonged inhibition of RNA synthesis there is a separation of the ribonucleoproteins and nonhistone material from the fibrils. This begins first in the structural heterochromatin, such as the centromeres, where pseudopuffs are formed.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Valeeva, F.S., Vlasova, I.E., Panova, T.M., Sebeleva, T.E. & Kolesnikov, N.N. 1979. Puffing and specific function of salivary gland cells in *Chironomus thummi*. I. Quantitative changes of protein and glycoproteins in the salivary gland at different larval stages. *Ontogenez* **10**: 161-172. (In Russian) [Translated in *Soviet Journal of Developmental Biology* **10**: 141-150]
Changes in proteins and glycoproteins in the salivary glands are related to changes in the activities of the Balbiani rings. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Vlasova, Y.E. & Lopatin, O.E. 1973. DNA replication in salivary chromosomes of *Chironomus thummi* during larval development and its regulation. *Proceedings of the 13th International Congress of Genetics*. *Genetics* **74** (Supplement 2): s139.
Describe the replication pattern of the polytene chromosomes in the salivary glands during the various larval instars. Experiments using cyclohexamide indicate that the initiation and the whole course of replication in the fourth instar are dependent upon the availability of newly synthesised proteins. No significant differences in puffing pattern were noted between periods when

DNA synthesis was absent and those when it was highest.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Vlasova, I.E. & Sherudilo, A.I. 1975*a*. Quantitative analysis of the DNA content in the salivary gland of *Chironomus thummi* at larval and pre-pupal stages. *Tsitologiya* **17**: 420-426. (In Russian, English summary)
A quantitation of the replication of DNA in polytenisation of the salivary gland chromosomes. Expands much of the data of Kiknadze, Vlasova & Lopatin (1973).

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Vlasova, I.E. & Sherudilo, A.I. 1975*b*. Quantitative analysis of DNA content in the salivary chromosomes of *Chironomus thummi* at larval and prepupal stages. *Cell Differentiation* **3**: 323-334.
An English language version of Kiknadze, Vlasova & Sherudilo (1975*a*).

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Zainiev, G.A., Panova, T.M., Istomina, A.G., Zacharenko, L.P. & Potapov, W.A. 1985. Identification of Balbiani ring chromomere in *Chironomus thummi* polytene chromosomes. *Biologisches Zentralblatt* **104**: 113-123. (English and German Summary)
Use microdissected clones from the regions of the Balbiani rings to demonstrate that these BRs originate from single thick bands. Illustrated by photographs, including *in-situ* hybridisations. Map of the region of chromosome IV from Kiknadze *et al*. (1983) is repeated.

Specialised subjects: Puffs - Balbiani rings, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Kiknadze, I.I., Zainiev, G.A., Panova, T.M., Zakharenko, L.P., Istomina, A.G. & Potapov, V.A. 1985. Identification and molecular-cytological organization of the Balbiani ring chromomeres in *Chironomus thummi* polytene chromosomes. *Tsitologiya* **27**: 376-382. (In Russian, English summary)
Largely repeats the results given in Kiknadze *et al*. (1983, 1985).

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus thummi* [=*C. riparius*]

Kimoto, Y. 1958*a*. On the vesicle formation in the salivary gland chromosomes of *Chironomus*. *La Kromosomo* **34-36**: 1225-1231. (In Japanese, English summary)
Examines the development of the nucleolus, the Balbiani ring and the bulb forming region of chromosome IV in living salivary glands. These develop from the normal band group through extension and expansion of the chromonemata. Illustrated by phase contrast photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Kimoto, Y. 1958*b*. An attachment of the salivary gland chromosomes to the nuclear membrane found in *Chironomus dorsalis*. *Cytologia* **23**: 479-484.
In living salivary glands examined under phase contrast microscopy, the salivary gland chromosomes are attached to the nuclear membrane and sometimes penetrated into it. Spherical bodies were observed in the vicinity of the attachment. It is postulated that this has relation to a mechanism for transferring material from the nucleus to the cytoplasm. Illustrated by phase contrast photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Kimoto, Y. 1959. On the vesiculation of bands in salivary gland chromosomes induced by physiological treatments. I. On the heavy bands of *Chironomus* salivary gland chromosomes. *Japanese Journal of Genetics* **34**: 55-60. (In Japanese, English summary).
Describes the appearance of vesiculated bands in the salivary gland chromosomes, which can be induced by physiological treatments, at different stages of larval development. This vesiculation is related to change in the chromosomal matrix. Illustrated by photographs and drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

King, R.L. & Beams, H.W. 1934. Somatic synapsis in *Chironomus* with special reference to the individuality of the chromosomes. *Journal of Morphology* **56**: 577-591.
Describes the appearance of the salivary gland chromosomes in two lots (?species) of *Chironomus*, with particular reference to the close and exact somatic pairing. Illustrated by photographs and drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp.

Kloetzel, J.A. & Laufer, H. 1968. Fine structural analysis of larval salivary gland function in *Chironomus thummi*. *Abstracts of Papers presented at the Eighth Annual Meeting of the American Society for Cell Biology*. *Journal of Cell Biology* **39**: 74a.
Investigates the ultrastructure of the salivary gland in order to relate patterns of tissue-specific chromosomal puffs to its specialised functions. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Kloetzel, J.A. & Laufer, H. 1969. A fine-structural analysis of larval salivary gland function in *Chironomus thummi* (Diptera). *Journal of Ultrastructure Research* **29**: 15-36.
Notes the presence of polytene chromosomes in the nuclei of salivary gland cells and that puffs and Balbiani rings are cytological indicators of activity. The ultrastructural analysis is to relate the patterns of gene activity to the function and development of the salivary gland cells. One photograph shows the polytene chromosomes within the nuclei of the gland cells. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Kloetzel, J.A. & Laufer, H. 1970. Developmental changes in fine structure associated with secretion in larval salivary glands of *Chironomus*. *Experimental Cell Research* **60**: 327-337.
Note a relationship between the decrease in size of a Balbiani ring and the production of dense secretory material by the cell during the prepupal stage up until the early pupa. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Kolesnikov, N.N., Karakin, E.I., Sebeleva, T.E., Meyer, L. & Serfling, E. 1981. Cell-specific synthesis and glycosylation of secretory proteins in larval salivary glands of *Chironomus thummi*. *Chromosoma* **83**: 661-677.
Studied the relationship between the glycoprotein composition of specific cells in the salivary gland and the Balbiani ring pattern in those cells. Certain special cells show an additional BR and an additional polypeptide, while the synthesis of the other major secretory proteins was reduced. Discuss the possible origin of the BR genes.

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Kolesnikov, N.N., Kiknadze, I.I., Bogachev, S.S., Blinov, A.G., Blinov, V.M., Panova, T.M., Gaidamakova, E.K., Fedorov, S.P., Sobanov, Yu.V., Shakhmuradov, I.A., Chekaev, N.A. & Hazarenko, I.A. 1986. Molecular-cytological approaches to the investigation of specific loci of polytene chromosomes, pp.146-156. *In* Kolesnikov, N.N. & Istomina, A.G. (eds.), *Evolution, species formation and systematics of chironomids*. 158pp. Novosibirsk. (In Russian)
This article not seen. It is likely to refer to the localisation of genes for specific Balbiani ring products and of transposable elements to specific bands on the polytene chromosomes. Illustrated. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Kolmer, W. & Fleischmann, W. 1928. Beobachtungen an den Speicheldrüsen von *Chironomus* arten. Konsistenz der Kernbestandteile, Verhalten bei Vital-farbungen. *Protoplasma* **4**: 358-366.
Note that the nucleolus can be seen in vital stained animals and that in some individuals it appears like a fat droplet separated from the chromatin thread. (Partim)

Specialised subjects: Nucleolus - structure
Species: *Chironomus* species

Koltroff, N. 1934. The structure of the chromosomes in the salivary glands of *Drosophila*. *Science* **80**: 312-313.
Considers the salivary gland chromosomes to be comprised of 16 genonemes which are clearly distinguishable in *Chironomus*. (Partim)

Specialised subjects: Polytene chromosomes - structure

Species: *Chironomus* species

Konstantinov, A.S. 1961. On the possibility of using Chironomidae for cytogenetic purposes. *Tsitologiya* **3**: 119-121. (In Russian)
Reviews briefly the work of various authors on the chromosomes of chironomids. No illustrations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus decorus* [gp.(R&F)], *C. dorsalis* [=*C. riparius*], *C. plumosus*, *C. thummi* [=*C. riparius*], *C.* spp., *Eucricotopus* spp., *Glyptotendipes barbipes*, *Prodiamesa* ?*olivacea*, *Sergentia* spp.

Konstantinov, A.S. 1964. Significance of chironomid chromosome study for the taxonomy of chironomids and cytogenetics. *Doklady Zoologicheskii Soveshchanie. Izdatelstvo Tomsk Universiteta*: 191-192.
Brief note on the karyotype of chironomids and how the characters of the small fourth chromosome in particular can be used to assist in separating morphologically similar species.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Chironomidae spp.

Konstantinov, A.S. 1967. Peculiarity of the salivary glands and their chromosome structure as species sign of chironomids, pp65-70. *In* Konstantinov, A.S. (ed.), *Fauna Volgogradskogo Vodokhranilishcha i Vliyanie na nee Zagryazneniya*. 107pp. Izdatelstvo Saratovskogo Universiteta. (In Russian)
Describes the morphology of the salivary glands of different genera of Chironomidae, then mentions some of the work done on differentiating species on the basis of the salivary gland chromosomes. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus dorsalis* [=*C. riparius*], *C. obtusidens*, *C. plumosus*, *C.* spp., *Cryptochironomus* spp., *Glyptotendipes* spp.

Konstantinov, A.S. & Nesterova, S.I. 1971*a*. Diagnostic importance of anatomical and karyotypic parameters in the systematics of chironomids. *Proceedings of the 13th International Congress of Entomology, Moscow,* 1968, **1**: 156. (In Russian)(Abstract)
Briefly outline the use of salivary gland chromosomes for differentiating between species on the basis of chromosome number and the arrangement of bands, nucleoli and Balbiani rings. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus dorsalis* [=*C. riparius*], *C. heterodentatus*, *C. obtusidens*, *C. pilicornis*, *C. tentans*

Konstantinov, A.S. & Nesterova, S.I. 1971*b*. Identification by anatomical and karyotypical parameters in the systematics of chironomids. *Third International Symposium of Chironomid Research. Limnologica* **8**: 19-25.
Describes how the anatomy of the larval salivary glands and their polytene chromosomes can be used to identify species of Chironomidae. Provides diagrammatic karyotypes of 19 species of Chironomini.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus cingulatus*, *C. dorsalis* [=*C. riparius*], *C. halophilus* [=*C. aprilinus*], *C. heterodentatus*, *C. pallidivittatus*, *C. pilicornis*, *C. plumosus*, *C. plumosus*-reductus [?=*C. nudiventris*,], *C. tentans*, *Cryptochironomus redekei*, *C. supplicans*, *Demeijerea rufipes*, *Endochironomus albipennis*, *Glyptotendipes barbipes*, *G. glaucus* [=*G. pallens*], *Limnochironomus* [=*Dicrotendipes*] *nervosus, Lipiniella araenicola*, *Pentapedilum* [=*Polypedilum*] *exsectum*, *Polypedilum nubeculosum*

Konstantinov, A.S. & Nesterova, S.I. 1972. Identification by anatomical and karyotypical parameters in the systematics of chironomids. *Proceedings of the 13th International Congress of Entomology*, *Moscow*, *1968,* **3**: 464. (Abstract)
Basically the same information as Konstantinov & Nesterova (1971*a*) but with additional information on the use of chromosomes in genera other than *Chironomus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. dorsalis, C. heterodentatus*, *C. obtusidens*, *C. pallidivittatus*, *C. pilicornis*, *C. tentans*, *Cryptochironomus* spp., *Demeijerea rufipes, Endochironomus* species, *Glyptotendipes* spp., *Limnochironomus* species [?=*Dicrotendipes nervosus*],

Lipiniella araenicola, Pentapedilum [=*Polypedilum*] *exsectum*, *Polypedilum* species [?=*P. nubeculosum*]

Korochkina, L.S., Kiknadze, I.I. Muradov, S.V. 1972. Effect of hormones on puffing in *Chironomus thummi thummi* Kieffer. *Ontogenez* **3**:
177-186. (In Russian, English summary)
[Translated in *Soviet Journal of Developmental Biology* **3**: 139-146]
Studied the effect of ecdysone and hydrocortisone on puffing patterns in *C. thummi* [=*C. riparius*]. Both hormones increased the size of the puffs of metamorphosis while having little effect on the puffs characteristic of the larval stages. Ecdysone generally had a greater effect than hydrocortisone. Illustrated by photographs. The name V.V. Novak is added to the authors in the English summary.

Specialised subjects: Puffs - hormone effects
Species: *Chironomus thummi thummi* [=*C. riparius*]

Korochkina, L.S., Kiknadze, I.I., Muradov, S.V. & Novak, V.V. 1972. See Korochkina, Kiknadze, Muradov (1972). (Additional author listed in the English summary of the paper).

Korochkina, L.S., Korochkin, L.I., Gruzdev, A.D. & Kostomakha, A.N. 1975. Cytochemical localization of ribonuclease activity in salivary gland cells of *Chironomus thummi*. *Tsitologiya* **17**: 574-575. (In Russian, English summary)
The nuclei and the polytene chromosomes of the salivary glands show the highest RNase activity. It is therefore assumed that some of the synthesised RNA is degraded directly on the chromosomes.

Specialised subjects: Polytene chromosomes - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Korschelt, E. 1884. Uber die eigenthümlichen Bildungen in den Zellkernen der Speicheldrüsen von *Chironomus plumosus*. *Zoologischer Anzeiger Supplement. Verhandlungen der deutsche Zoologische Gesellschaft* **7**: 189-194, 221-225, 241-246.
Following on from the work of Balbiani (1881), details the structure and occurrence of polytene chromosomes in *C. plumosus*. Considered the cross striation to be an optical effect resulting from ridges and valleys running across the chromosome. Most findings were remarkably accurate. Illustrated by drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Kosswig, C. 1948. Demonstration of preparations of salivary chromosomes of different tissues of *Chironomus*. *Proceedings of the Eighth International Congress of Genetics. Hereditas* (Supplement): 609-610. (Abstract)
A demonstration to show that polytene chromosomes from different tissues were of different lengths and breadths, and showed different banding patterns. Different nuclei of the same tissue also showed minor differences in banding pattern. The species is likely to have been *C. riparius* or *C. plumosus*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Kosswig, C. & Sengün, A. 1947*a*. Dev kromozomlarm strütürü üzerinde yeni arastirmalar. Neuere Untersuchungen über den Bau der Riesenchromosomen der Dipteren. *Istanbul Üniversitesi Fen Fakütesi Mecmuasi B* **12**: 107-121. (In German; Turkish summary)
Compare the banding patterns of polytene chromosomes in different tissues of *Chironomus* species and conclude that the banding is not identical. Differences in structure, based on the different appearance of the chromosomes and the bands in different tissues and different genera, are suggested. The chromosomes are illustrated by pen drawings, but no photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species 1 [=*C. riparius*], *C.* species 2 [=*C. plumosus*]

Kosswig, C. & Sengün, A. (spelt Shengün) 1947*b*. Intra-individual variability of chromosome IV of *Chironomus*. *Journal of Heredity* **38**: 235-239.
Compares the banding pattern of chromosome IV in different polytene tissues of larvae of different ages, concluding the pattern is not identical. The bands are considered to result from coiling of the chromosome to form discs, which would therefore not contain the same "genic" material. Illustrated by photographs and drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species 2 [=*C. plumosus*]

Kosswig, C. & Sengün, A. 1947*c*. Vergleichende Untersuchungen über die Riesenchromosomen der verschiedenen Dipteren. *Türk fiziki ve tabii ilimler sosyetesi yillik bildirigleri ve arsivi, Instanbul* **13**: 94-101. (In German, no summary)
Compares the appearance of the bands of the polytene chromosomes in different tissues of two *Chironomus* species with those of other Diptera. The results indicate that the appearance of the bands is very variable between tissues of the same individual and that chironomids have generally different banding structures than the other families. Illustrated by drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species 1 [=*C. riparius*], *C.* species 2 [=*C. plumosus*]

Kosswig, C. & Sengün, A. 1953. Haben die Riesenchromosomen der *Chironomus*-Larven eine definitive Strukturierung? *Naturwissenschaften* **40**: 111-112.
Compares the appearance of chromosome IV of a *Chironomus* species (probably either *C. riparius* or *C. plumosus*) in the salivary glands and the Malpighian tubules at different ages and following different conditions. Concludes that the appearance of the chromosome bands depends on the developmental conditions. Illustrated by drawings and photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Kosswig, C. & Shengün, A. 1947. See Kosswig & Sengün (1947*b*)

Krebs, H. 1973. *Der Zusammenhang zwischen Polytäniegrad, Kerngrösse und Chromosomen- durchmesser in den Regionen der Speicheldrüse von* Chironomus thummi. Staatsexamensarbeit Thesis, Saarbrücken, Germany.
Quoted by Müller (1976) as noting the relationship between nuclear size, chromosome diameter and DNA content.

Specialised subjects: Polytene chromosomes - structure, size relationships
Species: *Chironomus thummi* [=*C. riparius*]

Krieger-Wolff, E. & Wülker, W. 1971. Chironomiden (Diptera) aus der Umgebung von Freiburg i. Br. (mit besonderer Berücksichtigung der Gattung Chironomus). *Beiträge zur Naturkundlichen Forschung in SüdwestDeutschland* **30**: 133-145.
Give the cytological characters for identifying 14 species of *Chironomus* based on the studies of Keyl (Keyl & Keyl 1959, Keyl 1962). Includes two photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus, C. annularius, C. anthracinus*, *C. commutatus*, *C. dorsalis, C. luridus*, *C. melanotus*, *C. obtusidens, C. parathummi, C. plumosus, C. pseudothummi, C. striatus, C. thummi thummi* [=*C. riparius*], *C. uliginosus*

Kroeger, H. 1963*a*. Chemical nature of the system controlling gene activities in insect cells. *Nature* **200**: 1234-1235.
Studies the manner in which the balance of Na^+ and K^+ in the medium affects the puffing pattern in the polytene chromosomes of explanted salivary glands. It is postulated that the effect of hormones is mediated through such change in ionic balance.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1963*b*. Cellular mechanism regulating the activity of genes in insect development. *Proceedings of the 16th International Congress of Zoology*, *Washington* **4**: 251-255.
A brief review of gene regulation which includes the studies of puffing in *Chironomus tentans* (Beermann 1952) and *C. thummi* (Clever & Karlson 1960) (Partim)

Specialised subjects: Puffs - genetic control
Species: *Chironomus tentans, Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1963*c*. Experiments on the extranuclear control of gene activity in dipteran polytene chromosomes. *Journal of Cellular and Comparative Physiology* **62** (supplement 1): 45-60.
Studies the effect of hormones and their imitators on the puffing pattern of salivary gland chromosomes, particularly in relation to the process of rejuvenation under wound induction.
At marginal concentrations of Zn^{++} a mosaic gland is produced in which some nuclei are rejuvenated and others are not. Argue that genetic loci have individual sensitivities to different levels of the control system. Illustrated by diagrams.

Specialised subjects: Puffs - genetic control
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1964. Zellphysiologische Mechanismen bei der Regulation von genaktivitäten in den Riesenchromosomen von *Chironomus thummi*. *Chromosoma* **15**: 36-70. (English summary)
Explantation experiments were used to study the appearance and disappearance of seven puffs in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*]. Concludes that puff formation is independent of other puffs or of other parts of the genome. Also investigates the effect of ecdysone, which is mimicked by Zn^{++}.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1965. The mechanism of gene activation in dipteran salivary gland chromosomes. I. *Table ronde sur les manifestations hormonales liées aux mécanismes génétiques. Archives d'Anatomie Microscopique et de Morphologie Experimentale* **54**: 643-645.
Briefly reviews the knowledge of the mechanism of the control of puffing in salivary gland chromosomes.

Specialised subjects: Puffs - genetic control
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1966*a*. Potential differenz und puff-Muster. Elektro-physiologische und cytologische Untersuchungen an den Speicheldrüsen von *Chironomus thummi*. *Experimental Cell Research* **41**: 64-80. (English summary)
Studies the effect of changes in the balance of ions in the cell and across the plasma membrane on puffing in rejuvenated salivary gland cells. Considers that the effect of ions in this process is similar to their effect during normal development. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1966*b*. Micrurgy on cells with polytene chromosomes. *Methods in Cell Physiology* **2**: 61-92.
Reviews the techniques for micrurgical manipulation of polytene chromosomes, after reviewing the occurrence and structure of these chromosomes. Illustrated with photographs, electronmicrographs and drawings. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus tentans*, *C.thummi* [=*C. riparius*]

Kroeger, H. 1967*a*. Hormones, ion balances and gene activity in dipteran chromosomes. Endocrine Genetics. *Proceedings of a Symposium held at the University of Cambridge*, 1966. *Memoirs of the Society for Endocrinology* **15**: 55-66.
Reviews the evidence for the mechanism by which hormones influence the activity of genes as revealed in the study of puffing of polytene chromosomes. A model of hormonal action is presented.

Specialised subjects: Puffs - gene activity
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Kroeger, H. 1967*b*. Genomic activities and their control during insect metamorphosis. *Proceedings of the Seventh International Congress of Biochemistry*, *Tokyo*: 391-392.
Briefly lists some of the evidence for control of gene activity in polytene chromosomes by changes in the electrolyte composition of the nuclear sap.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. 1968. Gene activities during insect metamorphosis and their control by hormones, pp.185-219. *In* Etkin, W. & Gilbert, L.I. (eds.), *Metamorphosis, a Problem in Developmental Biology*. 459pp. North Holland, Amsterdam.
Reviews studies on hormonal control of puffing in polytene chromosomes, including some original data from his own work. Includes photographs of segments of polytene chromosomes of *Chironomus thummi* [=*C. riparius*] to show puffs. (Partim)

Specialised subjects: Puffs - genetic control
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Kroeger, H. 1971. Insect hormones and gene activity. *Endocrinologia Experimentalis* **5**: 108-113.
Briefly reviews the effect of ecdysone on gene activity with particular reference to changes in the electrolyte concentrations of the nucleus and the resulting changes in puffing activity of certain chromosomal regions in the salivary gland chromosomes. (Partim)

Specialised subjects: Puffs - genetic control
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Kroeger, H. 1973. Zur Normalentwicklung von *Chironomus thummi* Kieffer. Allgemeine Morphologie, Speicheldrüsenentwicklung und puffing Aktivität in Riesenchromosomen (Insecta, Diptera). *Zeitschrift für Morphologie der Tiere* **74:** 65-88. (English summary)
Describes the changes which occur in the polytene chromosomes, including the puffing pattern, as part of an overall description of the changes which occur in *C. thummi* [=*C. riparius*] from the last larval moult until pupation. Illustrated by detailed drawings of some puffs. (Partim)

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H., Gettmann, W. & Kalter, C. 1973. Zur Kontrolle der DNA-Replikation in Riesenchromosomen explantierter Speicheldrüsen. I. Zeitablauf und Einfluss verschiedener Medien. *Cytobiologie* **7**: 117-126. (English summary)
Autoradiographic studies are used to examine the effect of larval age and the molarity of the medium on the percentage of nuclei in explanted salivary gland cells in which the chromosomes undergo DNA replication. Concludes that electrolytes may play a key role in the control of DNA.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H., Jacob, J. & Sirlin, J.L. 1963. The movement of nuclear protein from the cytoplasm to the nucleus of salivary cells. *Experimental Cell Research* **31**: 416-423.
Chromosome sets were dissected from salivary glands incubated in labelled haemolymph. The dissected chromosomes were transferred to the cytoplasm of unlabelled cells and exposed as autoradiographs. The results indicate that a protein is present which moves preferentially from the cytoplasm to the nucleus. Illustrated by autoradiographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H. & Lezzi, M. 1966. Regulation of gene action in insect development. *Annual Review of Entomology* **11**: 1-22.
Reviews the data on puff morphology, puffing changes in development and experimental induction of puffs. (Partim)

Specialised subjects: General Dipteran Cytogenetics, Puffs - developmental sequence, experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus dorsalis* [=*C. riparius*], *C. pallidivittatus, C. tentans, C. thummi* [=*C. riparius*], *Cryptochironomus* species, *Trichocladius vitripennis* [=*Halocladius varians*]

Kroeger, H. & Müller, G. 1973. Control of puffing activity in three chromosomal segments of explanted salivary gland cells of *Chironomus thummi* by variation in extracellular Na^+, K^+ and Mg^{++}. *Experimental Cell Research* **82**: 89-94.
Salivary glands of *C. thummi* [=*C. riparius*] were incubated in media composed of various ionic combinations in concentrations at which there was no visible damage. The induction of puffs in three different chromosomal segments was examined. In most cases a change from 0 to 100% puff induction depended on changes in media composition of 10-20mM.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kroeger, H., Trösch, W. & Müller, G. 1973. Changes in nuclear electrolytes of *Chironomus thummi* salivary gland cells during development. *Experimental Cell Research* **80**: 329-339.
The puffing activity of two chromosomal segments of *C. thummi* [=*C. riparius*] was examined in relation to the titres of Na and K in the nucleus. An ecdysone-sensitive puff was particularly sensitive to K^+, while a juvenile hormone-sensitive puff was sensitive to Na^+. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Kronberg, I. 1986. Riesenchromosomen und Artareal einer baltischen *Telmatogeton*-Art (Diptera: Chironomidae: Telmatogetoninae). *Zeitschrift für zoologische Systematik und Evolutionsforschung* **24**: 190-197. (German and English summaries)
Examines the polytene chromosomes of *Telmatogeton remanei* (n=7) and concludes it is a synonym of *T. japonicus*. Illustrated by

photographs of polytene and mitotic chromosomes.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Telmatogeton remanei* [=*T. japonicus*]

Kuberskaya, E.F. 1974. On the characteristics of the karyotype and some special features of the nucleus structure in *Pseudodiamesa nivosa* from the Lake Baikal area. *Tsitologiya* **16**: 1426-1432. (In Russian; English summary)
Describes the structure of the nuclear apparatus and the three banded-salivary gland chromosomes of *Prodiamesa nivosa* (However subsequent work by Zacharias (1984) on the related species *P. branickii* indicates that a fourth chromosome is present as an unbanded network). Both drawn and photographic maps of the chromosomes are provided, and the similarity to *P. olivacea*, as described by Bauer (1936b), is noted. Also noted is attachment between telomeric and centromeric bands.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Pseudodiamesa nivosa*

Kuberskaya, E.F. 1979. Karyotype characteristics of the main species of the subfamily Diamesinae (Diptera, Chironomidae) of Lake Baikal, pp.47-50. *In* Chubareva, L.A. (ed.), *Karyosystematics of the Invertebrate Animals*. 130pp. Zoologicheskii Institut Academiia Nauk, S.S.S.R., Leningrad. (In Russian)
Describes the karyotypes of five species, three for the first time.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa* gp. *prolongata*, *Prodiamesa olivacea*, *Protanypus* gp. *morio*, *Pseudodiamesa branickii*, *P. nivosa*

Kuberskaya, E.F. 1980. *Morphology of the salivary glands and karyotypic characteristics of Diamesinae (Diptera, Chironomidae), main species of benthos of standing and flowing waters of Lake Baikal*. Doctoral Dissertation, Irkutsk. 23pp. (In Russian)
This reference not seen, but assumed to cover same species as Kuberskaya (1979).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa* gp. *prolongata*, *Prodiamesa olivacea*, *Protanypus* gp. *morio*, *Pseudodiamesa branickii*, *P. nivosa*

Kuberskaya, E.F. 1982. Polytene chromosomes of the salivary gland cells of mass species Diamesinae (Diptera, Chironomidae) of the Baikal region. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 37.
Describes the different appearance of the chromosomes in different regions of the salivary gland, as well as the major differences in the polytene chromosome complement of five species.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa* gp. *insignipes*, *Prodiamesa olivacea*, *Protanypus* gp. *morio*, *Pseudodiamesa branickii*, *P. nivosa*

Kuberskaya, E.F. 1984. Morphology of the salivary glands and characteristics of the karyotype of *Diamesa tsutsui* Tok. (Diptera, Chironomidae) from
the River Amur. *In* Biology of Freshwaters of the Far East, Vladivostok: 102-106. (In Russian).
Describes the polytene chromosome morphology of *D. tsutsui* [=*D. borealis*]. (Partim).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa tsutsui* [=*D. borealis*]

Kulagin, N. 1905. Zur Frage über die Struktur der Zellkerne der Speicheldrüsen und des Magens bei *Chironomus*. *Zeitschrift für Wissenschaftliche Insektenbiologie* **1**: 409-415.
Notes that the salivary gland nuclei of the species studied shows banded chromatic structures similar to those noted by previous workers such as Balbiani (1881). Illustrated by drawings. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Kulminskaya, A.S., Egorova, E.F. & Gazaryan, K.G. 1974. Protein synthesis in nuclear components of salivary glands of *Chironomus plumosus*. *Tsitologiya* **16**: 575-581. (In Russian, English summary)
Investigates protein synthesis in the nucleus and nucleolus. Concludes that short lived RNAs are involved in nucleolar protein synthesis. Includes a photograph of the salivary gland nuclei showing polytene chromosomes. (Partim)

Specialised subjects: Nucleolus - gene activity
Species: *Chironomus plumosus*

Kumagai, K., Okajima, A. & Yoshimatsu, H. 1981*a*. Citric acid-dahlia staining of the salivary gland chromosomes of *Chironomus yoshimatsui*. *Yamaguchi Diagaku Kyoyobu Kiyo* **15**: 75-87. (In Japanese, English summary)
Describes a new staining technique for polytene chromosomes and applies it to *C. yoshimatsui*, for which a drawn chromosome map is provided. This map differs in its numbering system to that of Martin & Sublette (1972). Also illustrates the third chromosome of Japanese *C. samoensis* [?=*C. flaviplumus*] and compares the banding pattern to that of *C. yoshimatsui*. Includes a number of photographs.

Specialised subjects: Techniques; Cytotaxonomy - polytene chromosomes
Species: *Chironomus samoensis* [?=*C. flaviplumus*], *C. yoshimatsui*

Kumagai, K., Okajima, A. & Yoshimatsu, H. 1981*b*. Puff formation in salivary gland chromosomes of *Chironomus yoshimatsui*. *Yamaguchi Diagaku Kyoyobu Kiyo* **15**: 89-102. (In Japanese, English summary)
Describes the typical sequence of puff formation during prepupal development. Illustrated by photographs.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus yoshimatsui*

Kumar, A. & Gupta, J.P. 1990 Cytogenetic studies of *Chironomus circumdatus* from India (Diptera: Chironomidae). *Genetica* **82**: 157-163.
Describe the polytene chromosomes, mitotic chromosomes and C-banding pattern of five populations around Varanasi, India. A photographic chromosome map is presented which makes no attempt to relate the banding pattern to that of any other species. Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus circumdatus*

Kunze, E. 1953. Untersuchungen über die Paarungsaffinität bei Riesenchromosomen. *Chromosoma* **5**: 501-510.
Includes some notes on pairing of the polytene chromosomes of three chironomid species, either based on salivary gland or Malpighian tubule chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus halophilus* gp. [=*C. aprilinus* gp.], *Eucricotopus* [=*Cricotopus*] *trifasciatus, Prodiamesa olivacea*

Kurth, P.D. & Bustin, M. 1979. Immunofluorescent localization of HMG-1 in *Chironomus thummi* polytene chromosomes. *Federation Proceedings* **38**: 491. (Abstract)
Antibodies to HMG-1 were reacted to polytene chromosomes of *C. thummi* [=*C. riparius*]. The results indicated that HMG was present and that its distribution changes with the developmental stage of the larva. Results published more fully in Kurth & Bustin (1981).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Kurth, P.D. & Bustin, M. 1981. Localization of chromosomal protein HMG-1 in polytene chromosomes of *Chironomus thummi*. *Journal of Cell Biology* **89**: 70-77.
A more detailed account of the distribution and developmental changes in the distribution of HMG-1 in the salivary gland chromosomes of *C. thummi* [=*C. riparius*] than that given by Kurth & Bustin (1979). A possible function of the protein is suggested. Illustrated by good quality photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Kurth, P.D., Bustin, M. & Moudrianakis, E.N. 1979. Concanavalin A binds to puffs in polytene chromosomes. *Nature* **279**: 448-450.
Fluorescein-labelled concanavalin A (Con A) was used to locate glucose- and mannose-containing molecules in polytene chromosomes of *Chironomus thummi* [=*C. riparius*]. Fluorescence was found to be greatest in the Balbiani rings of chromosome IV, with the extent of binding proportional to the size of the ring. The nature of the biochemical entity to which Con A binds was not determined. Illustrated by photographs.

Specialised subjects: Techniques; Puffs - gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Kurth, P.D., Moudrianakis, E.N. & Bustin, M. 1978. Histone localization in polytene chromosomes by immunofluorescence. *Journal of Cell Biology* **78**: 910-918.
The distribution of various histone fractions in the salivary gland chromosomes was studied using an indirect immunofluorescence technique. While H1 and H2A tended to show a diffuse fluorescence pattern, the other histones produced distinct banding patterns. It appears the overall organization of the histones is the same in all bands, with more antigenic sites being available when more DNA is present.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Kurth, P.D., Reisch, J.C. & Bustin, M. 1983. Selective exposure of antigenic determinants in chromosomal proteins upon gene activation in polytene chromosomes. *Experimental Cell Research* **143**: 257-269.
While HMG-1 was always available to antibody binding whether it was in a puffed area or in other chromosomal regions, histone H3 in transcriptionally active regions normally does not fluoresce in the presence of labelled antibody. However if the chromosomes are treated with 45% acetic acid before the addition of the antibody, the histone H3 is able to be bound. It is therefore concluded that in puffed regions the antigenic determinants of histone H3, but not MG-1, are sterically hindered by compounds extractable by 45% acetic acid. Illustrated by photographs.

Specialised subjects: Puffs - gene activitySpecies: *Chironomus thummi* [=*C. riparius*]

Kuvangkadilok, C. 1983. *Genetic variability in populations of* Chironomus oppositus. Doctor of Philosophy Thesis, University of Melbourne, 335pp.
Studied mainland populations of the cytologically-distinguished forms of *C. oppositus* identified from Tasmania by Martin *et al*. (1978). Showed differences in seasonal and geographic occurrence, C-banding pattern of the polytene chromosomes and sex determiner location. Laboratory hybridisations showed no reduction in fertility within or between forms. (Partim)

Specialised subjects: Karyotype - evolution, Hybrids - sibling species
Species: *Chironomus oppositus*

Kuvangkadilok, C. 1984. Genetic variability in populations of *Chironomus oppositus*. *Journal of the Australian Entomological Society* **23**: 104. (Abstract)
Abstract of thesis (Kuvangkadilok 1983).

Specialised subjects: Karyotype - evolution, Hybrids - sibling species
Species: *Chironomus oppositus*

Kuvangkadilok, C. 1985. Cytogenetic studies of *Chironomus plumatisetigerus* (Diptera: Chironomidae) in Thailand. *Journal of the Science Society of Thailand* **11**: 37-45.
Provides a photographic map of the polytene chromosomes and describes six inversion polymorphisms in populations from Bangkok. Illustrated also by photographs of heterozygotes.

Specialised subjects: Inversions - heterozygosity; Polytene chromosomes - maps
Species: *Chironomus plumatisetigerus* [=*C. circumdatus*]

Lakhotia, S.C., Nath, B.B., Burma, P. & Karchowdhuri, D. 1989. Effect of pairing on the rate of ^{3}H-uridine uptake at heat shock puff sites. *Abstracts of XII All India Cell Biology Conference, Hyderabad,* Abstract 121, p.76.
This abstract has not been seen and the work appears not to have been published.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species [probably *C. striatipennis*]

Lamb, M.M. & Daneholt, B. 1979. Characterization of active transcription units in Balbiani rings of *Chironomus tentans*. *Cell* **17**: 835-848.
Transcription units of the Balbiani rings on chromosome IV of *C. tentans* were examined under electron microscopy. The active fibres appear as a loop with RNP granules attached and are more extended than the inactive regions. Illustrated by electronmicrographs.

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus tentans*

Lambert, B. 1972a. *Repeated nucleotide sequences in polytene chromosomes. Molecular hybridization studies of RNA and DNA in salivary glands of* Chironomus tentans. Thesis, Department of Histology, Karolinska Institutet, Stockholm, Sweden. 35pp.
A thesis based on the publications of Lambert (1972, 1973), Lambert, Daneholt, Edström, Egyhazi & Ringborg (1973), Lambert, Egyhazi, Daneholt & Ringborg (1973) and Lambert,

Wieslander, Daneholt, Egyhazi, & Ringborg (1972). Numerous photographs and autoradiographs including an *in situ* hybridisation of BR2 RNA to chromosomes of rectum cells.

Specialised subjects: Puffs - structure
Species: *Chironomus tentans*

Lambert, B. 1972*b*. Repeated DNA sequences in a Balbiani ring. *Journal of Molecular Biology* **72**: 65-75.
DNA from BR2 of *Chironomus tentans* was studied by *in situ* hybridisation and DNA/RNA hybridisation on filters. The size of the RNA was shown to be an order of magnitude smaller than the size of the BR2 DNA, suggesting that several transcription units may be present. Illustrated by autoradiographs. (Partim)

Specialised subjects: Puffs - structure
Species: *Chironomus tentans*

Lambert, B. 1973. Tracing of RNA from a puff in the polytene chromosomes to the cytoplasm in *Chironomus tentans* salivary gland cells. *Nature* **242**: 51-53.
RNA from the cytoplasm was labelled and in situ hybridised to polytene chromosomes. Most of the label went to the Balbiani rings, with a small amount going to the nucleoli. This suggests that the RNA produced by the Balbiani rings is transported to the cytoplasm. Illustrated by autoradiographs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Lambert, B. 1974. Repeated nucleotide sequences in a single puff of *Chironomus tentans* polytene chromosomes. *Cold Spring Harbor Symposia*
on Quantitative Biology, 1973. **38**: 637-644.
In situ hybridisation of Balbiani ring RNA to salivary gland or rectal polytene chromosomes indicated that it was preferentially bound to the sites of the BRs and to the BR from which it was derived, although there was some cross hybridisation between BRs. When BR2 RNA was taken from the nuclear sap or the cytoplasm, it again hybridized to BR2. From the kinetics of the reaction it was estimated that this RNA was about 200 fold repeated, consistent with the idea that the BR contained 5-15 transcription units.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Lambert, B. 1975. The chromosomal distribution of Balbiani ring DNA in *Chironomus tentans*. *Chromosoma* **50**: 193-200.
RNA from BR2 of salivary gland cells of *C. tentans* was hybridised to polytene chromosomes of rectal cells, where the grains covered 3-5 bands. Concludes the BR2 DNA is not selectively amplified in salivary gland chromosomes but contains sequences which are extensively repeated within 3-5 transcription units. Illustrated by autoradiographs and drawings of chromosome IV.

Specialised subjects: Puffs - Balbiani rings, DNA sequence
Species: *Chironomus tentans*

Lambert, B. & Beermann, W. 1975. Homology of Balbiani ring DNA in two closely related *Chironomus* species. *Chromosoma* **51**: 41-47.
Uses hybridisation of RNA from BR2 of *Chironomus tentans* to salivary gland chromosomes of *C. pallidivittatus*, and of hybrids between the two species, to confirm that the DNA in BR2 of *C. pallidivittatus* is homologous to that of *C. tentans*. This RNA does not hybridise to the other BRs, indicating that they differ in DNA sequence. Illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - Balbiani rings, DNA sequence
Species: *Chironomus pallidivittatus, C. tentans*

Lambert, B., Daneholt, B., Edström, J.-E., Egyhazi, E. & Ringborg, U. 1973. Comparison between chromosomal and nuclear sap RNA from *Chironomus tentans* salivary gland cells by RNA/DNA hybridization. *Experimental Cell Research* **76**: 381-389.
RNA/DNA hybridisation studies indicate that the RNA in chromosomal segments is different to that in the nuclear sap. This appears to be due in large part to the bulk of the RNA in the nuclear sap coming from one Balbiani ring. The results further suggest that the bulk of chromosomal RNA is repetitive and that the DNA complementary to it is arranged in families of repeated sequences, with the sequences belonging to a particular family distributed in different chromosomes.

Specialised subjects: Puffs - RNA synthesis, DNA sequences
Species: *Chironomus tentans*

Lambert, B. & Edström, J.-E. 1974*a*. Balbiani ring nucleotide sequences in cytoplasmic RNA of *Chironomus tentans* salivary gland cells. *Molecular Biology Reports* **1**: 457-464.

By *in situ* hybridisation it was shown that the Balbiani rings produce RNA molecules which sediment at about 75S. These 75S RNA molecules are transferred from the nucleus to the cytoplasm without an appreciable size reduction. Illustrated by autoradiographs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Lambert, B., Egyhazi, E., Daneholt, B. & Ringborg, U. 1973. Quantitative micro-assay for RNA/DNA hybrids in the study of nucleolar RNA from *Chironomus tentans* salivary gland cells. *Experimental Cell Research* **76**: 369-380.
A technique for micro-assay of RNA/DNA hybrids was tested using nucleolar RNA. This indicated that the RNAs produced by the different nucleoli are similar in sequence. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus tentans*

Lambert, B., Wieslander, L., Daneholt, B., Egyhazi, E. & Ringborg, U. 1972. *In situ* demonstration of DNA hybridizing with chromosomal and nuclear sap RNA in *Chironomus tentans*. *Journal of Cell Biology* **53**: 407-418.
Labelled RNA from microdissected salivary gland cells was *in situ* hybridized to polytene chromosome squashes. High molecular weight RNA hybridized with Balbiani ring 2, while low molecular weight RNA showed a diffuse distribution with all chromosomes. Illustrated by 11 autoradiographs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Laufer, H. 1963. Hormones and the development of insects. *Proceedings of the 16th International Congress of Zoology, Washington, DC* **4**: 215-220.
Reduction in enzyme activity in the larval salivary glands due to environmental changes is accompanied by changes in the size of the nucleolus and Balbiani rings of the polytene chromosomes. Specific metabolic inhibitors also affect enzyme activities as well as reducing chromosomal puffs or the nucleolus. This suggests that synthesis of the enzymes is dependent upon the synthesis of RNA. The results are consistent with the idea that mRNAs are made on the chromosomes at the site of particular puffs. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. 1965*a*. Chromosomal puffing and its relations to cell function and development. *Table ronde sur les manifestations hormonales liées aux mécanismes génétiques. Archives d'Anatomie Microscopique et de Morphologie Experimentale* **54**: 648-651.
The proteins occurring in the salivary gland secretion are not specific to the salivary gland but are found throughout the larva. Therefore it is suggested that the role of the tissue specific puffs in the salivary gland chromosomes may lie in the elaboration of the system for transport of materials into the gland. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. 1965*b*. Developmental studies of the dipteran salivary gland. III. Relationships between chromosomal puffing and cellular function during development. *Developmental and metabolic control mechanisms and neoplasia. Proceedings of the 19th Symposium on Fundamental Cancer Research, Houston, Texas*: 237-250.
Looks at the relationship between the appearance of certain enzymatic activities and antigenic components in the cytoplasm of the salivary gland cells of *Chironomus thummi* [=*C. riparius*] and the appearance of the Balbiani rings. It is postulated that the products of these puffs may elaborate a specific transport system that functions in the recognition, uptake, concentration and secretion of specific macromolecules present in the salivary secretion.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. 1968*a*. Insect culture - a discussion. *Differentiation and Defence Mechanisms in Lower Organisms, A Symposium of the Tissue Culture Association,* 1967. *In Vitro* **3**: 118-119.
Makes reference to RNA synthesis under culture conditions in relation to hormonally induced changes in puffing pattern. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. 1968*b*. Developmental interactions in the Dipteran salivary gland. *American Zoologist* **8**: 257-271.
Reviews puffing activity in salivary gland chromosomes, both normal and experimentally induced. Includes a photograph of chromosome 4 of *Chironomus thummi*. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Laufer, H. & Calvet, J.P. 1972. Hormonal effects on chromosomal puffs and insect development. *General and Comparative Endocrinology, Supplement* **3**: 137-148.
Studied the effect of ecdysone and juvenile hormone on puffing events in *Chironomus tentans* and *C. thummi* [=*C. riparius*], to determine whether they affect the same or different puffs. The results indicate that they affect different chromosomal loci, contrary to the report of Lezzi & Gilbert (1969). The results are interpreted to imply that the two hormones regulate gene activity, bringing about their own specific and separate changes in synthetic pathways. Illustrated by photographs of hormonal effects on puffing.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Laufer, H. & Frackelton, A.R. 1970. Specific alterations of puffing and RNA labelling in the salivary gland chromosomes of *Chironomus* induced by gibberellic acid derivatives. *Abstracts of the Winter Meeting of the American Society of Zoologists, Chicago, Illinois. American Zoologist* **10**: 528.
Tests indicated that gibberellic acid did not affect chromosomal puffing in *C. thummi* [=*C. riparius*] as it did in *Acricotopus lucidus* [=*A. lucens*] (Panitz 1967). However the degradation product gibberic acid did affect the puffing of two Balbiani rings and prevented ecdysone from exerting an effect on puffing or precocious moulting.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus thummi* [=*C. riparius*]

Laufer, H. & Goldsmith, M. 1965. Ultrastructural evidence for a protein-transport system in *Chironomus* salivary glands and its implication for chromosomal puffing. *Abstract of the Fifth Annual Meeting of the American Society for Cell Biology, Philadelphia, Pennsylvania. Journal of Cell Biology* **27**: 57A.
The ultrastructure of the plasma membrane on the hemal border of salivary gland cells suggests they are engaged in micropinocytosis, supporting the view that the tissue specific puffs in the polytene chromosomes function in the production of substances concerned with the uptake and transport of material synthesised elsewhere. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus* species [?=*C. riparius*]

Laufer, H. & Greenwood, H. 1969. The effects of juvenile hormone on larvae of the dipteran *Chironomus thummi*. *Abstracts of the Summer Meeting of the American Society of Zoologists, Burlington, Vermont. American Zoologist* **9**: 603.
Growth of *Chironomus* larvae in medium containing synthetic juvenile hormone led to changes in puffing pattern in the polytene chromosomes. Therefore it is concluded that the activation or inactivation of specific chromosomal loci is an effect of juvenile hormone on development. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. & Holt, T.K.H. 1968. The control of *Chironomus* development by substances with juvenile hormone activity. *Proceedings of the Sixth International Congress of Embryology, Paris. Annales d'Embryologie et de Morphogenese, Supplement* **1**: 281-282.
Farnesoic acid and juvenile hormone were both shown to affect the normal prepupal puffing pattern in a similar manner. Conclude that juvenile hormone controls development by the regulation of differential gene activity.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species [?=*C. riparius*]

Laufer, H. & Holt, T.K.H. 1970. Juvenile hormone effects on chromosomal puffing and development in *Chironomus thummi*. *Journal of Experimental Zoology* **173**: 341-352.
Synthetic juvenile hormone was administered to several larval stages of *C. thummi* [=*C. riparius*], and the pattern of puffing examined. Nine puffs, which were normally developed in controls, were reduced following treatment. Balbiani ring IVb was enlarged and autoradiographic studies indicated intensive RNA synthesis, which is illustrated. A modified drawn map of the polytene complement is provided, against which the puffing patterns are compared. (Partim)

Specialised subjects: Puffs - chromosomal location, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. & Nakase, Y. 1965*a*. Salivary gland secretion and its relation to chromosomal puffing in the dipteran, *Chironomus thummi*. *Proceedings of the National Academy of Sciences* **53**: 511-516.
Based on an analysis of the salivary secretion and the presence of these substances elsewhere in the larval body it is concluded that the tissue specific puffs of the salivary gland chromosomes do not actually synthesise the secretory products. Instead they are assumed to be involved in the control of selective uptake of these substances into the salivary gland. (Partim)

Specialised subjects: Puffs - gene product
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. & Nakase, Y. 1965*b*. Developmental studies of the Dipteran salivary gland. II. DNase Activity in *Chironomus thummi*. *Journal of Cell Biology* **25**: 97-102.
The increase in DNase activity in the salivary gland at the approach of metamorphosis is correlated with changes in chromosomal puffs, including the nucleolus and the Balbiani rings. It is assumed that the change in DNase activity results from activation of one of the puffs that changes in activity only at the time of metamorphosis. (Partim)

Specialised subjects: Puffs - pupariation
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Nakase, Y. & Vanderberg, J. 1963*a*. Nucleo-cytoplasmic interactions in the development of salivary glands of *Chironomus thummi* (Diptera). *Abstracts of Papers presented at the Marine Biological Laboratory, Woods Hole, Massachusetts. Biological Bulletin* **125**: 359.
Changes in the enzymes of the salivary gland are paralleled by changes in the activity of the nucleolus and the Balbiani rings of the polytene chromosomes. DNase activity correlates best with the developmentally significant puffs. Wounding, hormone deprivation , and treatments affect the puffing, supporting the view that development involves differential gene activation. (Partim)

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Nakase, Y. & Vanderberg, J. 1963*b*. DNA-dependent development of Dipteran larvae. *Abstracts of the Third Annual Meeting of the American Society for Cell Biology. Journal of Cell Biology* **19**: 43A.
A brief outline of the results published in Laufer, Nakase & Vanderberg (1964).

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Nakase, Y. & Vandenberg, J. 1963*c*. Enzyme activities in the Dipteran salivary gland during metamorphosis. *Abstracts of Papers presented at the Winter Meeting of the American Society of Zoologists, American Zoologist* **3**: 486.
Absolute enzyme activities in the salivary gland of the larva of *Chironomus thummi* [=*C. riparius*] parallel the synthesis of RNA of several major chromosomal sites, the nucleolus and the Balbiani rings. (Partim)

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Nakase, Y. & Vandenberg, J. 1964. Developmental studies on the dipteran salivary gland. I. The effects of actinomycin D on larval development, enzyme activity, and chromosomal differentiation in *Chironomus thummi*. *Developmental Biology* **9**: 367-384.
Actinomycin D was found to cause a characteristic degree and rate of regression of puffing of the nucleolus and one of the Balbiani rings in the prepupal stage of *C. thummi* [=*C. riparius*]. It is suggested that many of the chromosomal puffs reflect DNA-primed RNA synthesis, inhibitable by actinomycin D. This supports the idea that one regulating mechanism of development may be a sequence of gene activations and inactivations. Illustrated by four photographs of the effects on chromosome 4. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Rao, B. & Nakase, Y. 1965. Dipteran salivary gland metamorphosis, a self regulating system. *Abstracts of Papers presented at the Winter Meeting of the American Society of Zoologists. American Zoologist* **5**: 642.
DNA determinations during the fourth instar of *Chironomus thummi* showed an increase in DNA content of the salivary glands until the prepupal stage. In the prepupal stage DNase activity increased, followed by a significant drop in DNA content, suggesting salivary gland metamorphosis is regulated by affecting chromosomal integrity, and results from chromosomal puffing.

Specialised subjects: Puffs - pupariation
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H., Rao, B. & Nakase, Y. 1967. Developmental studies of the Dipteran salivary gland. IV. Changes in DNA content. *Journal of Experimental Zoology* **166**: 71-76.
In the salivary glands of *Chironomus thummi* [=*C. riparius*], the amount of DNA increases during development from mid fourth instar larva to early prepupa, then decreases in the late prepupa. The significance of this is discussed in relation to chromosomal puffs. (Partim)

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Laufer, H. & Wilson, M. 1970. Hormonal control of gene activity as revealed by puffing of the salivary chromosomes in dipteran larvae, pp185-200. *In* Peter, R.E. & Gorbman, A. (ed), *A Student's Guide to Laboratory Experiments in General and Comparative Endocrinology*. 209pp. Prentice Hall, New Jersey.
A student laboratory guide to experiments using *Chironomus* to demonstrate the effect of hormones on puff formation in the salivary gland chromosomes. Describes all stages from the collection, through rearing, preparation of salivary gland chromosomes and observation of hormonal effects.

Specialised subjects: Techniques; Polytene chromosomes - preparation; Puffs - gene activity
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Lee, B.T.O. Martin, J. & Edström, J.-E. 1988. Cloning and molecular characterization of a dominant-male sex determining gene. *Abstracts of the XVIth International Congress of Genetics, Toronto, Canada. Genome* **30** (Suppl.1): 173.
A clone believed to contain the dominant MD from arm G of *Chironomus oppositus* f. *tyleri* was *in situ* hybridised to salivary gland chromosomes of a number of *Chironomus* species. It showed slight binding to the distal end of arm G but strong binding to one homologue at the site of the MD in males. (Partim)

Specialised subjects: Sex chromosomes - differential segment; Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus oppositus* f. *connori*, *C. oppositus* f. *tyleri*

Lemeunier, F., Derbin, C., Malfoy, B., Leng, M. & Taillandier, E. 1982. Identification of left handed Z-DNA by direct immunofluorescence in polytene chromosomes of *Chironomus thummi thummi*. *Experimental Cell* **141**: 508-513.
Antibodies against Z-DNA were used to stain polytene chromosomes of *C. thummi* [=*C. riparius*] and the regions of Z-DNA were identified by immuno-fluorescence. The major staining was to one interband region of chromosome II and two bands on chromosome IV. This is in marked contrast to the situation in *Drosophila* where there is much more general staining. It is suggested that the lower GC ratio of the DNA may play some part in the reduced presence of Z-DNA in *Chironomus*. Illustrated by photographs.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Lendahl, U. 1987. *Structure and expression of Balbiani ring genes: en evolutionary study of a eukaryotic gene family*. Thesis, Dept. Medical Cell Genetics, Karolinska Institutet, Stockholm, Sweden. 53pp.
Based in part on the studies published in Lendahl & Wieslander (1984). (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans*

Lendahl, U. & Weislander, L. 1984. Balbiani ring 6 gene in *Chironomus tentans*: a diverged member of the Balbiani ring gene family. *Cell* **36**: 1027-1034.
Four clones of *C. tentans* DNA, believed to contain the gene for Balbiani ring 6, were hybridised *in situ* to salivary gland chromosomes and found to bind to the BR6 locus. Illustrated by a photograph. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans*

Lentzios, G. & Stocker, A.J. 1979. Nucleolar relationships in some Australian *Chironomus* species as shown by Ag-As banding and other cytological techniques. *Chromosoma* **75**: 235-258.
Studied the formation, chromosomal distribution and evolutionary relationships of the nucleoli in a group of related Australasian *Chironomus* species. Illustrated by numerous photographs.

Specialised subjects: Nucleolus - evolution
Species: *Chironomus alternans* a, *C. alternans* b, *C. australis*, *C. cloacalis*, *C. duplex*, *C. nepeanensis*, *C. occidentalis*, *C. oppositus*, *C. tepperi*, *C. zealandicus* Type I [=*C. zealandicus*], *C. zealandicus* Type II [=*C.* species a]

Lentzios, G., Stocker, A.J. & Martin, J. 1980. C-banding and chromosome evolution in some related species of Australian Chironominae. *Genetica* **54**: 51-68.
The evolutionary relationships of a group of Australasian *Chironomus* species were investigated by an analysis of the C^+ heterochromatin of the polytene chromosomes. Changes in the amount of C^+heterochromatin appear to have occurred by the addition or deletion of small amounts, particularly by addition since the presumed primitive species has one of the lowest amounts. Illustrated by numerous photographs of C-banded and phase contrast chromosomes.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus alternans* a, *C. alternans* b, *C. australis*, *C. cloacalis*, *C. duplex*, *C. nepeanensis*, *C. occidentalis*, *C. oppositus*, *C. tepperi*, *C. zealandicus* Type I, *C. zealandicus* Type II [=*C.* .species a]

Levitan, M. 1958. Non-random associations of inversions. *Cold Spring Harbor Symposia on Quantitative Biology* **23**: 251-268.
Reviews the data of Beermann (1955a, b) and Acton (1957a, b) which indicate the existence of non-random associations between inversions on the same chromosome, or between an inversion and the male determining gene. (Partim)

Specialised subjects: Inversions - non-random associations
Species: *Chironomus annularius*, *C. dorsalis* [=*C. luridus*], *C. tentans*

Lewis, K.R. & John, B. 1968. The chromosomal basis of sex determination. *International Review of Cytology* **23**: 277-379.
In the course of an extensive review of sex determination, the sex linked inversions and the multiple chromosomes which may carry sex determining genes of *Chironomus* species are dealt with. (Partim)

Specialised subjects: Sex chromosomes - Y-chromosome evolution
Species: *Chironomus annularius*, *C. dorsalis* [=*C. luridus*], *C. plumosus*, *C. tentans*

Leydig, Fr. 1883. *Untersuchungen zur Anatomie und Histologie der Teire*. 174pp. Bonn.
Saw the cross striations of the polytene chromosomes of *Chironomus* but interpreted the striations as being restricted to the periphery of the thread cylinder without cutting through it or having connections through it. The cross striations are described as showing small indentations put together out of small sticks comparable to the elements of muscle disk. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Lezzi, M. 1961*a*. *Das Verhalten des Puff-Masters der Speicheldrüsen-chromosomen von* Chironomus *unter dem Einfluss von* Drosophila-*Einhalt*. Diplomarbeit, Eidgenössische Technische Hochschule, Zürich, Switzerland. 39pp.
Studied the development of the puffs of specific regions of the salivary gland chromosomes of *C. thummi* [=*C. riparius*] under normal and experimental (transplantation) conditions.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Lezzi, M. 1965. Die Wirkung von DNase auf isolierte Polytän-Chromosomen. *Experimental Cell Research* **39**: 289-292.
Isolated unfixed salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] were treated with DNase. The resulting breaks were in the interband regions, while RNase and protease do not cause breaks in these regions. Therefore concluded that there is continuous DNA in the chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Lezzi, M. 1966. Induktion eines Ecdyson-aktivierbaren Puff in isolierten Zellkernen von *Chironomus* durch KCl. *Experimental Cell Research* **43**: 571-577. (English summary)
KCl induces the same puff in isolated salivary gland nuclei of *C. tentans* and *C. thummi* [=*C. riparius*] as ecdysone does in glands of intact larvae. NaCl on the other hand induces puffs which normally disappear at high ecdysone titres. The findings support the hypothesis that ecdysone

regulates gene activities by changing ionic concentrations within the cell nucleus.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Lezzi, M. 1967*a*. RNS- und protein-synthese in Puffs isolierter Speicheldrüsen-chromosomen von *Chironomus*. *Chromosoma* **21**: 72-88. (English summary)
Isolated salivary gland chromosomes were able to synthesise both RNA and protein. Part of the protein appears to stem from the nucleoli. It is concluded that the puffs contain ribosomes.

Specialised subjects: Puffs - gene product
Species: *Chironomus tentans*

Lezzi, M. 1967*b*. Cytochemische Untersuchungen an Puffs isolierter Speicheldrüsen-Chromosomen von *Chironomus*. *Chromosoma* **21**: 89-108. (English summary)
Puffs and Balbiani rings contain a basic protein which differs from chromosomal histones but shows similarities with the basic structural protein of ribosomes. This is in agreement with the hypothesis that ribosomes participate in the build up of puffs.

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Lezzi, M. 1967*c*. Spezifische Aktivitätssteigerung eines Balbianiringes durch Mg^{2+} in isolierten Zellkernen von *Chironomus*. *Chromosoma* **21**: 109-122. (English summary)
Mg^{2+} induces enlargement of one Balbiani ring in isolated salivary gland nuclei of *C. tentans*, whereas Na^{+} or K^{+} do not. The enlargement appears to be due to increased RNA synthesis. A mechanism by which this may occur is suggested.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Lezzi, M. 1970*a*. Differential gene activation in isolated chromosomes. *International Review of Cytology* **29**: 127-168.
Reviews the techniques of isolation of polytene chromosomes from *Chironomus* salivary glands and the studies in which they have been used to answer questions relating to gene activity. The structure and chemical composition of the chromosomes is also briefly reviewed. There are no illustrations, but there are 203 references.

Specialised subjects: Polytene chromosomes - structure, gene activity
Species: *Chironomus dorsalis* [=*C. riparius*], *C. plumosus*, *C. tentans*, *C. thummi* [=*C. riparius*]

Lezzi, M. 1970*b*. Differentielle Geneaktivierung bei höheren Organismen. *Dreissigster Jahresbericht der Schweizerischen Gesellschaft für Vererbungsforschung, S.S.G. Archiv der Klaus-Stiftung für Vererbungs-forschung, Sozialanthropologie und Rassenhygiene* **45**: 13-20.
A brief review of gene activation based largely on his studies on puffs in *Chironomus tentans*.

Specialised subjects: Puffs - genetic control
Species: *Chironomus tentans*

Lezzi, M. 1974. In vitro effects of juvenile hormone on puffing in *Chironomus* salivary glands. *Molecular and Cellular Endocrinology* **1**: 189-208.
Investigated the effect of ecdysone and wounding on puff response to various concentrations of juvenile hormone in isolated salivary glands. The results suggest there is an antagonistic interaction of juvenile hormone and ecdysone with a cellular regulatory circuit involving cell membrane permeability changes.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Lezzi, M. 1975. Einfluss des Juvenilhormones auf die Genaktivierung von Polytänchromosomen. *Regulationsmechanismen der Genaktivität und Replikation bei Riesenchromosomen. Nachrichten der Akademie der Wissenschaften in Göttingen. Mathematisch-Physikalische Klasse*: 158-162.
Reviews studies of the effects of juvenile hormone and ecdysone on the salivary gland chromosomes of *Chironomus tentans*. Proposes models for the interaction of the hormones and metal ions on gene activity. Juvenile hormone exerts its effects by indirect regulation.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Lezzi, M. 1984. Heat-shock phenomena in *Chironomus tentans*. II. In vitro effects of heat and overheat on puffing and their reversal. *Chromosoma* **90**: 198-203.

The heat shock response of BR2 and the puff in region IV-5c was found to be similar in isolated glands to that noted *in vitro* (Lezzi *et al*. 1981). In injured glands a recovery process occurring under heat shock conditions was discovered. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Lezzi, M. & Frigg, M. 1971. Specific effects of juvenile hormone on chromosome function. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* **44**: 163-170.
Describes experiments to show the specific effects of juvenile hormones on particular puffs in the salivary gland chromosomes of *Chironomus tentans* and *C. thummi* [=*C. riparius*].

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Lezzi, M., Gatzka, F. & Meyer, B. 1984. Heat shock phenomena in *Chironomus tentans*. III. Quantitative autoradiographic studies on ^{3}H-uridine incorporation into Balbiani ring 2 and heat-shock puff IV-5C. *Chromosoma* **90**: 204-210.
When given a pulse of ^{3}H-uridine, the ability of BR2 and puff IV-5C to synthesise RNA was quantified. The labelling of the chromosomes paralleled closely the changes in their decondensation induced by heat, overheat and quenching except when inhibited by actinomycin D. Illustrated by autoradiographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Lezzi, M., Gatzka, F. & Robert-Nicoud, M. 1989. Developmental changes in the responsiveness to ecdysterone of chromosome region I-18C of *Chironomus tentans*. *Chromosoma* **98**: 23-32.
Formation of induced endogenous hybrid (IEH) with nascent RNA was used to measure transcriptional activity of region I-18C under oligopausic or subitaneous development, or following treatment with ecdysterone. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Lezzi, M. & Gilbert, L.I. 1969. Control of gene activities in the polytene chromosomes of *Chironomus tentans* by ecdysone and juvenile hormone. *Proceedings of the National Academy of Sciences* **64**: 493-503.
Demonstrates the effect of ecdysone on BR1 of *C. tentans* and that the effects of ecdysone and juvenile hormone on puffing are antagonistic. Illustrated by photographs and autoradiographs of chromosome IV and photographs of an inducible section of chromosome I.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Lezzi, M. & Gilbert, L.I. 1970. Differential effects of K^{+} and Na^{+} on specific bands of isolated polytene chromosomes of *Chironomus tentans*. *Journal of Cell Science* **6**: 615-627.
Since previous work (e.g. Kroeger 1963, 1966) had suggested that K^{+}/Na^{+} ratios in the nuclear sap were important in determining gene activities, studies were carried out on isolated chromosomes to determine whether these were direct or indirect effects. The results indicate differential effects of various cations, and combinations of cations on specific chromosome regions. It is suggested that the cations are affecting chromatin aggregation and histone dissociation.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Lezzi, M. & Gilbert, L.I. 1972. Hormonal control of gene activity in polytene chromosomes. *General and Comparative Endocrinology*, *Supplement* **3**: 159-167.
Review and provide new data on the role of ions and hormones on gene activation in *Chironomus* polytene chromosomes. Comparison is made between the puffing patterns of salivary gland and Malpighian tubule chromosomes during normal development. Correlations are drawn between the activity of BR1 and the appearance of an electrophoretically identifiable protein in the salivary secretion. Illustrated by graphs, photographs and autoradiographs.

Specialised subjects: Puffs - genetic control
Species: *Chironomus pallidivittatus*, *C. tentans*, *C. thummi* [=*C. riparius*]

Lezzi, M. & Kroeger, H. 1966. Aufnahme von ^{22}Na in die Zellkerne der Speicheldrüsen von

Chironomus thummi. *Zeitschrift für Naturforschung* **21b**: 274-277. (English summary)
The uptake curves of ^{22}Na from haemolymph into the salivary gland nuclei were related to the induction of puffs in the polytene chromosomes. (Partim)

Specialised subjects: Puffs - genetic control
Species: *Chironomus thummi* [=*C. riparius*]

Lezzi, M., Lutz, B. & Dorsch-Haesler, K. 1989. The ecdysterone-controlled chromosome region I-18C in *C. tentans*:from cytology to molecular biology. *Acta Biologica Debrecina Supplementum Oecologia Hungarica* **2**: 129-139.
Use *in situ* hybridisation of a primary antibody to nascent RNA to show diurnal changes in the activity of I-18C. Also used a clone of DNA from the I-18C region to identify the homologous region at IIId1 of *C. thummi* [=*C. riparius*]. Illustrated by photographs. [Partim]

Specialised subjects: Puffs - genetic controlSpecies:*Chironomus tentans*, *C. thummi* [=*C. riparius*]

Lezzi, M., Meyer, B. & Mähr, R. 1981. Heat shock phenomena in *Chironomus tentans*. I. In vivo effects of heat, overheat and quenching on salivary chromosome puffing. *Chromosoma* **83**: 327-339.
Incubation of fourth instar larvae of *C. tentans* at elevated temperatures leads to the appearance of 4-5 new puffs and the regression of previously present puffs, particularly the Balbiani rings. The pattern and timing of these heat shock phenomena were investigated. Illustrated by a drawn map of chromosome IV and graphs and photographs of the heat shock effects.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Lezzi, M., Meyer, B. & Wuhrmann, P. 1981. Stimulation of Balbiani ring genes expression: refractory and responsive phases during development. Abstracts of the 13th Annual Meeting of the Union of the Swiss Societies of Experimental Biology, Lausanne. *Experientia* **37**: 651.
Balbiani ring expansion can be enhanced up to 10-fold by stimulation of the secretory process. Without stimulation the size and activity of BR-genes is similar in fourth instar larvae of phase 4.5 and 5.5, following termination of diapause. However stimulation leads to enhancement at phase 5.5 but not at phase 4.5 or 5. This is interpreted as indicating that activation is a 2-step process with an initial preparatory step and a subsequent activation step.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Lezzi, M. & Richards, G. 1989. Salivary glands, pp.393-406. *In* Koolman, J. (ed.), Ecdysone. From Chemistry to Mode of Action. Thieme Medical Publishers, Inc., New York.
Review the nature of polytene chromosomes and the evidence for regulation of certain puffs, such as I-18c in *Chironomus tentans*, by ecdysone or 20-hydroxyecdysone. Also outline techniques for molecular investigation of such genes. Illustrated by photographs and diagrams.
(Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

Lezzi, M. & Robert, M. 1972. Chromosomes isolated from unfixed salivary glands of *Chironomus*. *Developmental studies on giant chromosomes*. *Results and Problems in Cell Differentiation* **4**: 35-37.
Review studies on isolated chromosomes, including the techniques for obtaining them. The inactive chromomeres are kept compact by histones. Ions are required to dissociate the histone bonds in an active site such as a Balbiani ring. The genes may react specifically to varying ionic concentrations in the nucleus. A model for the specific effects of ions in gene activation is given.

Specialised subjects: Techniques; Polytene chromosomes - isolation; Puffs - Balbiani rings, gene activity
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Lindeberg, B. 1967. Sibling species delimitation in the *Tanytarsus lestagei* aggregate (Diptera, Chironomidae). *Annales Zoologici Fennici* **4**: 45-86.
In the discussion of a paper concerning morphological differences between species, the possibility of morphological differences existing between the *Chironomus* species which are presently differentiated on a cytological basis is considered. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* spp., *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Linevich, A.A., Aleksandrov, V.N., Proviz, V.I. & Proviz, L.I. 1984. Karyotype and larval morphology of *Sergentia nebulosa* sp. n. (Diptera, Chironomidae) from Baikal Lake, pp.132-140. *In* Linevich, A.A. (ed.), *Systematiks and evolution of invertebrates from Baikal*. 160pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
This article has not been seen but it describes, and probably illustrates, the polytene chromosomes of *S. nebulosa,* a member of the *S. longiventris*-group. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Sergentia nebulosa*

Linevich, A.A. & Proviz, V.I. 1987. *Chironomus plumosus* L. in Baikal Lake and Baikal district, pp.129-134. *In* Narchuk, E.P. (ed.), *Diptera and their importance for animal husbandry and agriculture*. Akademiya Nauk, S.S.S.R., Zoologicheski Institut, Leningrad, 158pp. (In Russian)
This article has not been seen but, based on other papers by Proviz (1984, 1985, 1987) it will refer to *C. plumosus* and *C. agilis*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus agilis, C. plumosus*

Lloyd, J.R. 1986. *Genes and chromosomes*. Dimensions of Science, Macmillan Educators, Houndsmill, United Kingdom. ix+109pp.
Includes photographs of chromosome IV of *Chironomus tentans* showing the incorporation of radioactive uridine and its inhibition by actinomycin D. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Löbsack, T. 1969. Aktive Erbanlagen in Riesenchromosomen. In Speicheldrüsen-Chromosomen kann man die Tätigkeit der gene "sehen". *Mikrokosmos* **58**: 65-68.
Describes the structure of polytene chromosomes in relation to the nature of the gene, providing examples of puffs as sites of gene activity. Illustrated by figures from other publications, photographs of what appears to be *Chironomus thummi,* and an autoradiograph of *C. tentans*.

Specialised subjects: Polytene chromosomes - structure; Puffs - structure, developmental sequence
Species: *Chironomus thummi* [=*C. riparius*], *C. tentans*

Lönn, U. 1977. Direct association of Balbiani ring 75S RNA with membranes of the cytoplasmic reticulum. *Nature* **270**: 630-631.
RNA stripped from the microsomal membranes of the salivary glands was shown by *in situ* hybridisation to be complementary to the DNA of the Balbiani rings. Illustrated by an autoradiograph. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Lönn, U. 1980*a*. Isolation and partial characterization of replication intermediates in *Chironomus* polytene chromosomes. *Chromosoma* **77**: 29-40.
From the nature of DNA fragments obtained from polytene chromosomes it is suggested that the chromosomal bands contain sufficient DNA to act as the template for the replication unit. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Lönn, U. 1980*b*. Similar size of the replicons in *Chironomus* polytene chromosomes at two developmental stages. *Journal of Cell Science* **46**: 387-397.
The size of the DNA replication units was investigated at two larval stages which differed in the degree of polytenisation of the salivary gland chromosomes and in the intensity of DNA replication. However there appeared to be little or no difference in the size of the active replication units.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Lönn, U. 1981. Double stranded DNA with the size expected of replicons can be released from *Chironomus* polytene chromosomes. *Chromosoma* **81**: 641-653.
Based on the results of the DNA analyses, it is suggested that there can be an average of 5-7.5 DNA replication units per average polytene chromosome band in *C. tentans*. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Lönn, U. 1982. DNA replication in polytene chromosomes. *Topics in Biochemical Sciences* **7**: 24-26.
Reviews the distribution and structure of polytene chromosomes, then looks at the evidence for a relationship between bands and replication units. Concludes that this relationship is very complex and that there is no positive evidence that replication units depend upon the structure of the polytene chromosome.

Specialised subjects: Polytene chromosomes - structure, DNA replication
Species: *Chironomus* species

Lutz, B. 1989. *Studies on the heat shock response of a gene from the early ecdysterone-inducible puff site I-18C of* Chironomus tentans. Doctor of Natural Sciences Thesis, Swiss Federal Institute of Technology, Zürich.
Region I-18C of the salivary gland chromosomes forms puff after ecdysterone induction. Therefore a gene from this region was cloned and characterised in order to elucidate the regulation and function of this puff site. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus tentans*

MacInnes, J.W. & Uretz, R.B. 1966*a*. Temperature dependence of fluorescene polarization in acridine-orange stained polytene chromosomes from *Chironomus thummi*. *Abstracts of the Sixth Annual Meeting of the American Society for Cell Biology*. *Journal of Cell Biology* **31**: 72.
When stretched polytene chromosomes are heated they lose polarisation in a manner reminiscent of denaturation, except that the temperatures for half-loss of polarisation ($T_{R/2}$) are about 20°C lower than would be expected for the melting temperatures. The $T_{R/2}$ is sensitive to trypsin treatment, changing from 78°C to 61°C following treatment. The Balbiani rings have a $T_{R/2}$ of 65.6°C without treatment. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

MacInnes, J.W. & Uretz, R.B. 1966*b*. Spectral analysis of the binding of acridine orange to polytene chromosomes. *Proceedings of the National Academy of Sciences* **55**: 1109-1113.
Results indicate that the normally accepted view, that native DNA fluoresces green when stained with acridine orange while a red fluorescence indicates either RNA or denatured DNA, is not correct. Native DNA will also fluoresce red unless certain sites are blocked by some agent. Nuclear protein or addition of RNase reduce red staining by the same amount but apparently do not block the same sites. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

MacInnes, J.W. & Uretz, R.B. 1967*a*. Thermal depolarization of fluorescence from polytene chromosomes stained with acridine orange. *Journal of Cell Biology* **33**: 597-604.
An expanded version of the abstract in MacInnes & Uretz (1966*a*). In addition it is noted that the half-temperature is reduced as histone is removed from the chromosome. The GC content of the DNA was found to affect the bonding relationships to acridine orange. Illustrated by graphs and photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Mähr, R. 1978. *Massenisolationsmethode für Speicheldrüsen und polytaene Speicheldrüsenkerne von* Chironomus; *Transkription der speicheldrüsen-kerne "In Vitro"*. Dissertation, Eidgenössische Technische Hochschule, Zürich, Switzerland. 88pp.
Outlines the techniques published by Mähr, Lezzi & Eppenberger (1976, 1977). (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure, Puffs - RNA synthesis
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Mähr, R., Lezzi, M. & Eppenberger, H.M. 1976. A new method for the isolation of polytene *Chironomus* salivary gland nuclei. *Abstracts of the 8th Annual Meeting of the Union of Swiss Societies of Experimental Biology, Fribourg*. *Experientia* **32**: 803.

Note that chromosomes prepared by this technique show normal morphology, response to the ionic milieu, and transcription. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure, Puffs - RNA synthesis
Species: *Chironomus* spp. [=*C. tentans* & *C. thummi*]

Mähr, R., Lezzi, M. & Eppenberger, H.M. 1977. Mass isolation of polytene nuclei from *Chironomus* salivary glands. *Journal of Cell Science* **27**: 1-12.
Describe a technique for rapid mass isolation of polytene nuclei from salivary glands. The chromosomes show an unchanged morphology and normal patterns of transcription. Illustrated by photographs and autoradiographs of chromosomes following preparation by this method. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure, Puffs - RNA synthesis
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Mähr, R., Meyer, B., Daneholt, B. & Eppenberger, H.M. 1980. Activation of Balbiani ring genes in *Chironomus tentans* after a pilocarpine-induced depletion of the secretory products from the salivary gland lumen. *Developmental Biology* **80**: 409-418.
The Balbiani rings of *C. tentans* were considerably expanded following treatment of the larvae with pilocarpine and production of the corresponding 75 S RNA was increased. It is suggested that pilocarpine does not affect the Balbiani rings themselves but that the regulation is a physiological response to the emptying of the gland. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Mainx, F. 1949. The structure of the giant chromosomes in some Diptera. *Proceedings of the VIII International Congress of Genetics*, *Hereditas (Supplement)*: 622-623. (Abstract)
Salivary gland polytene chromosomes in different families of Diptera fall into three principal types. Those of Chironomidae fall into the first type in which the chromosomes are paired, recognisable by their individual structure and represent the haploid number, with or without a chromocentre. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: Chironomidae spp.

Mainx, F. 1954. Wirkung und Verteilung von Inversionen in natürlichen Populationen verschiedener Diptera. *Proceedings of the 9th International Congress of Genetics* (*Caryologia* **6**, *Supplement*) **2**: 756-757. (Abstract)
Summary of the significance of inversion polymorphism in *Chironomus dorsalis* [=*C. luridus*] as presented by Mainx et al (1953). (Partim)

Specialised subjects: Inversions - polymorphy
Species: *Chironomus dorsalis* [=*C. luridus*]

Mainx, F. 1955. Die Bedeutung der chromosomalen Struktur für das Evolutionsgeschehen in natürlichen Populationen. *Zoologischer Anzeiger*, Supplement **18**, *Verhandlungen der deutsche Zoologischen Gesellschaft* **1954**: 280-281.
Includes data on chromosomal polymorphisms in *Chironomus dorsalis* [=*C. luridus*] and *C. tentans*. (Partim).

Specialised subjects: Inversions - polymorphy
Species: *Chironomus dorsalis* [=*C. luridus*], *C. tentans*

Mainx, F. 1956. Der chromosomale Strukturpolymorphismus naturlicher Populationen als Problem der Genetik und der Evolution. *Instituto Gregorio Mendel*, *Roma*, *Mendel-Festschrift* (*1955*). *Novant 'anni delle Leggi Mendeliane*, *Roma*: 425-453.
Reviews chromosomal polymorphism, particularly paracentric inversions in Diptera. Lists inversions as being either common and widespread, or few and rare in 19 species of Chironomidae. (Partim).

Specialised subjects: Chromosomal polymorphisms: Inversions - geographical distribution
Species: *Chironomus annularius*, *C. dorsalis* [=*C. luridus*], *C. halophilus* gp. [=*C. aprilinus* gp.], *C. pallidivittatus*, *C. riparius*, *C. tentans, C.* species, *Cryptochironomus defectus*, *Endochironomus* sp. I, *Eucricotopus* [=*Cricotopus*] *trifasciatus, Glyptotendipes polytomus* [=*G. barbipes*], *Lauterbornia* species, *Microtendipes pedellus*, *Prodiamesa olivacea*, *Rheorthocladius* [=*Orthocladius*] *frigidus, Sergentia coracina*, *S. longiventris*,

Stictochironomus histrio [=*S. stictus*], *S. rosenscholdi*,

Mainx, F., Kunze, E. & Koske, T. 1953. Cytologische Untersuchungen an Lunzer Chironomiden. *Osterreichische zoologische Zeitschrift* **4**: 33-44.
General features of the polytene chromosomes are given for 9 species occurring in Lunz. More detailed information on the karyotype and inversion frequencies are given for *Chironomus dorsalis* [=*C. luridus*].

Specialised subjects: Karyotype - polytene chromosomes
Species: *Chironomus alpestris* [=*C. dorsalis*], *C. dorsalis* [=*C. luridus*], *C. halophilus* gp. [=*C. aprilinus* gp.], *C. thummi* [=*C. riparius*], *Eucricotopus trifasciatus*, *Lauterbornia* species, *Prodiamesa olivacea*, *Sergentia coracina*, *S. longiventris*

Makarchenko, E.A., Kiknadze, I.I. & Kerkis, J.E. 1988. Morpho-karyological description of *Euryhapsis subviridis* (Siebert) from the south of the Soviet far east. *Spixiana Supplement* **14**: 129-137.
Describes the mitotic and polytene chromosome complements of *E. subviridis* (2n=6). The polytene chromosomes are of good quality with higher levels of polyteny the further they lie from the centre of the glands. Photographic chromosome maps are provided and three paracentric inversions illustrated. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Euryhapsis subviridis*

Mala, J. 1970*a*. Kotazce zdurelin na polytennich chromosomech a genova aktivita v postembryonalnim vyvoji honyzu. *Ceskoslovenska Fysiologie* **19**: 317-322. (In Cseckoslovakian)
A review of studies of puffing and the factors which can affect it during postembryonic development. No illustrations.

Specialised subjects: Puffs - gene activity
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*], *Glyptotendipes* species

Marinozzi, V. & Bernhard, W. 1963. Presence dans le nucléole de deux types de ribonucléoprotéines morphologiquement distinctes. *Experimental Cell Research* **32**: 595-598.
Electron microscope observation of the nucleolus following pepsin digestion reveals granules and fibrils, indicating the presence of two types of ribonucleoprotein. It is possible the granules are a metabolic intermediate in the processing of the fibrils. Illustrated by electron micrographs.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus* species

Martin, J. 1961. *Chromosomal polymorphism in Victorian chironomids*. M.Sc. thesis, University of Melbourne, Melbourne, Australia. 224pp.
Preliminary chromosome maps or photographs of the polytene chromosomes are provided for 9 species of Chironomini from three different genera. A number of species, which are considered identical on morphological grounds, were recognised on the basis of their cytology. Inversion polymorphism was reported for 7 of the species studied, while *Chironomus tepperi* was polymorphic for a puff (subsequently shown to be a nucleolus) on chromosome 4. A more detailed analysis was made of the polymorphism of *C.* [=*Kiefferulus*] *intertinctus*. A review of the literature on chromosomal polymorphism is included. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes; Inversions - polymorphy
Species: *Chironomus alternans* A [=*C. alternans* a], *C. alternans* B [=*C. oppositus*], *C. alternans* C [=*C. cloacalis*], *C. australis, C. conjunctus* A [=*Kiefferulus martini*], *C.* [=*Dicrotendipes*] *conjunctus, C.* [=*Kiefferulus*] *intertinctus, C. intertinctus* B [=*K. paratinctus*], *C. tepperi, Polypedilum nubifer*

Martin, J. 1962*a*. Inversion polymorphism in an antarctic species living in a simple environment. *American Naturalist* **96**: 317-318.
Records the presence of two inversions in a population of *Belgica antarctica* on the Palmer Peninsular, Antarctica. The diploid somatic chromosome number was established to be 2n=6.

Specialised subjects: Karyotype - polytene chromosomes; Inversions - natural selection
Species: *Belgica antarctica*

Martin, J. 1962*b*. Interrelation of inversion systems in the midge *Chironomus intertinctus* (Diptera: Nematocera). I. A sex-linked inversion.

Australian Journal of Biological Sciences **15**: 666-673.
The Corio inversion on chromosome III of *C.* [=*Kiefferulus*] *intertinctus* was assumed to be closely linked to the sex determining region since it showed markedly different frequencies in males and females. This is interpreted to be the result of different selective values for the sequences in the different sexes. A scheme for the evolution of morphologically recognisable sex chromosomes is presented.

Specialised subjects: Inversions - sex linked
Species: *Chironomus* [=*Kiefferulus*] *intertinctus*

Martin, J. 1963. The cytology and larval morphology of the Victorian representatives of the subgenus *Kiefferulus* of the genus *Chironomus* (Diptera: Nematocera). *Australian Journal of Zoology* **11**: 301-322.
The polytene chromosomes are mapped and inversion polymorphisms described in three species of *Kiefferulus* which are recognisable from larval morphology, although two have essentially identical adults. The species referred to as "Botanic Gardens sp." was subsequently described as *Kiefferulus paratinctus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* [=*Kiefferulus*] *intertinctus*, *C.* [=*Kiefferulus*] *martini, C.* Botanic Gardens sp. [=*Kiefferulus paratinctus*]

Martin, J. 1965. Interrelation of inversion systems in the midge *Chironomus intertinctus* (Diptera: Nematocera). II. A nonrandom association of linked inversions. *Genetics* **52**: 371-383.
The linked Lonsdale and Barwon inversions on chromosome II of *C.* [=*Kiefferulus*] *intertinctus* are significantly correlated in several populations from southern Australia. The coupling combinations and the double heterozygotes occur in excess, while the repulsion combinations are deficient. A third, overlapping, sequence participates in this association in more northern populations.

Specialised subjects: Inversions - non-random associations
Species:*Chironomus* [=*Kiefferulus*] *intertinctus*

Martin, J. 1966*a*. *Population genetics of chironomids: cytogenetics and cytotaxonomy in the genus* Chironomus. Ph.D. thesis, University of Melbourne, Melbourne, Australia. 449pp.
The cytology of nine members of the genus *Chironomus*, including one from New Zealand, and of three members of the genus *Kiefferulus* (here considered a subgenus of *Chironomus*) are described and the phylogenic relationships between the chromosome banding patterns established. Three new species are described, of which the descriptions of *C. februarius* and *C.. pseudoppositus* have not been repeated elsewhere. A detailed analysis of the chromosomal polymorphism of *C. oppositus* and *K. intertinctus* are reported, noting the occurrence of non-random associations between inversions and of partial sex linkage in the Corio inversion of *K. intertinctus*. Meiosis of the various species was also studied. (Partim)

Specialised subjects: Spec.subj:Cytotaxonomy - polytene chromosomes; Inversions - polymorphy; Meiosis
Species: *Chironomus alternans* IV [=*C. nepeanensis*], *C. australis, C. cloacalis, C. februarius* [=*C. alternans* a], *C. occidentalis* [=*C. duplex*], *C. oppositus, C. pseudoppositus* [=*C. alternans* b], *C. tepperi, C. zealandicus* [=*C.* species a], *Kiefferulus intertinctus*, *K. martini, K. paratinctus,*

Martin, J. 1966*b*. Female heterogamety in *Polypedilum nubifer* (Diptera: Nematocera). *American Naturalist* **100**: 157-159.
Polypedilum nubifer is assumed to be female heterogametic since the end of chromosome IV shows a heterozygous heterochromatic tip in females, while males normally show no heterochromatin. Some males show slight development of heterochromatin but never to the extent seen in females. The extensive heterochromatin is assumed to be a marker for a female determining gene.

Specialised subjects: Sex chromosomes - female heterogamety
Species: *Polypedilum nubifer*

Martin, J. 1967*a*. Meiosis in inversion heterozygotes in Chironomidae. *Canadian Journal of Genetics and Cytology* **9**: 255-268.
Describes meiosis in 12 Australian and 10 North American species of Chironomini, with emphasis on the pairing and separation of homologues heterozygous for inversions. Non homologous pairing of the inverted region is shown to be an important factor in prevention of the formation of inviable gametes. The formation of heterozygous loops and of non-homologous pairing is illustrated in pachytene and diakinesis.

Specialised subjects: Inversions - male meiosis

Species: *Chironomus* ?*alternans* [=*C.nepeanensis*], *C.* [=*Einfeldia*] *brunneipennis, C. cloacalis*, *C. conjunctus* Type I [=*Dicrotendipes conjunctus*], *C. conjunctus* Type II [=*Dicrotendipes blandellus*], *C.* [=*Cladopelma*] *curtivalva, Chironomus* ?*decumbens*, *C.* [=*Kiefferulus*] *dux*, *C. februarius* [=*C. alternans* a], *C.* [=*Kiefferulus*] *intertinctus, C.* [=*Tribelos*] ?*jucundum, C.* [=*Kiefferulus*] *martini, C. occidentalis* [=*C. duplex*], *C. oppositus*, *C.* [=*Kiefferulus*] *paratinctus, C. staegeri*, *C. tentans*, *C.* species, *Glyptotendipes barbipes*, *G. :*?*testaceous*, *Polypedilum nubifer*, *Pseudochironomus richardsoni*

Martin, J. 1967*b*. Non-random association of unlinked inversions in *Chironomus* (*Chironomus*) *oppositus*. *Abstracts of the Twelfth Annual Meeting of the Genetics Society of Canada*. *Canadian Journal of Genetics and Cytology* **9**: 661.
An abstract report of the non-random associations of the inversion of *Chironomus oppositus*, which subsequently proved to be due to the presence of a number of races with at least partial reproductive isolation (Martin, Lee & Connor 1978).

Specialised subjects: Inversions - non-random associations
Species: *Chironomus oppositus*

Martin, J. 1969*a*. On the origin of inversion polymorphism. *American Naturalist* **103**: 267-275.
Data on inversions from Chironomidae and Culicidae were compared to those presented by Van Valen & Levins (1968) for a number of insect groups, including a much smaller sample of Chironomidae. The results indicate that inversions in Chironomidae tend to be about the same mean length as those of *Drosophila*, with a smaller spread about this mean, while having a higher mean length but similar spread to the Simuliidae. The results are still in agreement with the hypothesis that inversion length is determined by a balance between the effects of epistasis and double crossing over.

Specialised subjects: General Dipteran Cytogenetics; Inversions - length distribution
Species: *Chironomus acidophilus*, *C. anthracinus*, *C.* .sp.nr. *attenuatus* [=*C. maturus*], *C. cingulatus*, *C. cloacalis*, *C. februarius* [=*C. alternans* a], *C. halophilus* [=*C. aprilinus*], *C. holomelas*, *C. nepeanensis*, *C. nuditarsis*, *C. obtusidens*, *C. occidentalis* [=*C. duplex*], *C. oppositus*, *C. pseudoppositus* [=*C. alternans* b], *C. pseudothummi*, *C. rempeli, C.* sp.nr. *riparius* (i), *C.* sp.nr. *riparius* (ii), *C. tentans* [=*C. decorus* gp.], *C. zealandicus* [=*C.* species a], *Chaetolabis* [=*Chironomus*] sp.nr *atroviridis, Kiefferulus martini*, *Cryptochironomus* species, *Glyptotendipes testaceous*, *Riethia stictoptera*

Martin, J. 1969*b*. The salivary gland chromosomes *Chironomus oppositus* Walker (Diptera: Nematocera). *Australian Journal of Zoology* **17**: 473-486.
A hand-drawn standard map of the polytene chromosomes is provided and the extensive inversion polymorphism in the species described, with photographs of the heterozygotes. The chromosome arm combination is AE, BF, CD, G, corresponding to the pseudothummi-grouping of Keyl (1962), but an independent origin is possible.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus oppositus*

Martin, J. 1971*a*. A review of the genus *Chironomus* (Diptera, Chironomidae). II. Added descriptions of *Chironomus cloacalis* Atchley and Martin from Australia. *Studies in Natural Sciences* (*Portales, New Mexico*) **1**(2): 1-21.
As part of a full morphological description, the salivary gland chromosomes are briefly described and a photomap provided.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus cloacalis*

Martin, J. 1971*b*. A review of the genus *Chironomus* (Diptera, Chironomidae). IV. The karyosystematics of the *australis* group in Australia. *Chromosoma* **35**: 418-430.
Description of the salivary gland chromosomes of *C. australis* (2n=8) and *C. duplex* (2n=6) and determination of the phylogenetic relationships of these species and *C. oppositus*. The name *C. duplex* is resurrected from synonymy. Includes photographs of all chromosome arms of both species.

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus australis*, *C. duplex, C. oppositus*

Martin, J. 1973. Biometrical effects of the inversion polymorphism of *Kiefferulus intertinctus* (Skuse). *Australian Journal of Biological Sciences* **26**: 1371-1377.
A correlation is shown between the Lonsdale, Barwon and Corio inversions of *K. intertinctus* and the length of the larval bloodgills. This effect is related to the non-random associations which occur between these inversions (Martin 1962*b*, 1963, 1965).

Specialised subjects: Inversions - non-random associations, adaptive effects
Species: *Kiefferulus intertinctus*

Martin, J. 1974*a*. A review of the genus *Chironomus* (Diptera, Chironomidae). IX. The cytology of *Chironomus tepperi* Skuse. *Chromosoma* **45**: 91-98.
The salivary gland chromosomes of *C. tepperi* are describe and photographically mapped. Despite considerable morphological modification of the male terminalia, the species is shown to be closely related to other Australian species. No inversion polymorphism occurs but there is polymorphism for a "puff" (actually a nucleolus, see Eigenbrod 1978). Meiosis is briefly described.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus tepperi*,

Martin, J. 1974*b*. Should chromosome maps of Chironomidae be standardised in form and subject to a rule of priority? *Chironomus* (Newsletter of Chironomid Research) **1**: 117-118.
Calls for workers to recognise the maps published by earlier workers and for a rule of priority for published maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus oppositus*, *C. thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Martin, J. 1979. Chromosomes as tools in taxonomy and phylogeny of Chironomidae (Diptera). *Entomologica Scandinavica Supplement* **10**: 67-74.
Reviews the use of polytene chromosomes to determine species limits and the phylogenetic relationships of chironomids. Gives examples, illustrates salivary gland and Malpighian tubule chromosomes and provides the phylogeny for the arm F sequences of 52 species of *Chironomus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus*, *C. acidophilus, C. acidophilus, C. annularius, C. anthracinus, C. australis, C. bernensis, C. cingulatus, C. cloacalis, C. commutatus, C. crassicaudatus, C. decorus* gp.(R&F), *C. decorus* gp.(B), *C. dorsalis, C. duplex, C. februarius* [=*C. alternans* a], *C. frommeri, C. halophilus* [=*C. aprilinus*], *C. holomelas, C. lacunarius, C. luridus, C. maturus, C. melanescens, C. melanotus, C. neglectus* [=*C. jonmartini*], *C. nuditarsis, C. obtusidens, C. oppositus, C. pallidivittatus, C. parathummi, C. piger, C. plumosus, C. pseudothummi, C. riparius, C. sororius, C. staegeri, C. stigmaterus, C. tentans, C. tepperi, C. transvaalensis, C. uliginosus, C. utahensis, C. whitseli, C. yoshimatsui, C.* species a [=*C. decorus* gp.(sp. a)], *C.* species 3a [=*C. decorus* gp.(sp. 3a)], *C.* species 2q [=*C. major*], *C.* species 2r, *C.* species 9, *Cricotopus* spp. [=*C. ornatus*, *C. sylvestris*, *C.* [=*Halocladius*] *varians* , *C.* [=*Halocladius*] *vitripennis*], *Cryptochironomus defectus*, *Glyptotendipes* spp. [=*G. barbipes*, *G. glaucus*, *G. gripekoveni*, *G. lobiferus*, *G. pallens*, & *G. paripes*,], *Kiefferulus* spp. [=*K. intertinctus, K. martini,* & *K. paratinctus,*], *Paraclunio* spp. [=*P. pacificus,* & *P. trilobatus,*], *Sergentia* spp. [=*S. coracina,* & *S. longiventris,*], *hirtus*, *Telmatogeton* spp. [=*T. abnormis, T. fluviatilis, T. hirtus, T. japonicus, T. pacificus,* & *T. torrenticola,*]

Martin, J. 1981. Location of a sex determining region in *Chironomus tepperi* Skuse (Diptera: Chironomidae) using irradiation-induced chromosomal rearrangements. *Genetica* **57**: 113-117.
Irradiation-induced rearrangements were use to locate the sex determining gene(s) of *Chironomus tepperi* to the proximal region of arm A.

Specialised subjects: Techniques; Sex chromosomes - Y-chromosome evolution
Species: *Chironomus tepperi*

Martin, J. 1989. Inversion polymorphism in Chironomidae. *Abstracts of the Second Congress of the European Society for Evolutionary Biology, Roma*: 42.

Discusses the problem of determining whether inversions with similar breakpoints, occurring in species which are not closely related, are actually identical and whether they are identical by descent or of independent origin. Notes that availability of appropriate molecular probes may help resolve at least the first part of this problem.

Specialised subjects: Inversions - break point coincidence
Species: *Chironomus* spp.

Martin, J., Kuvangkadilok, C., Peart, D.H. & Lee, B.T.O. 1980. Multiple sex determining regions in a group of related *Chironomus* species (Diptera: Chironomidae). *Heredity* **44**: 367-382.
The sex determining region in a group of related Australian *Chironomus* species was found at a minimum of five different chromosomal locations, with variation within and between species. Published data for other species is also compatible with these five locations. The site of the sex determiner commonly changes between species and the significance of such changes is discussed.

Specialised subjects: Sex chromosomes - Y-chromosome evolution
Species: *Chironomus annularius*, *C. australis, C. bernensis, C. crassicaudatus, C. duplex, C. luridus, C. nuditarsis, C. obtusidens, C. occidentalis, C. oppositus, C. pallidivittatus, C. plumosus, C. rempeli, C. stigmaterus, C. tentans*

Martin, J. & Lee, B.T.O. 1981. Problems in speciation of *Chironomus oppositus* in southeastern Australia, 241-261. *In* Atchley, W.R. & Woodruff, D.S. (eds.), *Evolution and speciation: essays in honor of M.J.D. White*, 436pp. Cambridge University Press.
The distribution, polymorphism and occurrence of natural hybrids in three forms of *Chironomus oppositus* were investigated in Tasmania and Victoria, Australia. The results indicate that while the forms are broadly sympatric in distribution, they differ in microdistribution of larvae, seasonality and mating behaviour.

Specialised subjects: Incipient species
Species: *Chironomus oppositus*

Martin, J. & Lee, B.T.O. 1984a. A phylogenetic study of sex determiner location in a group of Australasian *Chironomus* species (Diptera, Chironomidae). *Chromosoma* **90**: 190-197.
The location of the male determining gene(s) (MD) in a group of related species belonging to the pseudothummi-complex was investigated in relation to the phylogeny of the group. The most common location for the MD is near the centromere of the CD chromosome, as opposed to the members of the thummi-complex in Europe and North America where it is most commonly in arm F. The occurrence of a possible polymorphism for MD location in *Chironomus oppositus* f. *whitei* is noted and the possible nature of the sex determiner system is discussed.

Specialised subjects: Sex chromosomes - Y-chromosome evolution, :functional transposition
Species: *Chironomus alternans* a, *C. alternans* b, *C. alternans* c, *C. australis, C. cloacalis, C. duplex, C. nepeanensis, C. occidentalis, C. oppositus* f. *connori, C. oppositus* f. *oppositus, C. oppositus* f. *tyleri, C. oppositus* f. *whitei, C. tepperi, C. zealandicus, C.* species a

Martin, J. & Lee, B.T.O. 1984b. Are there female heterogametic strains of *Chironomus tentans* Fabricius? *Canadian Journal of Genetics and Cytology* **26**: 743-747.
Laboratory crosses were used to re-examine the populations from eastern Canada and U.S.A., for which female heterogamety has been claimed (Thompson 1971, Thompson & Bowen 1972). The results indicate the existence of male heterogamety, and a re-evaluation of the results presented by Thompson (1971) and Thompson & Bowen (1972) reveals no conclusive evidence of female heterogamety. Instead it appears likely that the interpretation of the results was confused by the presence of lethal alleles linked to certain inversion sequences used as markers for the transmission of chromosome arms.

Specialised subjects: Sex chromosomes - female heterogamety
Species: *Chironomus tentans*

Martin, J. & Lee, B.T.O. 1988a. Sex determination and speciation in the genus *Chironomus*. *Pacific Science* **42**: 51-55.
Consider the variation in the location of the male determining loci found in a related group of Australian *Chironomus* species and suggest that changes in the location of the functional sex determiner may play a role in speciation of this group, and others in which similar variable sex determiners have been reported.

Specialised subjects: Speciation - origins of isolation

Species: *Chironomus australis, C. duplex*, *C. oppositus*, *C. tentans*, *C.* species [=*C. occidentalis*]

Martin, J. & Lee, B.T.O. 1988b. The chromosomal location of the malate dehydrogenase and the phosphoglucomutase loci in *Chironomus* and their relationship with a sex determining region. *Genetics* (*Life Science Advances*) **7**: 57-63.
The general chromosomal location of the malate dehydrogenase (Mal-1) and phosphoglucomutase (Pgm) loci were mapped by correlating the inheritance of particular alleles and chromosome sequences. The results confirmed that both loci were near the centromere of the CD chromosome, as previously reported by Rothen (1978). Crosses with *C. tentans* indicated that the Mdh-1 locus was actually on arm C, since it segregated in a sex-linked fashion in this stock in which the sex determiner is on arm C. The technique was not informative for the Pgm locus as it was invariant in the stock used. (Partim)

Specialised subjects: Linkage Group - Chromosome Correlation, polytene chromosomes
Species: *Chironomus alternans* c, *C. oppositus*, *C. tentans*, *C.* species a

Martin, J. & Lee, B.T.O. 1989a. Indirect evidence for multiple insemination in *Chironomus oppositus* Walker (Diptera, Chironomidae). *Journal of the Australian Entomological Society* **28**: 77-80.
Note that electrophoretic polymorphism is more sensitive than inversion polymorphism for determining whether the female which laid an egg mass had mated more than once.

Specialised subjects: Inversions - polymorphy
Species: *Chironomus oppositus*

Martin, J. & Lee, B.T.O. 1989b. Multiple sex determiner sites in *Chironomus oppositus* - polymorphism or cryptic species? *Abstracts of the Second Congress of the European Society for Evolutionary Biology, Roma*: 42.
In the form *whitei* of *C. oppositus* there are four different cytological sex determiner locations. Studies are aimed at clarifying whether these are an intraspecific polymorphism or indicative of the presence of further cryptic species in this complex.

Specialised subjects: Sex chromosomes - Y-chromosome evolutionSpecies: *Chironomus oppositus*

Martin, J., Lee, B.T.O. & Connor, E. 1978. Apparent incipient speciation in the midge *Chironomus oppositus* Walker (Diptera: Chironomidae). *Australian Journal of Zoology* **26**: 323-329.
Certain populations of *C. oppositus* from Tasmania showed unusual patterns of inversion heterozygosity which were interpreted to indicate that two, at least partially isolated, forms were present. Since the inversion sequences present were different to those found in mainland populations it was concluded the *C. oppositus* is composed of three forms which may be in the process of speciating.

Specialised subjects: Incipient species
Species: *Chironomus oppositus*

Martin, J. & Porter, D.L. 1973. The salivary gland chromosomes of *Glyptotendipes barbipes* (Staeger) (Diptera, Chironomidae): Description of inversions and comparison of Nearctic and Palaearctic Karyotypes. *Studies in Natural Sciences* (*Portales, New Mexico*) **1**(7): 1-25.
The limits of all previously known inversions and of ten new sequences are described. The Nearctic and Palaearctic karyotypes are compared and it is concluded that despite separation for at least 130,000 years, relatively little differentiation has occurred. A photographic map and photographs of the heterozgotes are included.

Specialised subjects: Inversions - geographical distribution
Species: *Glyptotendipes barbipes*

Martin, J. & Sublette, J.E. 1972. A review of the genus *Chironomus* (Diptera, Chironomidae). III. *Chironomus yoshimatsui*, new species from Japan. *Studies in Natural Sciences* (*Portales, New Mexico*) **1**(3): 1-59.
Material referred to as *C. dorsalis* from Japan was found to differ cytologically from European specimens. The Japanese material was described as a new species, *C. yoshimatsui*. A photographic chromosome map is provided and the phylogenetic relationships with Palaearctic species are given. Meiosis is briefly described. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus dorsalis*, *C. holomelas*, *C. luridus*, *C. thummi piger* [=*C. piger*], *C. yoshimatsui*

Martin, J., Sublette, J.E. & Sublette, M. 1979. Part III. Karyosystematics of selected Chironomidae of New Mexico. *Technical*

Completion Report, New Mexico Energy Institute **32**: 109-133.
Photographic maps are provided and the inversion polymorphisms recorded for ten species of Chironominae from New Mexico. Karyotypes of three *Chironomus* species are referred to the basic map of Keyl (1962). Provides the first cytological descriptions for the genera *Dicrotendipes*, *Phaenopsectra*, and *Tanytarsus*. Five of the species described are new to science.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus stigmaterus, C. utahensis, C.* species 3a [=*C. decorus* gp.(sp. 3a)], *Dicrotendipes californicus, D. fumidus*, *Phaenopsectra* n.sp. 1, *Stictochironomus marmoreus, S.* n.sp. 1, *S.* n.sp. 2, *Tanytarsus* n.sp. 8

Martin, J. & Wülker, W. 1971. Inversion polymorphism in *Chironomus staegeri* Lundbeck. *Canadian Journal of Genetics and Cytology* **13**: 306-321.
Six chromosome arms are polymorphic for inversions. There is often a significant deficiency of heterozygotes and many inversions show significant gametic disequilibrium. In particular there is a marked dimorphism between the inversions present in populations from deep and shallow habitats. It is suggested that speciation may be occurring.

Specialised subjects: Inversions - non-random associations, incipient speciation
Species: *Chironomus staegeri*

Martin, J. & Wülker, W. 1974. A review of the genus *Chironomus* (Diptera: Chironomidae). VIII. The cytology of *Chironomus stigmaterus* Say. *Studies in Natural Sciences* (*Portales, New Mexico*) **1**(11): 1-17.
A photographic chromosome map is provided for *C. stigmaterus* and its phylogenetic position relative to other *Chironomus* species is considered. Inversion polymorphism is reported for arms A, C, F, and G and the inversion heterozygotes are illustrated.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus stigmaterus*

Martin, J., Wuelker, W. & Sublette, J.E. 1972. Cytoevolution in the genus *Chironomus* (Diptera: Nematocera). *Proceedings of the 14th International Congress of Entomology, Canberra:* 116-117. Abstract.
Reviews the state of knowledge of the evolutionary groupings and phylogeny within the genus *Chironomus*. Text published in Martin, Wülker & Sublette (1974).

Specialised subjects: Phylogeny - polytene chromosomes
Species: *Chironomus* spp.

Martin, J., Wülker, W. & Sublette, J.E. 1974. Evolutionary cytology in the genus *Chironomus* Meigen. *Studies in Natural Sciences* (*Portales, New Mexico*) **1**(12): 1-12.
Review the progress made on the chromosomal phylogeny of the genus *Chironomus* since the work of Keyl (1962). Nine major cytological groupings are recognised and the question of whether all species with the same chromosome arm combination are necessarily of common origin is discussed. Illustrated by a phylogenetic chart and three photographs.

Specialised subjects: Phylogeny - polytene chromosomes
Species: *Chironomus annularius, C.* cf. *calligraphus* [=*C. columbiensis*], *C. carus, C. cloacalis, C. crassimanus, C. holomelas*, *C. melanescens, C. piger, C. plumosus, C. pseudothummi, C. riparius, C. yoshimatsui, Einfeldia* spp., *Goeldichironomus* spp.

Martin, J.H. 1966. A different organism for the demonstration of giant salivary gland chromosomes. *Turtox News* **44**: 178-180.
Provides a simple way to collect *Chironomus* larvae and to prepare the salivary gland chromosomes. Illustration of the larva and the glands, as well as a photograph of the salivary chromosome complement of a species which is probably a member of the *Chironomus decorus* group.

Specialised subjects: Techniques, Polytene chromosomes - karyotype
Species: *Chironomus decorus* gp.

Masich, S.V. & Zainiev, G.A. 1984. Study of the DNA packed in polytene chromosomes by means of controlled stretching. In: Struktura i funktsiya kletochnogo yadra. *Tez. 8th Vsesvetyi Simposiya, Pushchin,* pp.50-51. (In Russian)
Article not seen.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Masson, J. 1958. La sécrétion nucléolaire des chromosomes géants chez le Chironome (*Chironomus plumosus*, Insecte diptere). *Compte rendus Hebdomadaires des Séances de l'Academie des Sciences, Paris* **246**: 3108-3110.
Preliminary report on the physicochemical characteristics of the nucleolus in chromosome 4.

Specialised subjects: Nucleolus - structure
Species: *Chironomus plumosus*

Maximova, F.L. 1974. Some peculiarities in the morphological characteristics of polytene chromosome puffs of the larvae of *Chironomus plumosus*. Functional morphology, genetics and biochemistry of cells, Leningrad, pp.62-64. (In Russian)
Article not seen.

Specialised subjects: Puffs - structure
Species: *Chironomus plumosus*

Maximova, F.L. 1976. The karyotype of *Chironomus plumosus* from the Ust'-Izhora wild population of Leningrad region. *Tsitologiya* **18**: 1264-1269. (In Russian, English summary)
Describes the karyotype and inversion polymorphism of this population. Provides a photographic map which was used by Kerkis *et al*. (1989) as the basis of their comparison of the *C. plumosus* group. However Petrova *et al*. (*Cytobios* **70**: 185-189, 1992), claim this is not *C. plumosus* but differs from that species by inversion In16-22 in arm C. Subsequently, Ilyinskaya & Petrova (*Ent. Rev*. **72**: 135-147, 1993) note that this inversion is common in *C. plumosus* and the two populations simply reflect the extreme frequencies.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus*

Maximova, F.L. 1977. On the chromosome polymorphism in *Chironomus plumosus*. *Tsitologiya* **19**: 126-128. (In Russian, English summary)
Describes and figures the chromosomal polymorphism present in eight populations of *Chironomus plumosus*. The populations can be divided into two groups on the basis of an inversion in chromosome I. The second species may be *C. balatonicus* described by Kiknadze & Kerkis (1986).

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus plumosus*, *C. balatonicus*

Maximova, F.L. 1978. Structural pattern of the karyotype of *Chironomus plumosus* L. (Diptera, Chironomidae) in the connection with polymorphism of the species. *Abstracts of the XIV International Congress of Genetics, Moscow, Part* **1**: 269.
Analysed the inversion polymorphism present in 25 populations from widely separated parts of the U.S.S.R. Some translocations and fusions were seen, rearrangements which are considered due to speciation processes. It is concluded that *Chironomus plumosus* comprises 4 cytological races, which may represent two separate species. Subsequently these have all been described as separate species (Ilyinskaya & Petrova, *Ent. Rev*. **72**: 135-147, 1993).

Specialised subjects: Inversions, Reciprocal translocations - geographical distribution
Species: *Chironomus plumosus* gp. [=*C. agilis, C. balatonicus, C. entis, C. plumosus*]

Maximova, F.L. 1979. On the problem of the cytodiagnosis of larvae of *Chironomus plumosus* L., pp.51-55. *In* Chubareva, L.A. (ed.), *Karyosystematics of the Invertebrate Animals*. 130pp. Zoologicheskii Institut Academiia Nauk, S.S.S.R., Leningrad. (In Russian)
Describes four distinct karyotypes associated with larvae identified as *Chironomus plumosus* and provides a photographic map of karyotype 1. This has now been accepted as the standard karyotype for *C. plumosus* (Petrova *et al*. 1992). The other karyotypes have subsequently been described as separate species and an additional species recognized amongst the material (Ilyinskaya & Petrova, *Ent. Rev*. **72**: 135-147, 1993). Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus* karyotype 1 [=*C. plumosus* & *C. plumosus*], *C. plumosus* karyotype 2 [=*C. balatonicus*], *C. plumosus* karyotype 3 [*C. entis*], *C. plumosus* karyotype 4 [=*C.* (*forma larvalis bathophilus*)]

Maximova, F.L. 1980. Inversional polymorphism of the natural populations of *Chironomus plumosus* L. *New data on karyosystematics of Diptera. Trudy Zoologicheskii Institut, Academiia Nauk, S.S.S.R.* **95**: 31-39. (In Russian, English summary)
Studies of 12 populations indicate that the highest heterozygosity is in the central regions of the European part of the U.S.S.R., and that some karyotypic races may occur. Some of these

karyotypic races will correspond to forms subsequently described as separate species, see e.g. Belyanina *et al*. 1990, Devai *et al*. 1983, Kerkis *et al*. 1990, Michailova & Belcheva 1984, Ryser *et al*. *1983,*

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus plumosus* gp. [=*C. agilis, C. balatonicus, C. entis, C. plumosus*]

Maximova, F.L. 1982. Variability of the activity of polytene chromosomes in natural populations of *Chironomus plumosus*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 41.
Notes that compared to the standard "puffing pattern" of summer fourth instar larvae, there is variability in different populations in relation to the localisation and size of some puffs, including the Balbiani rings.

Specialised subjects: Puffs - seasonal and interpopulation effects, Balbiani rings
Species: *Chironomus plumosus*

Maximova, F.L. & Ilyinskaya, N.B. 1983a. Characterization of the puffing of polytene chromosomes in *Chironomus plumosus* during the summer period of development. *Tsitologiya* **25**: 320-327. (In Russian, English summary)
The pattern of puffing during the summer was studied using three different cytological approaches.

Specialised subjects: Puffs - seasonal effects
Species: *Chironomus plumosus*

Maximova, F.L. & Ilyinskaya, N.B. 1983b. The puffing in giant chromosomes of *Chironomus plumosus* in the course of development of IV instar larvae. *Tsitologiya* **25**: 380-384. (In Russian, English summary)
The pattern of puffing of the polytene chromosomes during the course of the fourth instar in a natural population was found to correspond to that observed in the laboratory stock. The variability is ascribed to differences between cells of the same gland.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus plumosus*

Maximova, F.L. & Petrova, N.A. 1978. Geographic variability of karyotype in *Chironomus plumosus* (Diptera, Chironomidae). *Zoologisheskii Zhurnal* **57**: 1816-1826. (In Russian, English summary)
Populations of *C. plumosus* which differ in larval morphology were studied for the inversion polymorphisms present. A partial correlation was found between morphology and karyotype. The phylogenetic relations of the forms was established and it was considered that a process of speciation was occurring. Three karyotypes are illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus* [=*C. agilis, C. balatonicus, C. muratensis*]

McNack, E.C. & Session, J.J. 1972. A karyological and immunological study of larvae of the midge *Chironomus attenuatus*, Walker. *Texas Journal of Science* **23**: 586. (Abstract)
Autoradiographic techniques applied to the polytene chromosomes are being used to study the processes of development, differentiation and speciation in *C. attenuatus* [=*C. decorus* gp.].

Specialised subjects: Puffs - species variation
Species: *Chironomus attenuatus* [=*C. decorus* gp.]

Mechelke, F. 1953. Reversible struktur-modifikationen der Speicheldrüsen-chromosomen von *Acricotopus lucidus*. *Chromosoma* **5**: 511-43.
Describes the salivary gland chromosomes and inversions of *A. lucidus* [=*A. lucens*]. There are three chromosomes with a nucleolus in chromosome III. The salivary gland has three recognisable sections with different Balbiani rings developed in each. These modifications occur in parallel to the production of a cell specific brown secretion. Illustrated by numerous detailed drawings and photographs, including photographs of the whole chromosome complement.

Specialised subjects: Polytene chromosomes - structure, Puffs - tissue specificity
Species: *Acricotopus lucidus* [=*A. lucens*]

Mechelke, F. 1958. The timetable of physiological activity of several loci in the salivary gland chromosomes of *Acricotopus lucidus*. *Proceedings of the 10th International Congress of Genetics, Montreal* **2**: 185. (Abstract)
Summarises the puffs and Balbiani rings present in *A. lucidus* [=*A. lucens*], and records that they have a definite developmental timetable. Puffs are considered to enlarge the surface of the locus to facilitate metabolic activity.

Specialised subjects: Puffs - developmental sequence, structure
Species: *Acricotopus lucidus* [=*A. lucens*]

Mechelke, F. 1959. Beziehungen zwischen der Menge der DNS und dem Ausmass der potentiellen Oberflächenentfaltung von Riësenchromosomenloci. *Die Naturwissenschaften* **46**: 609.
Preliminary, unillustrated report of the characteristics of the puffs of *Acricotopus lucidus* [=*A. lucens*].

Specialised subjects: Puffs - structure
Species: *Acricotopus lucidus* [=*A. lucens*]

Mechelke, F. 1960. Strukturmodifikationen in Speicheldrüsenchromosomen von *Acricotopus* als Manifestation eines Positionseffektes. *Die Naturwissenschaften* **47**: 334-335.
Reports that puffing at a Balbiani ring locus is subject to a position effect in association with an inversion. In the standard sequence no puff is present, in the heterozygote a moderate puff is formed, while in the alternative homozygote it becomes a Balbiani ring. Heterozygous heterochromatin present nearby plays no part in the modification of this locus. The effect, assumed to be a position effect, occurs only in the anterior lobe of the salivary gland. Illustrated by drawings of the alternative sequences.

Specialised subjects: Puffs - position effects
Species: *Acricotopus lucidus* [=*A. lucens*]

Mechelke, F. 1961. Das Wandern des Aktivitäts-maximums im BR_4-Locus von *Acricotopus lucidus* als Modell für die Wirkungsweise eines komplexen Locus. *Die Naturwissenschaften* **48**: 29.
Excellent sequential photographs of the puffs at the BR4 locus in the salivary gland chromosomes show that this complex locus is comprised of regions that reach maximum levels of puffing at slightly different times. It is suggested that the pattern of activity observed may be used as a model for other complex loci.

Specialised subjects: Puffs - developmental sequence
Species: *Acricotopus lucidus* [=*A. lucens*]

Mechelke, F. 1963. Spezielle Funktionszustände des genetischen Materials. *Funktionelle und morphologische Organisation der Zelle. Wissenschaft-liche Konferenz der Gesellschaft Deutscher Naturforscher und Ärzte, Rottach-Egern,* **1962**: 15-29.
Reviews, as well as providing some original data, the evidence that puffs in salivary gland chromosomes are sites of gene activity. Illustrated with figures and photographs of *Acricotopus lucidus* [=*A. lucens*] and *Chironomus tentans* to show phenomena related to differential activities of various loci.

Specialised subjects: Puffs - structure, gene activity
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Mechelke, F. 1967*a*. Biologische Grundfragen aus der Sicht der Genetik. *Reden und Abhandlungen des Landwirtschaftliche Hochschule*, *Universität Hohenheim* **21**: 10-48.
A review of basic genetics in which polytene chromosomes are used as an example, particularly with regard to puffing in Chironomidae. Illustrated by photographs, drawings and autoradiographs of chromosomes or chromosome segments. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - gene activity
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Melland, A.M. 1941. The salivary glands of *Prodiamesa olivacea*. A case of asymmetry in the Diptera. *Journal of Heredity* **32**: 165-167.
Gives a photograph of the salivary gland chromosomes of *P. olivacea*, but considers there to be five polytene elements. This is contrary to the interpretation of Michailova (1977, 1980) who describes three polytene elements and a heterochromatic B-chromosome, noting that chromosome II often breaks at the centromere region to give the impression of an extra pair of chromosomes.

Specialised subjects: Karyotype study
Species: *Prodiamesa olivacea*

Melland, A.M. 1942. Types of development of polytene chromosomes. *Proceedings of the Royal Society of Edinburgh*, *Section* ***B*** **61**: 316-327.
Describes the tissues in which polytene chromosomes occur in the Chironomidae and notes the occurrence of diplochromosomes in vittelophage cells. Also compares the appearance and structure of the polytene chromosomes in the various subfamilies of Chironomidae, noting variation in the degree of uncoiling and nucleic acid charge with the degree of polyteny. The chromosome number given

for *Prodiamesa olivacea* is four polytene elements, differing from the figure given in his earlier paper (Melland 1941). (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Anatopynia trifascinnus* [=*Asectrotanypus trifascipennis*], *A.* [=*Psectrotanypus*] *varius, Chironomus cingulatus*, *C. cristatus* [=*C. plumosus*], *C. decorus* [=*C. decorus* gp.], *C. dorsalis* [=*C. luridus*], *C. dorsalis* var. *venustris* [=*C. dorsalis*], *C.* [=*Glyptotendipes*] *lobiferus, C.* [=*Microtendipes*] *pedellus, C. plumosus*, *C. riparius*, *C. tentans*, *C.* spp., *Cricotopus sylvestris*, *Endochironomus* spp., *Glyptotendipes glaucus* [=*G. pallens*], *Pentaneura* [=*Ablabesmyia*] *monilis, Procladius* spp., *Prodiamesa olivacea*, *Tanypus* spp.

Metz, C.W. 1939. The visible organization of the giant salivary gland chromosomes of Diptera. *American Naturalist* **73**: 457-466.
Discusses the structure of polytene chromosomes in terms of the droplet theory of Metz & Lawrence (1937). Illustrated by diagrams and by photographs of particular bands in *Chironomus*.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus* spp.

Metz, C.W. 1941. Structure of salivary gland chromosomes. *Cold Spring Harbor Symposia on Quantitative Biology* **9**: 23-39.
Reviews the structure of polytene chromosomes, comparing the droplet theory of Metz & Lawrence (1937), with those of other authors. Includes diagrams and several photographs of sections of *Chironomus* salivary gland chromosomes. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus* spp.

Metz, C.W. & Lawrence, E.G. 1937. Studies on the organization of the giant gland chromosomes of Diptera. *The Quarterly Review of Biology* **12**: 135-151.
Advance a theory that polytene chromosomes are comprised of chromosome material separated by layers of achromatic droplets. Illustrated by two figures of *Chironomus* salivary gland chromosome sections, including different optical levels of the same stretched segment. The theory was refuted by Morita (1942). (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus* spp.

Meyer, B. 1982. *Experimentelle Regulation von Sekretproteingenen in Speicheldrüsen von* Chironomus tentans. Doktors der Naturwissenschaften, Eid-genössischen Technischen Hochschule, Zürich. (In German, English summary)
Largely the data published in Meyer *et al*. (1983). Illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Meyer, B., Mähr, R., Eppenberger, H.M. & Lezzi, M. 1983. The activity of Balbiani rings 1 and 2 in the salivary glands of *Chironomus tentans* larvae under different modes of development and after pilocarpine treatment. *Developmental Biology* **98**: 265-277.
Measure the extent of activity of BR1 and BR2 in continuous or interrupted modes of development, with and without pilocarpine treatment. The two BRs have different patterns of activity and these differ with the developmental mode. The activity of BR2, but not BR1, is greatly increased after pilocarpine treatment. Illustrated by histograms and a photograph.

Specialised subjects: Puffs - Balbiani rings, developmental sequence
Species: *Chironomus tentans*

Meyer, B., Mähr, R., Gatzka, F., Hertner, T., Eppenberger, H.M. & Lezzi, M. 1982. Regulation of activity of a major secretory protein gene (Balbiani ring 2) in the larval salivary gland of *Chironomus tentans*, *in vivo* and *in vivo*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 42.
Activity of BR2 can be stimulated by depletion of the lumen of the salivary gland. This stimulation is found to be dependent upon the developmental stage of the larva. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Miall, L.C. & Hammond, A.R. 1900. *The structure and life-history of the harlequin fly* (Chironomus). Clarendon Press, Oxford, 196 pp.
Includes general descriptions and figures of reproductive organs and stages of gametogenesis. Drawings of the salivary gland polytene chromosomes, after Balbiani (1881), with some discussion of their significance. (Partim)

Specialised subjects: Polytene chromosomes, Spermatogenesis
Species: *Chironomus dorsalis*

Michailova, P. 1973*a*. Triploidy in *Clunio marinus* Haliday from the Bulgarian Black Sea coast. *Dokladii Bulgarski Akademii Nauk* **26**: 1541-1543.
Reports the karyotype of *C. marinus* from the Black Sea area as 2n=6, with three pairs of metacentric chromosomes. 18 out of 33 females examined were triploid, and therefore assumed to be parthenogenetic. Illustrated by photographs of polytene, mitotic and meiotic chromosomes which are not very clear.

Specialised subjects: Karyotype study; Thelytoky - polyploidy
Species: *Clunio marinus*

Michailova, P. 1973*b*. Untersuchungen über den Chromosomenpolymorphismus bei *Chironomus salinarius* Kieff., *Chironomus valkanovi* Michailova und *Chironomus anchialicus* Michailova (Diptera, Chironomidae) von der bulgarischen Schwartz-meerküste. *Zoologisches Anzeiger* **191**: 348-364.
Describes the mitotic and salivary gland chromosome karyotypes of the three species, as well as any chromosomal polymorphism present. A drawn chromosome map of *C. valkanovi* is presented to act as a standard for the group. Three karyotypes of this species are reported, and these and the chromosomal polymorphism are illustrated. Photographs of the fourth chromosome of *C. anchialicus* and of the chromosomes and inversion heterozygotes of *C. salinarius* are also provided.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anchialicus, C. salinarius*, *C. valkanovi*

Michailova, P. 1974. Zwei neue Arten der Gattung *Chironomus* (Diptera, Chironomidae) von der bulgarischen Schwartzmeerküste. *Zoologische Beitrage* **20**: 339-357. (In German; English summary)
Describes the mitotic and salivary gland chromosomes of two new species, *C. anchialicus* and *C. valkanovi*, as well as the Bulgarian populations of *C. salinarius*. The possible phylogenetic relationships between the species are discussed. Drawn chromosome maps and photographs of the chromosomes are provided. Unfortunately the names of both new species are misspelt, as *C. enchialicus* and *C. valkanovis* respectively. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anchialicus, C. salinarius, C. valkanovi*

Michailova, P. 1975. Karyological characteristics of *Cricotopus varians* Staeg. and *Cricotopus vitripennis* Meig. (Diptera, Chironomidae) from the Bulgarian Black Sea Coast. *Acta Zoologica Bulgarica* **2**: 25-37 (In Russian, English summary)
Compares the cytology of the two closely related species *C.* (=*Halocladius*) *varians* (2n=4) and *H. vitripennis* (2n=6). Mitotic and salivary chromosome complements are described and illustrated, and drawn chromosome maps provided. Evidence is provided for the recent origin of *H. varians*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cricotopus* [=*Halocladius*] *varians, C.* [=*Halocladius*] *vitripennis*

Michailova, P. 1976*a*. *Karyosystematical studies of species of family Chironomidae (Diptera, Nematocera) from the Bulgarian Black Sea coast and lakes*. Autoreferat, Bulgarska Academiia na Naukte Zoologicheskii Institut, Sofia: 38 pp.
Describes the karyotypes of 17 species of Chironomidae from the subfamilies Chironominae and Orthocladiinae, and provides a key for cytological identification. Chromosomal polymorphisms are described and discussed. In *Cricotopus* [=*Halocladius*]*varians*, females are characterised by a complex heterozygous inversion.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus anchialicus, C. halophilus* [=*C. aprilinus*], *C. piger, C. plumosus, C. salinarius, C. thummi* [=*C. riparius*], *C. valkanovi, Clunio marinus, Cricotopus algarum, C. ornatus, C. sylvestris, C.* [=*Halocladius*] *varians, C.* [=*Halocladius*

] *vitripennis, Glyptotendipes barbipes, G. gripekoveni, Thalassomya frauenfeldi,*

Michailova, P. 1976*b*. An additional B chromosome in *Thalassomyia frauenfeldi* Schiner (Diptera, Chironomidae) from Bulgaria's Black Sea coast. *Dokladii Bulgarskoii Akademii Nauk* **29**: 267-269.
A B chromosome was found in all specimens of *T. frauenfeldi* from the Black Sea coast. Its appearance in the polytene chromosomes and behaviour at meiosis are described and illustrated by photographs.

Specialised subjects: Supernumerary chromosomes - population studies
Species: *Thalassomyia* [=*Thalassomya*] *frauenfeldi*

Michailova, P. 1976*c*. Cytotaxonomical diagnostics of species from the genus *Cricotopus* (Chironomidae, Diptera). *Caryologia* **29**: 291-306.
Describes the mitotic and salivary chromosomes of the closely related species pair *C. sylvestris* (2n=4) and *C. ornatus* (2n=6). Drawn and photographic chromosome maps are provided and comparisons are made between the karyotypes of the two species.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cricotopus ornatus*, *C. sylvestris*

Michailova, P. 1977. Karyotaxonomische Charakteristik der *Prodiamesa olivacea* Meigen und *Prodiamesa bureschi* sp. n. (Diptera, Chironomidae). *Zoologische Beiträge (Neue Folge)* **23**: 387-404. (English summary)
The karyotype of *P. bureschi* is described and compared with that of *P. olivacea,* from which it differs by fixed inversions as well as in the number and appearance of bands. The diploid chromosome number of both species is given as 2n=6, which differs from that given by Bauer (1935, 1936) (although Bauer & Beermann (1952b) mention n=3) and Melland (1941) for *P. olivacea*. The difference lies in whether the small heterochromatic chromosome is part of the normal complement or a B-chromosome not present in all dividing somatic cells (Michailova 1980). Five hybrid individuals, with heterozygosity and asynapsis of the homologs, were noted amongst the 220 larvae analysed.

Specialised subjects: Cytotaxonomy - polytene chromosomes, hybrids
Species: *Prodiamesa bureschi*, *P. olivacea*

Michailova, P. 1978*a*. Cytotaxonomic peculiarities in some species of the family Chironomidae (Diptera) from Bulgaria. *Abstracts of the XIV International Congress on Genetics, Moscow, Part* **1**: 269.
By karyotypic analysis, four species of *Cricotopus* which are indistinguishable in the larval stage, could be identified. The hybrid origin of *Cricotopus sylvestris* was proven. Hybrid individuals between *Prodiamesa olivacea* and *P. bureschi* were identified by the disturbance to the normal pairing of the polytene chromosomes.

Specialised subjects: Cytotaxonomy - polytene chromosomes, hybrids
Species: *Cricotopus ornatus, C. sylvestris*, *C. tricinctus*, *C. trifasciatus*, *Prodiamesa bureschi, P. olivacea*

Michailova, P. 1978*b*. Karyological characteristics of *Cricotopus algarum* Kieffer (Diptera, Chironomidae). *Cytologia* **43**: 187-196.
The mitotic and salivary chromosomes of *C. algarum* were described and drawn and photographic chromosome maps provided. The species is the first recorded in the genus with a chromocentre. A high degree of chromosomal polymorphism was recorded. The diploid chromosome number is 2n=6 but there are 4-6 K chromosomes in the germ line.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cricotopus algarum*

Michailova, P. 1979*a*. Comparative karyological analysis of the species of the genus *Glyptotendipes* Kieff. (Diptera, Chironomidae). *Caryologia* **32**: 23-44.
Investigated five species of *Glyptotendipes*, comparing the banding patterns of the salivary chromosomes and constructing a phylogeny based on this analysis. Photographic maps are provided of all species. In addition drawn maps are provided for *Glyptotendipes gripekoveni* and *G. caulicola*, with photographs of the mitotic chromosomes and chromosomal rearrangements.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Glyptotendipes barbipes, G. caulicola, G. glaucus, G. gripekoveni, G. paripes*

Michailova, P.V. 1979*b*. Structural changes in the polytene chromosomes of *Chironomus valkanovi* Michailova, *Cricotopus silvestris* Staeg. and *Cricotopus varians* Fabr. (Diptera, Chironomidae)

under the influence of various factors. *Doklady Bulgarskoi Akademiia Nauk* **32**: 377-380.
Describes the effects of environmental changes on the appearance of the polytene chromosomes of the Chironomidae species. The effect of different salinity on *Chironomus valkanovi*, of microsporidial infection on *Cricotopus sylvestris*, and of oil pollution on *C.* [=*Halocladius*] *varians* are described and illustrated.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus valkanovi*, *Cricotopus sylvestris*, *C.* [=*Halocladius*] *varians*

Michailova, P. 1980*a*. The chromosomal polymorphism of some species of the family Chironomidae, Diptera. *Acta Universitas Carolinae-Biologica* ***1978*****:** 141-149.
Describes the chromosomal polymorphism, mainly paracentric inversions, of *Chironomus valkanovi*, *C. salinarius* and *Thalassomyia frauenfeldi*. Changes in the frequency of these polymorphisms with time and environmental change are recorded. It is concluded that the polymorphism is adaptive. Photographs of the heterozygotes are provided.

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus salinarius*, *C. valkanovi*, *Thalassomyia* [=*Thalassomya*] *frauenfeldi*

Michailova, P. 1980*b*. Cytotaxonomic features of species of the subfamily Orthocladiinae (Diptera, Chironomidae) from Bulgaria. *Animal genetics and evolution. Selected papers of the XIV Congress of Genetics, Moscow, 1978. Genetica* **52/53**: 263-266.
Discusses the karyotype of 11 species from three different genera of the Orthocladiinae, comparing the banding pattern of the polytene chromosomes, the distribution of heterochromatin and the location of the nucleoli. It is concluded that the polytene chromosomes are useful for species identification. In *Prodiamesa olivacea* and *P. bureschi* it is noted that the B-chromosome (see Michailova 1977) is not found in all dividing cells of the brain. Additionally it is noted that chromosome II often breaks at the centromere region.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cricotopus algarum*, *C. fuscus*, *C. ornatus*, *C. pirifer*, *C. sylvestris*, *C. tricinctus*, *Halocladius mediterraneus*, *H. variabilis*, *H. varians*, *Prodiamesa bureschi*, *P.olivacea*

Michailova, P. 1980*c*. A review of the European species of the genus *Clunio* Haliday, 1855 (Diptera, Chironomidae). *Zoologisches Anzeiger* **205**: 417-432.
Compares the morphological, phenological and cytological characteristics of three *Clunio* species, including a new species, *C. ponticus*. Photographs of polytene and mitotic chromosomes are provided, and the characteristics of the polytene chromosomes are used to construct a larval key. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Clunio balticus*, *C. marinus*, *C. ponticus*

Michailova, P. 1982*a*. Localization of the constitutive heterochromatin in some species and hybrids of the family Chironomidae, Diptera. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 44.
The banding intensity and other properties of heterochromatin were used to divide it into 3 types. The distribution of these types was found to differ between related species.

Specialised subjects: Heterochromatin - polytene chromosomes
Species: *Chironomus nuditarsis*, *C. plumosus*, *Endochironomus albipennis*, *E. impar*, *E. tendens*

Michailova, P. 1982*b*. External morphological and karyological characteristics of *Orthocladius bipunctellus* Zett., 1850 (Diptera, Chironomidae). *Zoologisches Anzeiger* **208**: 82-91.
Describes the salivary gland and meiotic karyotype (2n=6) of *O. bipunctellus*, providing photographs and a drawn chromosome map. A supernumerary chromosome was observed in low frequency. It was found that larvae identified as three different species all had the same karyotype and belonged to the same species. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Orthocladius bipunctellus*

Michailova, P.V. 1985a. Cytotaxonomic review of some species of the genus *Orthocladius* van der Wulp (Diptera, Chironomidae). *Entomologische Abhandlungen Staatliches Museum für Tierkunde Dresden* **48**: 149-165. (English and German summaries)

Provides photographic chromosome maps of the salivary gland chromosomes and photographs of the meiotic chromosomes of six species of *Orthocladius*. In addition the phylogenetic relationships of the chromosome sequences are compared between these species and the previously described *O. bipunctellus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Orthocladius bipunctellus, O. frigidus, O. fuscimanus, O. oblidens, O. olivaceus, O. rubicundus, O. thienemanni*

Michailova, P.V. 1985b. Tendencies in the karyotype evolution of species of the family Chironomidae (Diptera). *Acta Zoologica Bulgarica* **26**: 3-22.
Reviews the various cytological phenomena that appear to have been involved in the evolution of the Chironomidae: chromosomal rearrangements, amount and distribution of heterochromatin, hybridisation, absence of sex chromosomes in most species, male or female heterogamety and prezygotic selection. Illustrated by photographs and diagrams.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus acidophilus, C. anchialicus, C. annularius, C. australis, C. bernensis, C. cingulatus, C. crassicaudatus, C. crassimanus, C. dorsalis, C. duplex, C. halophilus* [=*C. aprilinus*], *C. holomelas, C. luridus, C. melanotus, C. nuditarsis, C. obtusidens, C. oppositus, C. pallidivittatus, C. piger, C. plumosus*, *C. pseudothummi, C. rempeli, C. salinarius, C. stigmaterus, C. tentans*, *C. valkanovi, Clunio balticus*, *C. marinus*, *C. ponticus*, *Cricotopus algarum, C. fuscus*, *C. ornatus*, *C. pirifer*, *C. sylvestris*, *C. tricinctus*, *Endochironomus albipennis, E. impar, E. tendens, Glyptotendipes barbipes, G. caulicola, G. glaucus, G. gripekoveni, G. mancunianus, G. paripes, Halocladius mediterraneus*, *H. varians, H. vitripennis, Orthocladius bipunctellus, Polypedilum nubifer, Prodiamesa bureschi, P. olivacea, Thalassomya frauenfeldi*

Michailova, P.V. 1985c. Cytological sex determination of some Chironomidae species (Diptera). *National Conference on Genetics, Sofia,* 1984, pp.100-104. (In Bulgarian, English summary)
Discusses the cytological features of the sex determining section of the polytene chromosomes of
species from three genera of Chironomidae, where it is indicated by heterozygosity for inversions or heterochromatic blocks. Discusses the role of prezygous selection and segregation distortion in relation to sex determination.

Specialised subjects: Sex chromosomes - evolution
Species: *Chironomus plumosus, Glyptotendipes caulicola, Halocladius varians*

Michailova, P.V. 1987a. Comparative karyological studies of three species of the genus *Glyptotendipes* Kieff. (Diptera, Chironomidae) from Hungary and Bulgaria and *Glyptotendipes salinus* Sp.N. from Bulgaria. *Folia Biologica* (*Krako*w) **35**: 43-56. (English, Hungarian and Russian summaries)
Describes and provides photographic maps of the polytene chromosomes of *G. barbipes*, *G. glaucus*, *G. paripes* and the new species *G. salinus*. The new species is related to *G. barbipes*, being adapted to salt water habitats. *G. glaucus* material could be divided into two forms on the basis of chromosome II, but the two forms hybridised with no reduction in fertility. Hungarian populations of *G. paripes* contained a B chromosome but were otherwise karyotypically standard. The Bulgarian populations, on the other hand, differed to such an extent that they should be considered a separate species. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Glyptotendipes barbipes, G. glaucus, G. paripes, G. salinus*

Michailova, P.V. 1987b. Comparative karyological analysis of species of the genus *Endochironomus* Kieffer (Diptera: Chironomidae). *Entomologica Scandinavica Supplement* **29**: 105-111.
Describes the polytene karyotype of five species of *Endochironomus* from Europe and North America. Notes these fall into two groups, one containing *E. albipennis* and *E. nigricans*, the other containing the other three species. *E. tendens* is considered derived because it carries a tandem fusion and it also shows a high chromosomal polymorphism. Provides photographs of comparisons between *E. albipennis* and *E. nigricans*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Endochironomus albipennis, E. impar, E. nigricans, E. tendens, E.* species

Michailova, P. 1987c. C-banding in the polytene chromosomes of species of the *plumosus* group (Diptera, Chironomidae) and their experimental hybrids. *Genetica* **74**: 41-51.
Examines the localisation and amount of heterochromatin in 3 species of the *C. plumosus* group and their experimentally produced hybrids. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus balatonicus*, *C. plumosus*, *C. vancouveri*

Michailova, P. 1988. A review of the genus *Polypedilum* Kieffer. The cytotaxonomy of *Polypedilum aberrans* Tshernovskji. *Spixiana Supplementum* **14**: 239-246.
Describes the polytene karyotype of *P. aberrans* and compares it with that of other studies species of *Polypedilum*. Suggests the sequences in arms A, E and F of *P.* aberrans are quite ancient as the sequences also occur in the other species. There is no polymorphism other than a female-specific heterochromatinisation of the end of arm G. Illustrated by photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes; Karyotype - evolutionSpecies: *Polypedilum aberrans, P. nubeculosum, P. nubifer, P.* species

Michailova, P. 1989a. Cytotaxonomic studies on the experimental hybrid of *Glyptotendipes barbipes* (Staeger) and *Glyptotendipes salinus* Michailova (Diptera, Chironomidae). *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 141-150.
Studied the polytene and meiotic chromosomes of hybrid larvae compared to those of the parental species. The homologous chromosomes in the hybrid are largely unpaired and there are changes in the appearance of the heterochromatin, leading to differences in C-banding pattern compared to those in *Glyptotendipes barbipes*. The results seem to imply that meiosis was usually normal, which conflicts with results of Michailova & Belcheva (1989), but this may be due to language problems. Crossing-over was confined to those regions that were closely paired in the polytene chromosomes. Illustrated by photographs.

Specialised subjects: Hybrids - asynapsis, DNA replication, male meiosis
Species: *Glyptotendipes barbipes, G. salinus,*

Michailova, P. 1989b. The polytene chromosomes and their significance to the systematics of the family Chironomidae, Diptera. *Acta Zoologica Fennica* **186**: 1-107.
Briefly reviews the structural and functional organisation of the polytene chromosomes and their significance for studying the systematics and phylogeny of the group. Notes that hybridisation also assists in phylogenetic analysis. Describes the salivary gland chromosome karyotype of 98 species from the subfamilies Chironominae, Diamesinae, Orthocladiinae, Prodiamesinae and Telmatogetoniae, giving the diagnostic

characteristics. Illustrated by a plate of photographs for each species treated, as well as other photographs illustrating particular features.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Acricotopus lucens, Brillia* cf. *longifurca, B.modesta, Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans, C.* [=*Chironomus*] species, *Chironomus aberratus, C. annularius, C. anchialicus, C. balatonicus, C.bernensis, C. crassimanus, C. dorsalis, C. halophilus* [=*C.aprilinus*], *C. muratensis, C.nuditarsis, C. obtusidens, C. parathummi, C. piger, C. plumosus, C. pseudothummi, C. riparius, C. salinarius, C. valkanovi, C.* species, *Clunio ponticus, Cricotopus algarum, C. bicinctus, C.* ex gp. *festivellus, C.* ex gp. *fuscus, C.* ex gp. *tremulus, C. fuscus, C. intersectus, C. ornatus, C. sylvestris, C. tricinctus, C. trifascia, Cryptochironomus* cf. *defectus, Cryptocladopelma* [=*Cladopelma*] *fridmanae, Demicryptochironomus vulneratus, Diamesa aberrata, D. carpatica, D. cinerella, D. insignipes, D. theinemanni* [=*D. tonsa,*], *Dicrotendipes nervosus, Endochironomus albipennis, E. impar, E. tendens, E.* species, *Glyptotendipes barbipes, G. caulicola, G. glaucus, G. gripekoveni, G. mancunianus, G. paripes, G. salinus, G.* species, *Halocladius millenarius, H. variabilis, H. varians, Metriocnemus atratulus* [=*M. albolineatus, Micropsectra* cf. *recurvata, M.* gp. *notescens, M. lindrothi, M. viridiscutellata, Microtendipes* cf. *pedellus, Orthocladius abiskoensis, O. bipunctellus, O.* cf. *oblidens, O.* cf. *olivaceus, O. consobrinus, O. frigidus, O. fuscimanus, O. rubicundus, O. saxicola, O. thienemanni, Parachironomus arcuatus, P. parilis, Paracladius conversus, P. inaequalis, Paratanytarsus lauterborni, Pentapedilum* [=*Polypedilum*] *exsectum, P.* [=*Polypedilum*] *sordens, Polypedilum aberrans, P. nubeculosum, Prodiamesa bureschi, P. olivacea, Psectrocladius barbimanus, P.* cf. *dilatatus, P. delatoris, Pseudodiamesa branickii, Rheocricotopus chalybeatus, R. effusus, Stictochironomus chalybeatus, S.* gp. *histrio* [=*S.* gp. *stictus*], *Thalassomyia* [=*Thalassomya*] *frauenfeldi*

Michailova, P. & Belcheva, R. 1989. Meiosis in an experimental hybrid of *Glyptotendipes salinus* Michailova x *Glyptotendipes barbipes* (Staeger) (Diptera, Chironomidae). *Cytobios* **58**: 101-107.
Meiosis in the hybrids is blocked at diakinesis in females and at prophase I in males. This is interpreted as indicating a form of hybrid dysgenesis in these hybrids of *G. salinus* and *G. barbipes*. Meiosis in the parental species is normal. Illustrated by photographs.

Specialised subjects: Hybrids; Meiosis - division failure
Species: *Glyptotendipes barbipes*, *G. salinus*

Michailova, P. & Belyanina, S. 1984. *Chironomus kiknadzeae* sp.n. from the Ob Sea (USSR) (Diptera, Chironomidae). *Reichenbachia* **22**: 79-85.
Provide photographic and drawn maps to the salivary gland chromosomes. This is a synonym of *C. muratensis* (Kiknadze *et al*. ATLAS, Nauka, Novosibirsk, 1991). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus kiknadzeae* [=*C. muratensis*]

Michailova, P. & Belyanina, S. 1990. Different effect of lead on external morphology and polytene chromosomes of *Glyptotendidpes barbipes* (Staeger) (Diptera, Chironomidae). *Folia Biologica (Kraków)* (English & Polish summary)
Investigate the effect of two levels of lead on the chromosome morphology. Found almost complete asynapsis of chromosome I, underreplication of centromeric heterochromatin, different degrees of polyteny, a paracentric and a pericentric inversion, and the expression of new puffs. Illustrated by photographs. (Partim)

Specialised subjects: Chromosome aberrations - induction by pollutants
Species: *Glyptotendipes barbipes*

Michailova, P.V. & Dimitrova, B.D. 1984. Karyological characteristics of *Acricotopus lucens* (Zett.) (Diptera, Chironomidae) from Bulgaria. *Doklady Bulgarskoi Akademiia Nauk* **37**: 1081-1084.
Provide photographic and drawn maps of the salivary gland chromosomes, along with diagrams of the position of the various Balbiani rings. A photograph of the chromosomes in the sex cells is also provided and it is noted that these can contain up to 17 chromosomes, presumably due to limited chromosomes.

Specialised subjects: Cytotaxonomy - polytene chromosomes, L-chromosomes
Species: *Acricotopus lucens*

Michailova, P. & Fischer, J. 1984. Cytogenetic studies on *Chironomus plumosus* L. (Diptera, Chironomidae) from different populations and their experimental hybrids. *Memoirs of the American Entomological Society* **34**: 211-221.
Analysis of the salivary gland chromosomes of larvae from three lakes, two in Switzerland and one in Canada, indicate inversion differences between them. On the basis of the pairing relationships in hybrids and the location of heterochromatin, as indicated by C-banding, it is assumed that the two Swiss populations are subspecies but the Canadian material belongs to a distinct species. The Canadian material was subsequently designated *Chironomus vancouveri* (Michailova & Fischer 1986a). Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus*, *C. vancouveri*

Michailova, P. & Fischer, J. 1986a. *Chironomus vancouveri* sp.n. from Canada (Diptera, Chironomidae). *Reichenbachia* **23**: 99-106.
Provide photographic maps of the salivary gland chromosomes. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus vancouveri*

Michailova, P. & Fischer, J. 1986b. Speciation within the plumosus group of the genus *Chironomus* Meigen (Diptera, Chironomidae). *Zeitschrift für zoologische Systematik und Evolutionsforschung* **24**: 207-222. (English & German summaries)
Investigate the phylogenetic relationships of five species related to *C. plumosus*, on the basis of the banding patterns of the salivary gland chromosomes. It is postulated that the European species under went sympatric speciation, while *C. vancouveri* in North America formed by allopatric speciation. Illustrated by photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus*, *C. muratensis*, *C. nudiventris, C. plumosus, C. vancouveri*

Michailova, P. & Gercheva, P. 1982. Cytotaxonomical characteristics of the species of genus *Endochironomus* Kieff. (Diptera, Chironomidae). *Caryologia* **35**: 33-56.
Describe the salivary chromosome complement of three European species of the genus *Endochironomus*, providing drawn and photographic chromosome maps and describing the chromosomal polymorphism and distribution of heterochromatin in these species. Illustrated by many photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Endochironomus albipennis, E. impar, E. tendens*

Michailova, P.V. & Maximova, F.L. (erroneously printed as Michailova, F.L.) 1980. Karyological variability of *Chironomus plumosus* L. (Diptera, Chironomidae) and its importance for species divergence. *Acta Zoologica Bulgarica* **14**: 5-18. (In Bulgarian, English summary)
The differentiation of the karyotype of *Chironomus plumosus* in different populations was reviewed and fixed inversions of chromosomes I and IV were analysed. Chromosome I was found in five different homozygous combinations, chromosome IV in two different combinations. These fixed inversions occur in high frequency in different parts of the distribution. As well, the distribution of heterochromatin in the different homozygous types was analysed. It is considered that these differences contribute towards the creation of an isolating mechanism.

Specialised subjects: Inversions - geographic patterns; Incipient species
Species: *Chironomus plumosus*

Michailova, P.V. & Michailova, F.L. 1980. - see Michailova & Maximova 1980.

Michailova, P. & Petrova, N. 1984. Initial stages of sympatric divergency in species of the genus *Glyptotendipes* Kieff. (Diptera, Chironomidae). *Caryologia* **37**: 293-307.
Studied the salivary gland karyotype of two *Glyptotendipes* species from Lake Bratsk in the Asian part of the U.S.S.R. Describe the differences from previously studied populations and the polymorphism of chromosome I in both species, which appears to have some relationship to hybridisation. Illustrated by photographs, including additional photographic chromosome maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes, Inversions, Hybrids - species formation
Species: *Glyptotendipes gripekoveni*, *G. paripes*

Michailova, P. & Petrova, N.A. 1987. The peculiarities of the karyotype of *Micropscectra* gp. *notescens* (Diptera, Chironomidae) taken from different populations. *Tsitologiya* **29**: 1056-1060. (In Russian, English summary)
Describe the mitotic (2n=8) and salivary gland chromosomes of a species in *Micropsectra* gp. *notescens*, from two populations. One population was monomorphic, the other polymorphic for an inversion and a puff. Provide photographic maps of the salivary gland chromosomes.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Micropsectra* gp. *notescens*

Mihailova, P. or P.V. see Michailova, P.

Miseiko, G.N. 1971*a*. On the correlation between the systematics of the larvae and the imagines of Chironomidae. *Third International Symposium of Chironomid Research, Moscow, 1968. Limnologica* **8**: 47-48.
Attempts to separate larvae on morphological grounds often lead to the obtaining of adults of several species from the same larval type. Therefore the possibility of using the characteristics of the polytene chromosomes was investigated. These allowed the recognition of five members of the *Cryptochironomus defectus* group, although six karyotypes are actually recorded. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus cryptotomus, C. defectus, C. monotomus, C. nigrotibialis, C. pararostratus* gp.

Miseiko, G.N. 1971*b*. On the question of the correlation between the systematics of Chironomidae larvae and imagines. *Proceedings of the 13th International Congress of Entomology, Moscow, 1968,* **1**: 178-179. (In Russian)
A Russian language version of Miseiko (1971*a*).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus cryptotomus*, *C. defectus*, *C. monotomus*, *C. nigrotibialis*, *C. pararostratus* gp.

Miseiko, G.N. 1972. On the correlation between the systematics of the larvae and the imagines of Chironomidae. *Proceedings of the 13th International Congress of Entomology, Moscow, 1968,* **3**: 471.
Essentially the same content as Miseiko (1971*a*) although it is correctly stated that six karyotypes are recognised in *Cryptochironomus defectus* gp.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus cryptotomus, C. defectus, C. monotomus, C. nigrotibialis, C. pararostratus* gp.

Miseiko, G.N., Kiknadze, I.I. & Minsarinova, B.K. 1971. Extra micro-chromosomes in chironomids. *Doklady Akademiia Nauk, S.S.S.R.* **200**: 709-711. (In Russian) [Translated in *Doklady Biological Sciences* **200**: 585-587]
Three species of *Glyptotendipes* were investigated and microchromosomes were found in one species, *G. paripes*. The microchromosomes, which are illustrated by photographs, were found in larvae from heavily polluted waters. The evolutionary implications are discussed.

Specialised subjects: Supernumerary chromosomes - population studies
Species: *Glyptotendipes barbipes, G. glaucus, G. paripes*

Miseiko, G.N. & Minsarinova, B.K. 1974. The karyological structure of natural populations of *Glyptotendipes glaucus* and *Glyptotendipes paripes* (Chironomidae). *Tsitologiya* **16**: 893-897. (In Russian, English summary)
Provide photographic chromosome maps and descriptions of the inversion polymorphism in *G. glaucus* and *G. paripes*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Glyptotendipes glaucus, G. paripes*

Miseiko, G.N., Minsarinova, B.K. & Kiknadze, I.I. 1971. The karyotype structure in natural populations of *Glyptotendipes barbipes* (Diptera, Chironomidae). *Tsitologiya* **13**: 1501-1505. (In Russian, English summary)
Provide a photographic chromosome map and describe the extensive inversion polymorphism found in the Novosibirsk populations of *G. barbipes*.

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Glyptotendipes barbipes,*

Miseiko, G.N. & Popova, V.S. 1970*a*. Karyological studies of *Cryptochironomus* gp. *defectus*. I. General characteristics of karyotype diversity. *Tsitologiya* **12**: 158-165. (In Russian, English summary)
Four different karyotypes have been found in larvae of *C. defectus* gp.. Two of these karyotypes have 2n=6 and two have 2n=4. The different karyotypes are represented diagrammatically and by photographs. Extensive chromosomal polymorphism is reported. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus defectus* gp.

Miseiko, G.N. & Popova, V.S. 1970*b*. A karyological study on *Cryptochironomus* gp. *defectus* Kieff. (Diptera, Chironomidae). II. The first karyotype characteristics. *Tsitologiya* **12**: 1170-1182. (In Russian, English summary)
Five karyotypes for *C. defectus gp*. are now recorded and one of these, with 2n=6, is described in detail. A photographic map is provided as well as numerous photographs of the extensive chromosomal polymorphism.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Cryptochironomus defectus* gp.

Mohr, E., Trieschmann, L. Grossbach, U. 1989. Histone H1 in two subspecies of *Chironomus thummi* with different genome sizes: homologous chromosome sites differ largely in their content of a specific H1 variant. *Proceedings of the National Academy of Sciences* **86**: 9308-9312.
A structurally variant of histone H1, H1 I-1, accounts for 20% of the total histone in *C. thummi piger* [=*C. piger*] and about 30% in *C. th. thummi* [=*C. riparius*]. Indirect immunofluorescence of the salivary gland chromosomes in F1 hybrids indicates that the difference in content of this variant between the two species depends on differences at a number of distinct homologous chromosome bands. In *C. thummi* these bands fluoresce in response to a labelled antibody to H1 I-1, while in *C. piger* they remain dark. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi piger* [=C. *piger*,], *C.th. thummi* [=*C. riparius*]

Morath, E. 1970*a*. *Untersuchungen zur Morphologie und Cytotaxonomie kolumbianischer* Chironomus*arten (Diptera)*. Diplomarbeit, Freiburg Universität, Freiburg, Germany. 62pp.
The complete contents of this thesis are not known. It describes the karyotypes of a number of *Chironomus* species, including one near *C. calligraphus* with the chromosome arm combination AG, BF, CD, E., subsequently described as *C. columbiensis* by Wülker *et al*. (1989). Other parts of the thesis were published by Wülker & Morath (1989).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anonymus*, *C.* nr. *calligraphus* [=*C. columbiensis*], *C.* spec. Coyote Creek, *C.* spec. Las Brisas, *C.* spec. Meerenberg A, *C.* spec. Meerenberg B, *C.* spec. Rio de Janeiro A, *C.* spec. Rio de Janeiro B, *C.* spec. Villa Paz, *C.* spec. WOC

Morcillo, G., Barettino, D., Carmona, M.J., Carretero, M.T. & Diez, J.L. 1988. Telomeric DNA sequences differentially activated by heat shock in two *Chironomus* subspecies. *Chromosoma* **96**: 139-144.
Examine the patterns of puffing, transcription and protein synthesis under heat shock, of the closely related species *C. thummi* [=*C. riparius*] and *C. piger*. While mostly similar in response, there is a distinct difference in the telomeric Balbiani rings; developed at IIIR in *C. thummi* but at IVR in *C. piger*. The functional significance of these T-BRs is discussed in relation to possible equivalents in other Diptera. Illustrated by photographs, autoradiographs and *in situ* hybridisations.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Morcillo, G., Santa-Cruz, M.C. & Diez, J.L. 1981. Temperature-induced Balbiani rings in *Chironomus thummi*. *Chromosoma* **83**: 341-352.
Temperatures from 33^{o}-39^{o}C induce a Balbiani ring at the telomere of the right arm of chromosome III in *C. thummi* [=*C. riparius*]. This BR incorporates tritiated uridine but appears insensitive to Actinomycin treatment. At extreme temperatures a further Balbiani ring is induced in chromosome I. The existence of heat shock puffs is also reported. Well illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Morita, J. 1942. A contribution to the study of the structure of the salivary gland chromosomes in *Chironomus*. *Cytologia* **12**: 135-162.
Describes detailed studies of the salivary gland chromosomes in two species of *Chironomus*. Detailed drawings of the whole karyotype and various segments are provided for *C. dorsalis* [?=*C. yoshimatsui*]. Refutes the droplet theory of Metz (e.g. Metz & Lawrence 1937) as the polytene chromosomes are shown to consist of multiple threads. Much discussion of synaptic relationships of homologues and of banding pattern details.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*], *C.* species

Mosolov, A.N., Belaya, A.N. & Gruzdev, A.D. 1971. Effects of myxoviral enzymes on isolated polytene chromosomes of *Chironomus dorsalis*. *Tsitologiya* **13**: 104-108. (In Russian, English summary)
Isolated living polytene chromosomes were exposed to inactivated Sendai virus or influenza virus PR-8. The chromosomes rapidly swelled to 2-2.5 times normal size. The role lipoproteins play in these changes was investigated. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - parasite effects
Species: *Chironomus dorsalis* [=*C. riparius*]

Moyne, G. 1972. Une méthode cytochimique de mise en évidence de l'ADN à l'usage de la microscopie électronique. *Compte rendu Hebdomadaire des Séances de l'Académie des Sciences, Paris* **274**: 247-250.
Describes a technique for staining DNA utilising thallium, which was evaluated using rat pancreas and *Chironomus* salivary glands. The technique stained the bands of the polytene chromosomes, as illustrated by electronmicrographs. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Müller, G.H. 1976. The measurement of the size of salivary gland cell nuclei of *Chironomus thummi*. *Leitz Scientific and Technical Information* **6**: 239-245.
Uses the salivary gland of *C. thummi* [=*C. riparius*] as an example of measuring nuclear size. Notes that Krebs (1973) has considered the relationship between nuclear size and chromosome diameter. Shows a colour photograph of a salivary gland in which the coiled chromosomes are readily visible. (Partim)

Specialised subjects: Polytene chromosomes - structure, size relationships
Species: *Chironomus thummi* [=*C. riparius*]

Mulnard, J. 1956. Présence d'inclusions Feulgen-positives dans les nucléoles larvaires de quelques Dipteres. *Archives de Biologie, Paris* **67**: 485-498.
Feulgen staining structures are described in the nucleoli of larval salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] and other Diptera. No illustrations of *Chironomus* amongst the photographs published. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Nagel, G. & Rensing, L. 1972. Struktur und Funktion von Riesenchromosomen und Puffs. *Naturwissenschaftliche Rundschau* **25**: 53-64.
A review of the structure of polytene chromosomes and of puffs and Balbiani rings. The transcription, translation, regulation and experimental induction of puffs is considered. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=A. *lucens*], *Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Nair, C.K.K. & Gopalan, H.N.B. 1978. Association of DNA replication with the nuclear membrane in larvae of *Chironomus thummi*. *Experientia* **34**: 353-354.
Salivary gland chromosomes have been shown to have a connection with the nuclear membrane (Trösch & Lindemann 1973), therefore this study investigated whether DNA replication was associated with the nuclear membrane as in bacteria. Extraction of DNA from larvae incubated in tritiated thymidine indicated that the newly synthesised DNA was in a complex associated with the nuclear membrane.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Nath, B.B. & Lakhotia, S.C. 1989. Heat-shock response in a tropical *Chironomus*: seasonal variation in response and the effect of developmental stage and tissue type on heat shock protein synthesis. *Genome* **32**: 676-686. (English & French summary)
Examined the effect of heat shock on puffing in the polytene chromosomes of *C. striatipennis*. Larvae reared at 24°C showed nine heat-shock puffs at 39°C, while those reared at summer temperatures (33-36°C) sometimes showed no induction of heat shock puffs at the same temperature. Also, there was no puff induction at the summer temperatures, even though these temperatures caused partial induction in larvae reared at 24°C. A photographic chromosome map of *C. striatipennis* is provided. Illustrated by photographs and autoradiographs. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus striatipennis*

Nelson, D.J. & Blaylock, B.G. 1963. The preliminary investigations of salivary gland chromosomes of *Chironomus tentans* Fabr. from the Clinch River. *Proceedings of National Symposium on Radioecology* **3**: 367-372.
Larvae of a member of the *Chironomus decorus* gp., incorrectly identified as *C. tentans*, from a locality showing 20 to 1000 times the normal background radioactivity were investigated cytologically. A relatively high frequency of chromosomal aberrations was reported. Specimens with only three pairs of chromosomes were reported but these were *C. staegeri* (Martin & Wülker 1971). Illustrated by photographs of the whole complement of each species and some details of chromosomal rearrangements.

Specialised subjects: Inversions, Mutations - environmental effects
Species: *Chironomus staegeri*, *C. tentans* [=*C. decorus* gp.(B)]

Nelson, L.G. & Daneholt, B. 1981. Modulation of 75S RNA synthesis in the Balbiani rings of *Chironomus tentans* with galactose treatment. *Chromosoma* **83**: 645-659.
Treatment of larvae of *C. tentans* with galactose lead to a reduction in the size of BR2 and an expansion of BR1 in chromosome IV. This change in size was associated respectively with an increase and a decrease in the production of 75S RNA at the sites. Illustrated by photographs of chromosome IV. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Nesterova, S.I. 1967*a*. The investigation of giant chromosomes in some species of Chironomidae (Diptera). *Tsitologiya* **9**: 524-529. (In Russian, English summary)
Provides information, including illustrations of the karyotypes of 10 species of Chironomini. One of these species is called Tendipedinae [=Chironominae] *kanevi,* which is an invalid name, but for which no valid name exists. Morphologically similar species, especially those of *Chironomus*, can be readily differentiated by the chromosomes, especially chromosome IV. Three different karyotypes were recorded for *C. plumosus*, one of which has n=3 due to the fusion of chromosome IV onto chromosome I. Karyotype 2 corresponds to *C. muratensis* and karyotype 3 may correspond to *C. nudiventris*, both described from Switzerland by Ryser, Scholl & Wülker (1983). The species studied showed a high level of inversion polymorphism.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius*, *C. dorsalis*, *C. plumosus* karyotype 1 [=*C. plumosus*,], *C. plumosus* karyotype 2 [=*C. muratensis*], *C. plumosus* karyotype 3 [=*C. nudiventris*], *C. tentans*, *Cryptochironomus defectus* gp., *Glyptotendipes gripekoveni*, *G. polytomus* [=*G. barbipes*], *Pentapedilum* [=*Polypedilum*] *exsectum, Polypedilum* gp. *nubeculosum*, 'Tendipedinae' [=Chironomini] *'kanevi'*

Nesterova, S.I. 1967*b*. On species diagnosis of larvae of the genus *Chironomus* Meig. on the basis of karyological data, pp.71-75. *In* Konstantinov, A.S. (ed.), *Fauna of the Volgograd reservoir and influence of pollution on it*. 107pp. Izdatelstvo Saratovskogo Universiteta. (In Russian)
Describes the fourth chromosome of four species of *Chironomus* and provides a key for the identification of the species based on the characteristics of this chromosome. Illustrated by drawings.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus dorsalis* [=*C. riparius*,], *C. obtusidens*, *C. plumosus, C. tentans*

Nesterova, S.I. 1968. *Structure of giant chromosomes and karyosystematics of larvae of*

subfamily Chironominae (Chironomidae, Diptera). Candidate Thesis, Saratov University, U.S.S.R. (In Russian)
This reference has not been seen but it is likely to contain the studies published by Nesterova (1967*a* & *b*). Some of the species are noted by Kiknadze *et al*. (ATLAS, Nauka, Novosibirsk, 1991).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius*, *C. dorsalis*, *C. plumosus* karyotype 1 [=*C. plumosus*], *C. plumosus* karyotype 2 [=*C.:muratensis*], *C. plumosus* karyotype 3 [=*C. nudiventris*], *C. tentans*, *Cryptochironomus defectus* gp., *Glyptotendipes gripekoveni*, *G. polytomus* [=*G. barbipes*], *Pentapedilum* [=*Polypedilum*] *exsectum, Polypedilum* gp. *nubeculosum*, 'Tendipedinae' [=Chironomini] *'kanevi'*

Nesterova, S.I. 1969*a*. A characterization of the karyotypes of larvae of the genus *Chironomus* Meig, pp 57-61. *In* Konstantinov, A.S. (ed.), *The Species Occurrence, Ecology and Productivity of Hydrobionts of Volgograd Reservoir*. 106 pp. Izdatelstvo Saratovskogo Universiteta, (In Russian).
Briefly describes the salivary gland chromosomes of *C. cingulatus* and *C. heterodentatus*. Provides drawings to illustrate the fourth chromosomes and a puff and a Balbiani ring in *C. cingulatus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus cingulatus*, *C. heterodentatus*

Nesterova, S.I. 1969*b*. Cytotaxonomic study of certain species of genus *Glyptotendipes* (Chironomidae, Diptera), pp 49-52. *In* Konstantinov, A.S. & Larina, N.I. (eds.), *Influence of Economical Activities of Humans on the Animal Life of Saratov-Povolzia*. 105 pp. Izdatelstvo Saratovskogo Universiteta. (In Russian).
Describes the fourth chromosome of three species of *Glyptotendipes* and provides a key to the species based on the characteristics of this chromosome. Illustrated by drawings.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Glyptotendipes barbipes*, *G. glaucus*, *G. gripekoveni*

Nesterova, S.I. - see Belyanina, S.I. for publications after 1974.

Nevers, P. 1972. *Beiträge zur Cytotaxionomie, Morphologie, Systematik und Biologie der Gattung* Sergentia *Kieffer (Diptera, Chironomidae)*. Diplomarbeit, Freiburg Universität, Germany. 64 pp.
This reference has not been seen. Only partly concerned with cytogenetics.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Sergentia coracina*, *S.* spp.

Newman, L.J. 1975. Cytogenetics of the Hawaiian *Telmatogeton* (Diptera). *United States/International Biological Program Island Ecosystems Integrated Research Program, Technical Report* **56**: 1-23.
Recognises four chromosomally distinct members of the *T. torrenticola* complex. These have different chromosome numbers, varying from n=3 to n=7. In *T. torrenticola*-Hawaii the chromosome number differs between males and females due to the fusion of two acrocentric chromosomes to form a metacentric Y-chromosome.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Telmatogeton torrenticola*

Newman, L.J. 1977. Chromosomal evolution of the Hawaiian *Telmatogeton* (Chironomidae, Diptera). *Chromosoma* **64**: 349-369.
Describes the mitotic, meiotic and salivary gland chromosomes of two marine and five freshwater species of *Telmatogeton* from Hawaii. The chromosome number varies from n=7 to n=4. The inversion polymorphism and phylogenetic relationships of the species are discussed. Illustrated by drawings and photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Telmatogeton abnormis*, *T. fluviatilis*, *T. hirtus*, *T. pacificus, T. torrenticola, T.* n.sp.

Newman, L.J. 1981. Evolution of gnats of the genus *Telmatogeton*. *In* Mueller-Dombois, D. Bridges, K.W. & Carson, H.L. (eds.), *Island Ecosystems. Biological Organization in Selected Hawaiian Communities*. Hutchinson Ross Publishing Company, Stroudsburg, Pa. *United States/ International Biological Program Synthesis Series* **15**: 467-470.

Briefly reiterates major points from Newman (1977).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Telmatogeton abnormis*, *T. fluviatilis, T. hirtus, T. japonicus, T. torrenticola, T.* n.sp.1

Newman, L.J. 1988. Evolutionary relationships of the Hawaiian and North American *Telmatogeton* (Insecta; Diptera: Chironomidae). *Pacific Science* **42**: 56-64.
Extends the previous studies of the Hawaiian *Telmatogeton* species and includes the North American species which are normally placed in the genus *Paraclunio*, but which are very closely related and probably of the same genus. Results indicate that two separate invasions of freshwater habitats have occurred in the evolution of the freshwater fauna of the Hawaiian Islands. Illustrated by photographs of selected chromosome arms.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Paraclunio alaskensis, P. spinosus, P. trilobatus, Telmatogeton abnormis*, *T. fluviatilis, T. japonicus, T. macswaini, T. pacificus, T. torrenticola, T.* n.sp.1

Nikolayenko, N.S., Gruzdev, A.D., Reznik, N.A. & Pinaev, G.P. 1977. Effects of enzymes of lipid metabolism on isolated polytene chromosomes. *Tsitologiya* **19**: 50-56. (In Russian, English summary)
From the effect of lypolytic enzymes on isolated chromosomes it is postulated that lipids associated with protein are involved in the maintenance of native polytene chromosome structure.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Nöthiger, R. & Steinmann-Zwicky, M. 1985. A single principle for sex determination in insects. *Cold Spring Harbor Symposia for Quantitative Biology* **50**: 615-621.
Discuss sex determination in *Drosophila* and then consider the application of the genetic cascade to other insects, including the genus *Chironomus*. It is suggested that the dominant male determining gene would correspond to the hypothesised signalling gene R of *Drosophila*. They also suggest that the female heterogametic species (they used the doubtful case of *C. tentans*, but it could apply to species such as *Polypedilum nubifer* - see Porter & Martin 1977) could be caused by mutation of the sexlethal locus. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Sex chromosomes - evolution
Species: *Chironomus tentans*, *Chironomus* spp.

Nöthiger, R. & Steinmann-Zwicky, M. 1987. Genetics of sex determination in Eukaryotes. *In* Hennig, W. (ed.), *Structure and Function of Eukaryotic Chromosomes. Results and Problems in Cell Differentiation* **14**: 271- 300.
Reviews the studies on sex chromosomes and sex determination in *Chironomus* species and, as in Nöthiger & Steinmann-Zwicky (1985), ties them into a theory of sex determination based on the cascade found in Drosophila. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Sex chromosomes - functional transposition
Species: *Chironomus tentans*, *Chironomus* spp.

Nonchev, S.G., Michailova, P.V., Venkov, C.D. & Tsanev, R.G. 1989. Histone H1 in the centromeric heterochromatin of *Glyptotendipes barbipes* larval polytene chromosomes. *Chromosoma* **98**: 64-68.
Analysis of the centromeric heterochromatin blocks indicated that these contained histone H1, but packed in such a way that H1 antigenic determinants are unable to react with it *in situ*. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Glyptotendipes barbipes*

Ohara, H. 1966a. Comparative study on the development of giant chromosomes in Chironomidae (Diptera). *Scientific Reports of the Tokyo Kyoiku Diagaku,* Section B **12**: 107-130.
The mitotic, meiotic and/or polytene chromosomes were investigated in 11 species of Chironomidae and haploid chromosome numbers are given for 8 of these. The mitotic and meiotic chromosomes are referred to as rod-shaped but this is apparently not intended to imply that they are acrocentric. The development of the polytene chromosomes in a variety of tissues of *Chironomus dorsalis* [?=*C. yoshimatsui*] was investigated. Illustrated by a number of drawings and photographs.

Specialised subjects: Polytene chromosomes - tissue differences; Karyotype - comparative

Species: *Chironomus dorsalis* [?=*C. yoshimatsui*], *C. enteromorphae*, *Cricotopus bifascia*, *Clunio tsushimaensis*, *Orthocladius* [=*Tokunagayusurika*] *akamusi, O.* species, *Spaniotoma* species, Tanypodinae species, *Tanytarsus magnihamatus*, *T.* species, *Telmatogeton japonicus*

Olins, A.L., Olins, D.E. & Franke, W.W. 1980. Stereo-electron microscopy of nucleoli, Balbiani rings and endoplasmic reticulum in *Chironomus tentans* salivary gland cells. *European Journal of Cell Biology* **22**: 714-723.
From stereo-electron microscopy of sections of salivary glands of *C. tentans*, models were constructed of the structure of the strands in the peripheral nucleolus and of the transcription axes of the Balbiani rings. The nucleolar strands have granules, possibly pre-ribosomal RNP, connected to a central axis. The BR transcription axes have lateral fibres which often coil at the distal end to form a granule. Illustrated by electron-micrographs and drawings of the proposed models. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - Balbiani rings, ultrastructure
Species: *Chironomus tentans*,

Olins, A.L., Olins, D.E. & Lezzi, M. 1982. Ultrastructural studies of *Chironomus* salivary gland cells in different states of Balbiani ring activity. *European Journal of Cell Biology* **27**: 161-169.
Salivary glands from *C. tentans* larvae treated with pilocarpine to stimulate transcriptional activity of the BRs, were fixed, sectioned and examined by conventional and stereo-electron microscopy. RNP lateral fibre densities were similar in treated and untreated BRs, despite the ten-fold difference in activity. A new type of multilayered structural variant was observed in nucleoli. Illustrated by electron micrographs, including stereo pairs.

Specialised subjects: Nucleolus, Puffs - Balbiani rings, ultrastructure
Species: *Chironomus tentans*

Oliver, D.R. 1976. Chironomidae (Diptera) of Char Lake, Cornwallis Island, N.W.T., with description of two new species. *Canadian Entomologist* **108**: 1053-1064.
Notes that the parthenogenetic species *Lauterbornia sedna* is triploid and probably of hybrid origin. The work should be attributed to Porter (1973). (Partim)

Specialised subjects: Thelytoky - polyploidy
Species: *Lauterbornia* [=*Micropsectra*] *sedna*

Panitz, R. 1960*a*. Gewebespezifische Manifestierung einer Heterozygote des Nucleolus in Speicheldrüsenchromosomen von *Acricotopus lucidus* (Chironomide). *Die Naturwissenschaften* **47**: 359.
Reports heterozygosity of the nucleolus in some cells of the salivary gland and the Malpighian tubules, while in other it appears symmetrical. This heterozygosity arises from unbalanced activity of the nucleolus organiser. Illustrated by drawings.

Specialised subjects: Nucleolus - polymorphy
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1960*b*. Innersekretorische Wirkung auf Strukturmodifikationen der Speicheldrüsen-chromosomen von *Acricotopus lucidus* (Chironomide). *Die Naturwissenschaften* **47**: 383.
Reports the different developmental pattern of the Balbiani rings in the different lobes of the salivary gland. These changes can be induced by incubating glands in lymph from prepupae and pupae or containing the pupal brain complex. This indicates that the changes are not autonomous but induced by external secretions.

Specialised subjects: Puffs - Balbiani rings, developmental sequence
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1964*a*. Hormonkontrollierte Genaktivitäten in den Riesenchromosomen von *Acricotopus lucidus*. *Biologisches Zentralblatt* **83**: 197-230. (English summary)
Describes experimental studies on the relationships between hormones, particularly ecdysone, and puff formation at certain loci, particularly the Balbiani rings, in the salivary gland chromosomes of larvae. Many illustrations.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1964*b*. Experimentell induzierte Inaktiviering Balbiani-Ring bildender Gen-Loci in Riesenchromosomen, pp.225-232. *In* Stubbe, H (ed.), *Struktur und Funktion des genetischen Materials,* Erwin-Baur-Gedächtnisvorlesungen, 1963. Berline Akademie-Verlag. (English summary)
Larval salivary glands of *Acricotopus lucidus* [=*A. lucens*] were transplanted into larvae or prepupae,

or cultivated in the haemolymph of these stages. The activity of the Balbiani rings was found to follow that of the normal development in the transplanted stage. The factor responsible was found to be that part of the ring gland which produces ecdysone. Illustrated by a number of photographs of the Balbiani rings under normal conditions or following particular treatments.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1965. Heterozygote Funktions-strukturen in den Riesenchromosomen von *Acricotopus lucidus*. Puffs als orte unilokaler Struktur-mutationen. *Chromosoma* **17**: 199-218. (English summary)
An illustrated account of various single-band heterozygosities in *A. lucidus* [=*A. lucens*], most of which do not affect loci concerned in puff formation. Two which did affect puff formation were studied, these lead to puff heterozygosity although the effect was not seen in some lobes of the salivary gland. The changes may be due to differential heterochromatinisation.

Specialised subjects: Puffs - heterozygosity; Heterochromatin - structure
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1967. Funktionelle Veränderungen an Riesenchromosomen nach Behandlung mit Gibberellinen. *Biologisches Zentralblatt* **86** (Supplement): 147-156.
Demonstrates that gibberellic acid affects certain loci, particularly by repressing Balbiani rings in the main and lateral lobes of the salivary glands. This result differs from that obtained by Laufer & Frackelton (1970), who found that gibberellic acid itself had no effect on puffing in *Chironomus thummi* [=*C. riparius*].

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1968. Über die Rolle der Chromosomen bei der Informations-übertragung höheren Organismen. *Biologisches Zentralblatt* **87**: 545-565. (English summary)
Discusses problems of information transfer in higher organisms, comparing polytene and lampbrush chromosomes. Considers experimental studies on puffing and nucleolar activity, largely in *Acricotopus lucidus* [=*A. lucens*], and includes some results on the genetic fine structure of the chromomeres. Well illustrated with photographs and diagrams of polytene regions containing active loci, plus the full salivary gland chromosome complement of *A. lucens*. (Partim)

Specialised subjects: Puffs - structure, :RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus pallidivittatus*, *C. tentans*

Panitz, R. 1970. Riesenchromosomen als Modellobjekte molekulargenetischer Forschung bei Eukaryoten, pp.7-16. *In* Pfister, C.L. (ed.), *Ergebnisse* der *Experimentelle Medizin Band 2. Beitrage zur Molekulargenetik*. 74pp. Veb Verlag Volk & Gesundgeit, Berlin.
A review of the structure of polytene chromosomes and puffs, as well as the genetic fine structure and regulation of puffed regions. No illustrations.

Specialised subjects: Polytene chromosomes - structure; Puffs - genetic control
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*, *C.* spp.

Panitz, R. 1972. Balbiani ring activity in *Acricotopus lucidus*. *Developmental studies on giant chromosomes*. *Results and Problems in Cell Differentiation* **4**: 209-227.
Reviews and gives new data on the developmental pattern, gene regulation and the various factors which can affect the activity of the Balbiani rings in the larval salivary glands of *A. lucidus* [=*A. lucens*]. Illustrated by numerous photographs and diagrams.

Specialised subjects: Puffs - developmental sequence
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Panitz, R. 1978*a*. Cell specific effect of ecdysone on RNA synthesis in the differentiated salivary gland of *Acricotopus lucidus*. *Cell Differentiation* **7**: 387-398.
Shows that the effect ecdysone has on RNA synthesis by the Balbiani rings in the salivary gland chromosomes of *A. lucidus* [=*A. lucens*] differs depending on whether the cell is in the main or anterior lobe of the salivary gland. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1978*b*. Nucleo-cytoplasmic relationship and cell- and development-dependent

differences in the RNA synthesis of the *Acricotopus* salivary gland. *Biologisches Zentralblatt* **97**: 549-559. (English & German summary)

Found a decline in the synthesis of poly(A)$^+$ RNA during transition from larva to prepupa and that the anterior lobe of the salivary gland lost the capability of synthesis of 4S RNA. This change is suggested to be related to the cell-specific inactivation of Balbiani rings. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. 1979. Two transcripts of an individual Balbiani ring from the salivary gland cells of *Acricotopus lucidus* (Diptera, Chironomidae). *Chromosoma* **74:** 253-268.
BR1 in the main lobe of the salivary glands of *A. lucidus* [=*A. lucens*] varies in size in conjunction with a subterminal inversion. The homozygous standard arrangement was found to transcribe an additional RNA fraction to that transcribed by the inverted form. Illustrated by photographs and autoradiographs of the Balbiani rings. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R. & Rieger, R. 1969. Zellkern und Chromosomen, pp.336-398. *In* Bielka, H. (ed.), *Molekulare Biologie der Zelle*. 1st Edition. 645pp. Gustav-Fischer Verlag, Jena.
This edition was not seen but the contents are believed to be similar to those of the updated 2nd edition (Panitz & Rieger 1973), despite the change in title. (Partim)

Specialised subjects: Polytene chromosomes - structure, Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Panitz, R. & Rieger, R. 1973. Chromosomen der Eukaryonten, pp.591-646. *In* Bielka, H. (ed.), *Molekulare Biologie der Zelle*. 2nd Edition. 725pp. Gustav-Fischer Verlag, Jena.
As part of a general review of chromosome structure and function, the polytene chromosomes are used as a model system. Their structure and function are basically considered in relation to puffing and the regulation of RNA synthesis. Includes photographs of the whole complement of *Acricotopus lucidus* [=*A. lucens*] and photographs or drawings of specific chromosome segments. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus tentans*

Panitz, R., Serfling, E. & Wobus, U. 1972. Autoradiographische Untersuchungen zur RNA-syntheseleistung von Balbiani-Ringen. *Biologisches Zentralblatt* **91**: 359-380. (German & English summary)
Autoradiographic studies indicated that, in *Acricotopus lucidus* [=*A. lucens*], the rate of RNA synthesis of the Balbiani rings is not proportional to the size of the puff. The rate of synthesis in BR2 is relatively lower than in other Balbiani rings and it is postulated that it contains untranscribed spacer sequences. Illustrated by photographs and autoradiographs of BR1 and BR2, as well as a number of diagrams. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Acricotopus lucidus* [=*A. lucens*]

Panitz, R., Wobus, U. & Serfling, E. 1972. The effect of ecdysone and ecdysone analogues on two Balbiani rings of *Acricotopus lucidus*. *Experimental Cell Research* **70**: 154-160.
Injection of ecdysone or ecdysone analogues into last instar larvae of *A. lucidus* [=*A. lucens*] led to inactivation of Balbiani rings in a manner identical to that observed in normal development. The relative effectiveness of the analogues was compared and a threshold dose calculated. Illustrated by photographs of BR3 and BR4 before and after treatment.

Specialised subjects: Puffs - experimental induction
Species: *Acricotopus lucidus* [=*A. lucens*]

Pankow, W. 1973. *Entwicklungsspezifische Balbianiring-Aktivität und Sekretproteinsynthese in Speicheldrüsen von* Chironomus tentans. Dissertation Nr. 5166, Eidgenössische Technische Hochschule, Zürich, Switzerland: 1-60.
The results of this thesis were published, in slightly modified form in Pankow, Lezzi & Holderegger-Mëhling (1976).

Specialised subjects: Puffs - structure, RNA synthesis
Species: *Chironomus tentans*

Pankow, W., Lezzi, M. & Holderegger-Mëhling, I. 1976. Correlated changes of Balbiani ring expansion and secretory protein synthesis in larval salivary glands of *Chironomus tentans*. *Chromosoma* **58**: 137-153.

The rate of expansion of the Balbiani rings of *C. tentans* was measured quantitatively and found to correlate positively to the rate of synthesis of their secretory proteins. For BR B1, this correlation follows the developmental change when the Balbiani ring is depressed in intermoult and diapausing animals.

Specialised subjects: Puffs - Balbiani rings, structure, - RNA synthesis
Species: *Chironomus tentans*

Pankratova, V.Y. 1984. On the question of chironomid evolution, pp.19-28. *In* Kolesnikov, N.N. & Istomina, A.G. (eds.), *Evolution, species formation and systematics of chironomids*. 158pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
This reference has not been seen.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Chironomidae spp.

Pankratova, V.Y., Chubareva, L.A. & Petrova, N.A. 1980. On the systematics of some *Chironomus* species (Chironomidae) from the Sevan Lake. *New data on karyosystematics of Diptera. Trudy Zoologicheskii Institut Academiia Nauk, S.S.S.R.* **95**: 50-54. (In Russian, English summary)
The banding patterns of the polytene chromosomes were used to assist in the identification of the *Chironomus* species present in Sevan Lake. The karyotypes of *C. tentans*, *C. plumosus*, and *C.* (*forma larvalis bathophilus*) are illustrated. The last species is a member of the *C. plumosus*-group (Ilyinskaya & Petrova, *Ent. Rev.* **72**: 135-147, 1993). Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* (*forma larvalis bathophilus*), *C. plumosus,* ;*C. tentans*

Passelewitz, B. 1982. *Das elekronenoptische Bandmuster gespreiteter Speicheldrüsen-chromosomen bei* Chironomus tepperi. Staatsprüfung Diplom Report, Institut für Genetik, Ruhr-Universität, Bochum, Germany. 21pp.
Prepared salivary gland chromosomes using the surface spreading technique, and examined them using the electron microscope to produce drawn maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus tepperi*

Pavan, C. 1965. Nucleic acid metabolism in polytene chromosomes and the problem of differentiation. *Genetic Control of Differentiation. Brookhaven Symposia in Biology* **18**: 222-241.
Notes the early work on puffs in *Chironomus* by Beermann and notes the effects of a microsporidian infection in enlarging the salivary gland chromosomes of *C. anthracinus*. (Partim)

Specialised subjects: Polytene chromosomes - puffs
Species: *Chironomus anthracinus*

Pavan, C. & Da Cunha, A.B. 1969. Gene amplification in ontogeny and phylogeny of animals. *Genetics Supplement* **61**: 289-304. (English & Spanish summary)
Use the comparison of the DNA content of the polytene bands of *Chironomus thummi* [=*C. riparius*] and *C. piger* in a discussion of gene amplification and in deriving a model of such amplification (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Pavlova, M.V. & Belyanina, S.I. 1977. A contribution to the composition of the chironomids of Lake Issyk-Kul. *Gidrobiologicheskii Zhurnal* **13**(2): 67-70. (In Russian) [Translated in *Hydrobiological Journal* **13**(2): 58-60.]
Studied the karyotypes of 12 chironomid species as part of an investigation of the composition of the chironomid fauna of the lake. The diploid chromosome number is given for each species. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. anthracinus, C. nigricans, C. pallidivittatus, C. plumosus, C. tentans*, *C. thummi thummi* [=*C. riparius*], *Cryptochironomus supplicans, Glyptotendipes barbipes, G. gripekoveni, Stictochironomus pictulus, Tanytarsus* species

Pelc, S.R. 1972. Metabolic DNA in ciliate protozoa, salivary gland chromosomes and mammalian cells. *International Review Cytology* **32**: 327-355.
Describes the structure of polytene chromosomes, with particular reference to *Chironomus*, but

concludes that the classical polytene hypothesis cannot explain such things as the difference in appearance of bands in different tissues. Such differences are explained on the basis of the existence of metabolic DNA, i.e. additional copies of some DNA, which is closely paired to the genetic DNA of the chromomere. Illustrated by diagrams. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*, *C.* spp.

Pelling, C.(Printed as G.) 1959. Chromosomal synthesis of ribonucleic acid as shown by the incorporation of uridine labelled with tritium. *Nature* **184**: 655-656.
Metachromatic staining or tritium labelling of the polytene chromosomes of *Chironomus tentans* revealed about 100 bands per cell involved in RNA synthesis, including puffs, Balbiani rings and the nucleolus organiser. This pattern was constant in all cells of the gland, except for 3-5 special cells. Illustrated by a photograph and autoradiographs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1962. Application of tritiated compounds to the midge *Chironomus* and some aspects of the metabolism of salivary chromosomes. *Proceedings of the Symposium on the Detection and Use of Tritium in the Physical and Biological Sciences, International Atomic Energy Agency, Vienna 1961*. **2**: 327-334. (English, French, German & Russian summaries)
Discusses the way in which tritiated compounds can be used to demonstrate DNA and RNA synthesis in the chromosomes and nucleolus, with a discussion of some aspects of RNA synthesis. His conclusion that nucleolar RNA synthesis begins in the organiser was challenged by Sirlin, Tandler & Jacob (1963), who claim interpretation was probably hampered by the penetration of organiser strands into the nucleolus itself in *C. tentans*. Illustrated with a photograph of the chromosome complement of *C. tentans* and a number of autoradiographs.

Specialised subjects: Polytene chromosomes - chromosomal replication, Puffs, Nucleolus - RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1963. Variability of RNA synthesis in polytene tissues. *Proceedings of the 11th International Congress of Genetics*. *Genetics Today* **1**: 108-109. (Abstract)
In contrast to diploid embryonic tissue, polytene tissues show variation in the rate of RNA synthesis within tissues, between tissues and between animals of equivalent age.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1964. Ribonukleinsäure-synthese der Riesenchromosomen. Autoradiographische Untersuchungen an *Chironomus tentans*. *Chromosoma* **15**: 71-122. (English summary)
Provides a detailed description and drawn maps, supported by numerous photographs, autoradiographs and drawings, of the salivary gland chromosomes. Reports 277 structures in the chromosomes, i.e. puffs, Balbiani rings, etc., which contain RNA. Notes a general correlation between the rate of RNA synthesis and the degree of puffing, and compares the relative proportions of RNA synthesis by different parts of the chromosomes.

Specialised subjects: Polytene chromosomes , Puffs - RNA synthesis
Species: *Chironomus tentans*,

Pelling, C. 1965a. The mechanism of gene activation in dipteran salivary gland chromosomes. II. Characteristics of puffing in giant chromosomes. *Table ronde sur les manifestations hormonales liées aux mécanismes génétiques*. *Archives d'Anatomie Microscopique et Morphologie Experimentale* **54**: 645-674.
Disputes the conclusion of Kroeger (1965) that concentrated KCl solutions imitate the effect of ecdysone, in that this is true for only some of the puffs induced by ecdysone and that the KCl treatment does not initiate the further steps controlled by ecdysone. Then reviews his findings that 300 bands form puffs in *Chironomus tentans* and that the size of the puff is proportional to the rate of RNA synthesis. Also discusses the structure of puffs. (Partim)

Specialised subjects: Puffs - structure, RNA synthesis
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Pelling, C. 1965b. Ribonukleinsäure-Synthese an den aktiven Genorten der Riesenchromosomen. *Naturwissenschaftliche Rundschau* **18**(5): I & III.
This article comprises the cover picture of the journal issue, an autoradiograph of the salivary gland chromosomes of *Chironomus tentans*, with a description of the RNA-containing structures shown in the autoradiograph. There are about 300

active structures, about 15% of the genome, which include the nucleoli, Balbiani rings and puffs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1966. A replicative and synthetic chromosomal unit - the modern concept of the chromomere. *Proceedings of the Royal Society B*. **164**: 279-289.
Discusses the concept of the chromomere based largely on the behaviour of the bands in polytene chromosomes, and the concludes that each band act as an independent unit in replication and puffing. Well illustrated with photographs, autoradiographs and drawings, including a photograph of the full salivary chromosome complement of *Chironomus tentans*. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - genetic control
Species: *Chironomus pallidivittatus*, *C. plumosus, C. tentans*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Pelling, C. 1968. Giant chromosomes and chromosome structure. *Proceedings of the 12th International Congress Genetics, Tokyo*. **2**: 74 (Abstract).
Review and discussion of chromosome structure based on studies of polytene chromosomes of *Chironomus tentans*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Pelling, C. 1969. Synthesis of nucleic acids in giant chromosomes. *Progress in Biophysics and Molecular Biology* **19**: 239-270.
Reviews the morphology of polytene chromosomes, with the arguments for the polytene theory, as well as DNA replication, RNA synthesis and regulation. Illustrated by photographs, including the whole salivary gland complement of *Chironomus tentans*, autoradiographs and drawings. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - RNA synthesis
Species: *Chironomus tentans*, *C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Pelling, C. 1970. Puff RNA in polytene chromosomes. *Cold Spring Harbor Symposia on Quantitative Biology* **35**: 521-531.
Briefly reviews the salivary gland chromosome complement of *Chironomus tentans*, illustrating chromosome 4. Then reviews the spectra of RNAs produced by puffs such as BR2, in relation to the RNAs present in the nuclear sap. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1972. Transcription in giant chromosomal puffs. *Developmental studies on giant chromosomes. Results and Problems in Cell Differentiation* **4**: 87-99.
Reviews the evidence for transcription from puffs, particularly Balbiani rings of *Chironomus tentans*. It is assumed that the puff consists of a single transcribing segment and that the whole DNA of the structure involved participates in the transcription. The results confirm that the transcription units are functionally compartmentalised.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Pelling, C. 1973. RNA synthesis in giant chromosomal puffs and the mode of puffing. *Biochemistry of Cell Differentiation. Federation of European Biochemical Societies Seventh Meeting, Varna, 1971,* **24**: 77-89.
Reviews the data on the morphology of puffs in polytene chromosomes and compares the mode of gene action in this system with that of lampbrush chromosomes. Illustrations include a photograph and an autoradiograph of chromosome IV of *Chironomus tentans* to indicate RNA synthesis in the Balbiani rings. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Pelling, C. & Beermann, W. 1966. Diversity and variation of the nucleolar organizing regions in chironomids. *International Symposium on the Nucleolus, its Structure and Function, Montevideo, Uruguay, 1965. National Cancer Institute Monographs* **23**: 393-409. (English and Spanish Summary)
Review the data on the morphology and structure of nucleoli in chironomids. Well illustrated with photographs.

Specialised subjects: Nucleolus - structure

Species: *Acricotopus lucidus* [=*A. lucens*]*Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Pelling, C. & Scholtissek, C. 1964. Die Funktion der Ribonucleinsäuren im Organismus. Biochemische und cytologische Aspekte der Übertragung genetischer Information. *Angewandte Chemie* **76**: 881-888.
Reviews the function of nucleic acids in relation to genetic information, based on cytological studies of salivary gland chromosomes. Illustrated by good photographs and autoradiographs to demonstrate, amongst other things, the difference between DNA and RNA synthesis in chromosomes and nucleoli, and protein synthesis. (Partim)

Specialised subjects: Polytene chromosomes - chromosomal replication, gene activity
Species: *Chironomus tentans*

Pelling, G. 1959. See Pelling, C. 1959.

Pennypacker, M. 1950. Large "anal gill" chromosomes of a chironomid larva. *Journal of Heredity* **41**: 155 & 164.
Polytene chromosomes were prepared from anal gills and salivary glands of the same specimens of *Tendipes* [=*Chironomus*] *riparius*. Chromosome IV from the two tissues showed some differences in the superficial appearance.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Tendipes* [=*Chironomus*] *riparius*

Perov, N.A. 1971. *Electronmicroscope studies of chromosome activity on examples of dipterous polytene chromosomes and lamp brush type chromosomes*. Candidate Thesis, Moscow State University, Moscow, U.S.S.R. (In Russian)
Not seen but assumed to contain at least some of the data published by Perov & Chentsov (1971). (Partim)

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus plumosus, C. thummi* [=*C. riparius*]

Perov, N.A. & Chentsov, Y.S. 1971. Electron-microscope study of polytene chromosomes in the salivary glands of larvae of *Chironomus plumosus*. *Doklady Akademiia Nauk, SSSR* **196**: 1452-1455. (In Russian) [Translated in *Doklady Biological Sciences* **196**(6): 1-4]
Studied the ultrastructure of the salivary gland chromosomes of *C. plumosus*, concentrating particularly on the structure of the interband areas. In these areas they noted granules similar to those reported from the Balbiani rings, and concluded that these were areas of RNA synthesis. They also reported numerous micronucleoli spread along the length of the chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Perov, N.A., Kiknadze, I.I. & Chentsov, Y.S. 1975*a*. Specific ultrastructure of puffs in the 4-E2b-e region of *Chironomus thummi*. *Doklady Akademiia Nauk, SSSR* **223**: 1465-1467. (In Russian) [Translated in *Doklady Biological Sciences* **223**(6): 290-292]
Describes the ultrastructure of specific puffs in the telomere region of chromosome 4. These puffs change in morphology during the pupal moult, when numerous large and distinctive globules appear.

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Perov, N.A., Kiknadze, I.I. & Chentsov, Y.S. 1975*b*. Ultrastructural organization of the salivary polytene chromosomes of *Chironomus thummi* Kieffer. *Tsitologiya* **17**: 390-396. (In Russian, English summary)
Compare electronmicroscope maps of regions of the salivary chromosomes of *C. thummi* [=*C. riparius*] with the standard light microscope maps. Conclude that the same bands can be seen but that some details, particularly of doublets are different. The centromeres, telomeres and some heavy bands formed characteristic contacts with the nuclear membrane. Illustrated by electron micrographs, with drawings of the chromosome maps of the equivalent region.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Perov, N.A., Kiknadze, I.I. & Chentsov, Y.S. 1976. The puff ultrastructure in polytene chromosomes of *Chironomus thummi*. *Tsitologiya* **18**: 840-846. (In Russian, English summary)
Studied the ultrastructure of puffs in larvae and prepupae of *C. thummi* [=*C. riparius*]. On the basis of differences in fine structure, the puffs could be divided into seven groups. Changes during puff formation were also studied. and the possible causes of the variability in ultrastructure discussed. Illustrated by electron micrographs.

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Petrova, N.A. 1978. Karyologic study of Orthocladiinae (Diptera, Chironomidae). *Abstracts of the XIV International Congress of Genetics, Moscow*, **1**: 271.
Presents information on the diploid chromosome numbers of six species from three genera of the Orthocladiinae, based on polytene chromosomes. Considers these chromosomes are promising material for investigating the relationships between the taxonomic groups. Published in detail in Petrova (1980).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa* spp., *Orthocladius* spp., *Prodiamesa olivacea*

Petrova, N.A. 1980. Karyological research of Orthocladiinae (Diptera, Chironomidae). *Genetica* **52/53**: 275-279.
Describes and provides photographs of the polytene chromosomes of six species from three genera of the Orthocladiinae. The species are distinguishable by differences in chromosome number, number and position of nucleoli or by the specific banding pattern.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Diamesa insignipes*, *D. nivalis, D. stylata, Orthocladius* sp. 1, *O.* sp. 2, *Prodiamesa olivacea*

Petrova, N. 1983. Karyotype and unstable associations of polytene chromosomes in *Sindiamesa nivosa* (Diptera, Chironomidae). *Zoologicheskii Zhurnal* **62**: 69-74. (In Russian, English summary)
Describes the karyotype of *Syndiamesa nivosa* on the basis of the polytene chromosomes of the salivary glands and Malpighian tubules. Notes the occurrence of unstable telomere associations and suggests that these lead to tandem chromosome fusions which have lead to an evolutionary reduction in the chromosome numbers of the Orthocladiinae from 2n=16 to 2n=4. The diploid chromosome number in *S. nivosa* is 2n=14. Provides photographic maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Syndiamesa nivosa*

Petrova, N.A. 1986. The significance of karyological characters for the taxonomy, systematics and evolution of chironomids, pp.29-35. *In* Kolesnikov, N.N. & Istomina, A.G. (eds.), *Evolution, species formation and systematics of chironomids*. 158pp. Nauka, Siberian Division, Novosibirsk. (In Russian)
This paper has not been seen. Illustrated.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Chironomidae spp.

Petrova, N.A. 1987. Chromosome numbers in the Chironomidae. pp.136-142. *In* Nartshuk, E.P. (ed.), *Diptera and their importance for animal husbandry and agriculture*. Trudy Zoologicheskii Institut Akademiia Nauk, CCCP, Leningrad. (In Russian)
This article has not been seen.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Chironomidae spp., *Halliella tauricus* [=*Baeotendipes noctivaga*], *Macropelopia paranebulosa, Procladius* spp., *Stictochironomus* species

Petrova, N.A. 1989a. Results and prospects of the karyological study of chironomids. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 295-304.
Reviews studies of polytene chromosomes in Chironomidae. Notes that it is generally not chromosome number but the sequence of the chromosome bands which is most important for species identification. Reproductive isolation is often due to accumulation of chromosomal rearrangements. Generally widespread species are more polymorphic. Recommends that future studies should give more emphasis to the primitive members of the family.

Specialised subjects: Cytotaxonomy - polytene chromosomes; Inversions - polytypy
Species: *Ablabesmyia* species [=*A. monilis*], *Acricotopus* species [=*A. lucens*], *Anatopynia* spp., *Belgica* species [=*B. antarctica*], *Camptochironomus* [=*Chironomus*] spp., *Chironomus annularius, C. balatonicus, C. entis, C. nudiventris, C. obtusidens, C. oppositus, C. plumosus, Clinotanypus* species [=*C. nervosus*], *Clunio* spp., *Cricotopus* spp., *Cryptochironomus* spp., *Demieijerea* sp. [=*D. rufipes*], *Diamesa* spp., *Einfeldia* species [=*E. carbonaria*],

Endochironomus albipennis, E. spp., *Fleuria* species [=*F. lacustris*], *Glyptotendipes glaucus, G. paripes, G.* spp., *Halocladius* spp., *Halliella* species [=*Baeotendipes noctivaga*], *Harnischia* species [=*H. curtilamellata*], *Kiefferulus* spp., [=*K. intertinctus, K. martini, K. paratinctus*], *Lauterbornia* [=*Micropsectra*] species, *Limnophyes* species, *Lipiniella araenicola, L. moderata, Lundstroemia* species [=*Paratanytarsus grimmi*], *Macropelopia* sp. [=*M. paranebulosa*], *Metriocnemus* spp., *Micropsectra* gp. *notescens, M.* spp., *Microtendipes* spp., *Orthocladius* spp., *Pentapedilum* spp. [= *Polypedilum exsectum, P. sordens*], *Polypedilum* spp., *Procladius* spp., *Prodiamesa* [=*Pseudodiamesa*] *branickii, Prodiamesa bureschi, P. olivacea, Protanypus* sp. [=*P.* gp. *morio*], *Psectrocladius* spp., *Psectrotanypus varius, Pseudodiamesa* spp., *Sergentia coracina, S.* spp., *Smittia* sp. [=*S. parthenogenetica*], *Stenochironomus* sp. [=*S. fascipennis*], *Stictochironomus* spp., *Tanytarsus* spp., *Telmatogeton fluviatilis, T. japonicus, T. torrenticola, T.* spp., *Thalassomya* sp. [=*T. frauenfeldi*], *Trichotanypus pectinatus*

Petrova, N.A. 1989b. Characteristics of the karyotypes of the midges (Diptera, Chironomidae) of the world fauna. I. Subfamilies Telmatogetoninae, Podonominae, Tanypodinae, Diamesinae, Prodiamesinae and Orthocladiinae. *Entomologicheskoe Obrozrenie* **68**: 107-120. (In Russian)
Tabulates the characteristics of the karyotype (chromosome number, relative chromosome length, presence of germ line limited chromosomes, etc.) for most of the described representatives of the subfamilies listed in the title, based on a search of the literature.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Ablabesmyia monilis*, *Acricotopus lucidus* [=*A. lucens,*], *Anatopynia* [=*Psectrotanypus*] *dyari, Anatopynia plumipes, Clinotanypus nervosus, Clunio balticus, C. marinus, C. ponticus, Cricotopus algarum, C. atritarsis* [=*C. ornatus*], *C. fuscus, C. ornatus, C. pirifer, C. sylvestris, C. tricinctus, C. trifasciatus, Diamesa insignipes, D. nivalis, D.* gp. *prolongata, D. stylata, D. tsutsui* [=*D. borealis*], *Halocladius mediterraneus, H. varians, H. vitripennis, Limnophyes* species, *Macropelopia paranebulosa, Metriocnemus cavicola* [=*M. martinii*], *M. hygropetricus, M. inopinatus, M.* species, *Orthocladius bipunctellus, O. frigidus, O. fuscimanus, O. oblidens, O. olivaceus, O. rubicundus, O.* sp. 1, *O.* sp. 2, *O.* species, *Procladius crassinervis, P. sagittalis, P.* species, *Prodiamesa* [=*Pseudodiamesa*]*branickii, Prodiamesa bureschi, P. olivacea, Protanypus* gp. *morio, Psectrocladius obvius*, *P. platypus*, *P.* species, *Psectrotanypus varius, Pseudodiamesa nivosa, Smittia parthenogenetica, Syndiamesa nivosa, Telmatogeton abnormis, T. hirtus, T. japonicus, T. pacificus, T. torrenticola, T.* species, *Thalassomyia* [=*Thalassomya*] *frauenfeldi, Trichotanypus pectinatus*

Petrova, N.A. 1990. Characteristics of the karyotypes of the midges (Diptera, Chironomidae) of the world fauna. II: Subfamily Chironominae. *Entomologicheskoe Obrozrenie* **69**: 193-214. (In Russian)
A continuation of the tabulation of karyotype characteristics of Chironomidae from Petrova (1989). This paper surveys the literature pertaining to the subfamily Chironominae, It erroneously includes the Orthocladiinae species *Belgica antarctica*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Baeotendipes tauricus* [=*B. noctivaga*], *Belgica antarctica, Camptochironomus* [=*Chironomus*] *pallidivittatus, C.* [=*Chironomus*] *tentans, C.* [=*Chironomus*] species, *Chironomus aberratus, C. acidophilus, C. acutiventris, C. agilis, C. alluaudi, C. alternans* a, *C. alternans* b, *C. alpestris, C. alpestris* [=*C. lacunarius*], *C. annularius, C. anthracinus, C. anchialicus, C. acidophilus, C.* sp. nr. *atteniatus* [=*C. decorus* gp.]*C. australis, C. balatonicus, C. bathophilus, C. borokensis, C. behningi, C. bernensis, C. bonus, C. calligraphus* [=*C. columbiensis*], *C. carus, C. cingulatus, C. cloacalis, C. commutatus, C. crassimanus, C. crassicaudatus, C. cucini, C. decorus* [=*C. decorus* gp., *C. dorsalis, C. duplex, C. frommeri, C.* f.l. *bathophilus* [=*C. markosjani*], *C. halophilus* [=*C. aprilinus*], *C. heterodentatus, C. holomelas, C. hyperboreus, C.* [=*Kiefferulus*]

intertinctus, C. islandicus, C. lacunarius, C. luridus, C. major, C. [=*Kiefferulus*] *martini, C. maturus, C. melanescens, C. melanotus, C. muratensis, C. nepeanensis, C. neglectus* [=*C. jonmartini*], *C. neocorax, C. nigricans, C. nuditarsis, C. nudiventris, C. occidentalis, C. obtusidens, C. oppositus, C. oppositus* f. *connori, C. oppositus* f. *tyleri, C. oppositus* f. *whitei, C. pankratovae, C. parathummi, C. plumosus, C. pseudothummi, C. rempeli, C. riihimäkiensis, C. riparius, C. salinarius, C. salinarius* gp., *C. sancticaroli, C. saxatilis, C. solitus, C. sororius, C. staegeri, C. stigmaterus, C. striatus, C. tardus, C.* cf. *tenuistylus, C. tepperi, C. thummi piger,* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *C. transvaalensis, C. tshernovsky, C. uliginosus, C. utahensis, C. valkanovi, C. vancouveri, C. whitseli, C. yoshimatsui, C. zealandicus* a [=*C. zealandicus*], *C. zealandicus* b [=*C.* species a], *C.* species, *C.* species [=*Kiefferulus paratinctus,*], *C.* species 1, *C.* species 2, *C.* spec. Apple Valley, *C.* species r [=*C.* species (n=2),], *C.* sp. *strenzkei*-complex, *Cryptochironomus defectus, C. defectus* gp. (1st karyotype), *C. defectus* gp. (2nd karyotype), *C. defectus* gp. (3rd karyotype), *C. defectus* gp. (4th karyotype), *C.* [=*Cladopelma*] *fridmanae, C. obreptans, C. psittacinus, C. supplicans, C.vulneratus* [=*C. psittacinus*], *C.* sp. (*defectus* gp.), *Demeijerea rufipes, Einfeldia carbonaria, Endochironomus albipennis, E. impar, E. impar* (sp. 1), *E. impar* (sp. 2), *E. nigricans, E. tendens, E.* species, *E.* sp. 1, *E.* sp. 2, *Fleuria lacustris, Glyptotendipes barbipes, G. caulicola, G. cauliginellus, G. glaucus, G. gripekoveni, G. mancunianus, G. paripes, G. polytomus* [=*G. pallens*], *G. salinus, G.* sp. 1, *G.* sp. 2, *Harnischia curtilamellata, Kiefferulus* Botanic Gardens sp. [=*K. paratinctus*], *Lauterbornia* [=*Micropsectra*] species, *Lipiniella araenicola, L. moderata, L.* species, *Lundstroemia parthenogenetica* [=*Paratanytarsus grimmi*], *Micropsectra* gp. *notescens, M. praecox* [=*M. junci*], *M.* spp., *Microtendipes* gp. *chloris, M. pedellus, Nilodorum biroi* [=*Kiefferulus barbatitarsis*], *Pentapedilum* [=*Polypedilum*] *exsectum, P.* [=*Polypedilum*] *sordens, Polypedilum bicrenatum, P. nubeculosum, P.* gp. *nubeculosum, P. nubifer, P.* gp. *pedestre, P. scalaenum, P.* species, *Sergentia coracina, S. intermedia, S.longiventris, S.nebulosa, S. profundorum* [?=*S. coracina*], *Stenochironomus fascipennis, Stictochironomus crassiforceps, S. histrio* [=*S. stictus*], *S. pictulus, S. psammophilus, S. rosenscholdi, S.* species, *Tanytarsus* gp. *lestagei, T.* species

Petrova, N.A. & Chubareva, L.A. 1978. The peculiarities of the karyotype of *Prodiamesa olivacea* Meig. (Diptera, Chironomidae, Orthocladiinae). *Tsitologiya* **20**: 1208-1211. (In Russian, English summary)
Describes and provides photographs of the mitotic (gonadal) and salivary gland chromosomes of *Prodiamesa olivacea*. The polytene karyotype is characterised by the unique appearance of the short chromosome V, and by telomeric connections between the larger chromosomes.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Prodiamesa olivacea*

Petrova, N.A., Chubareva, L.A. & Kuzmenko, K.N. 1977. The karyotypes of five species of Chironomidae (Diptera). *Tsitologiya* **19**: 900-905. (In Russian, English summary)
Describes the polytene chromosomes and gives some morphological features of the larvae of five species of Chironomini.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anthracinus*, *C. plumosus, C. salinarius* gp., *Einfeldia carbonaria*, *Polypedilum scalaenum*

Petrova, N.A., Chubareva, L.A., Zolotaryova, L.V. & Kaliberdo, T.A. 1981. The karyotypes of chironomids from the Bratsk Reservoir. *Tsitologiya* **23**: 1180-1187. (In Russian, English summary)
Describe the larval morphology and the chromosomes of *Chironomus plumosus*, *Polypedilum nubeculosum*, and a species of the *Cryptochironomus defectus* group. About 10% of the larvae of *C. plumosus* possessed a B chromosome. Illustrated by photographs of larval parts, the karyotypes of *P. nubeculosum* and *C. defectus* gp., and the B chromosome of *C. plumosus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus plumosus, Cryptochironomus defectus* gp., *Polypedilum nubeculosum*

Petrova, N.A. & Feher, L.V. 1985. Chromosomal polymorphism in *Glyptotendipes paripes* (Edw.) (Diptera, Chironomidae). *Tsitologiya* **27**: 710-712. (In Russian, English summary)
The only inversion polymorphism in the Bratsky reservoir population was for three inversions in chromosome I, all of which were in Hardy-Weinberg expected frequencies. Illustrated by photographs.

Specialised subjects: Inversions - heterozygosity
Species: *Glyptotendipes paripes*

Petrova, N.A., Kiknadze, I.I & Michailova, P.V. 1986. Species integration using the example of the '*plumosus*-group' of chironomids, pp.138-161.. *In* Kontrimavichyus, V.L., Volskis, R.S., Krivolutskii, D.A., Lugauskas, A.Yu., Nizhnik, G.V., Polyanskii, Yu.I., Sukatskas, V.T. & Yankyavichene, R.L. (eds.), *Systems of species integration*. 292pp. Vilnius: Institute of Zoology & Parasitology, Lithuanian SSR. (In Russian)
Also *In* Volskis, R.S. (ed.), *Systems of species integration*. 291pp. Nauka SSSR, Vilnius. (In Russian)
This reference has not been seen but compares the karyotypes of at least *Chironomus plumosus, C. muratensis* and *C. balatonicus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus balatonicus, C. muratensis, C. plumosus*

Petrova, N.A. & Maximova, F.L. 1978. The role of chromosomal rearrangements in speciation of chironomids (Diptera, Chironomidae). *Genetika* **14**: 1201-1207. (In Russian) [Translated in *Soviet Genetics* **14**: 849-853]
Describe and provide photographs of the salivary gland and mitotic chromosomes of a new species related to *Chironomus plumosus* but with only three pairs of chromosomes. Later studies have shown it to be *C. nudiventris* (Ryser, Scholl & Wülker 1983) with geographic differences in the sequences of some arms. The polytene banding pattern is compared to that of *C. plumosus*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus, C. plumosus* f. *larvalis reductus* [=*C. nudiventris*]

Petrova, N.A. & Michailova, P.V. 1986. The population karyological studies of some Chironomidae species. *Tsitologiya* **28**: 727-734. (In Russian, English summary)
Investigate the inversion polymorphism in three species of Chironomini. Conclude that the genome is comprised of two components, the conservative and the unstable. Interspecific differentiation begins in the unstable component and then follows in the conservative component. Illustrated by photographs.

Specialised subjects: Karyotype - evolution
Species: *Chironomus annularius*, *C. obtusidens*, *Glyptotendipes glaucus*

Petrova, N.A. & Michailova, P.V. 1989. Chromosome polymorphism of natural populations of *Endochironomus albipennis* Meig. (Diptera, Chironomidae). *Tsitologiya* **31**: 1200-1205. (In Russian, English summary)
Describe the inversion polymorphism in five widely separated populations of this species, which has 2n=6. The western populations are almost monomorphic, but eastern populations are highly polymorphic. Propose that the species has spread to the east where the species became highly polymorphic in the new ecological conditions. The Lake Korotskoe, Novograd population was particularly polymorphic (94.1% heterozygotes), possibly due to contamination of the biotope. Illustrated by three plates of photographs of the heterozygotes and the inversion limits, based on photographic maps.

Specialised subjects: Cytotaxonomy - polytene chromosomes, Inversions - geographical distribution
Species: *Endochironomus albipennis*

Petrova, N.A. & Zolotareva, L.V. 1982. Morphology and karyotype of a larva of *Micropsectra* sp. (Diptera, Chironomidae) from the East Pamirs. *Zoologicheskii Zhurnal* **61**: 1605-1607. (In Russian)
Provide photographic maps of the polytene chromosomes and a photograph, with drawing, of the mitotic chromosome complement of an unnamed *Micropsectra* species. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Micropsectra* species

Pfeiffer, H.H. 1939. Studies on *Chironomus* chromosomes with the polarizing microscope. *Nature* **143**: 335.

Suggests a model for the nature of the changes occurring when a salivary gland chromosome is stretched or squashed.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species,

Pfeiffer, H.H. 1940. Mikrurgische Versuche in polarisierten Lichte zur Analyse des Feinbaues der Riesenchromosomen von *Chironomus*. *Chromosoma* **1**: 526-530.
Further studies of salivary gland chromosomes by polarised light in an attempt to clarify his model of the submicroscopic structure. Illustrated by small photographs and by a diagram of the proposed submicroscopic structure.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species,

Pfeiffer, H.H. 1941. Mikrurgisch-polarisationsoptische Beiträge zur sub-mikroskopischen Morphologie larvaler Speicheldrüsenchromosomen von *Chironomus*. *Chromosoma* **2**: 77-85.
Further experimental and theoretical discussion of the submicroscopic structure of the salivary gland chromosomes. Illustrated only by diagrams.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species,

Pfeiffer, H.H. 1948. Über den Orientierungsgrad der Nucleinsäure-Leptonen in Speicheldrüsen-chromosomen. *Zeitschrift für Naturforschung* **3b**: 328-330.
Analysed salivary gland chromosomes in various fixatives with polarised light microscopy. Gives a theoretical discussion of the results in terms of possible orientation of the nucleic acids in the chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Philip, U. 1942. An analysis of chromosomal polymorphism in two species of *Chironomus*. *Journal of Genetics* **44**: 129-42.
Examined mitosis, meiosis and the salivary gland chromosomes of a number of species of chironomid but gives data basically only for two, *C. dorsalis* [=*C. luridus*] and *C. riparius*. Inversions were found to be common in both species, with mating being at random with respect to inversion type. The study of meiosis suggested that chiasmata were normally formed outside the inverted regions, since no bridges and fragments were observed at anaphase I. Illustrated by drawings of mitotic and meiotic chromosomes, and by photographs of an inversion in chromosome IV of *C. riparius*.

Specialised subjects: Inversions - geographical distribution
Species: *Chironomus cingulatus, C. dorsalis* [=*C. luridus*], *C.* [=*Einfeldia*] *longipes, C. thummi* [=*C. riparius*], *Cryptochironomus* species

Plagens, U. 1978. Effect of salt treatment on manually isolated polytene chromosomes from *Chironomus tentans*. *Chromosoma* **68**: 1-19.
Describes a method for rapid isolation of salivary gland chromosomes and the effect of 2M salt solutions on chromosomes prepared in this way. The results indicate the presence of a class of non-histone proteins involved in keeping the DNA in a supercoiled state. These proteins are also present in the nuclear membrane. Illustrated by photographs of the chromosomes before and after treatment, and by photographs or diagrams of the results of electrophoresis.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus tentans*

Porter, D.L. 1971. Oogenesis and chromosomal heterozygosity in the thelytokous midge, *Lundstroemia parthenogenetica* (Diptera, Chironomidae). *Chromosoma* **32**: 332-342.
L. parthenogenetica [=*Paratanytarsus grimmi*]was found to be a triploid thelytokous species with a uniform karyotype, always heterozygous for three chromosomal rearrangements. The karyotype is illustrated and a drawn chromosome map provided. The apomictic restitutional oogenesis is described and illustrated. Possible modes of evolution are discussed.

Specialised subjects: Thelytoky - apomixis, heterozygosity, karyotype
Species: *Lundstroemia parthenogenetica* [=*Paratanytarsus grimmi*]

Porter, D.L. 1973. *Parthenogenesis, chromosomal polymorphism and morphological variation in chironomids*. Ph.D. Thesis, University of Melbourne, Melbourne, Australia. 275pp.
Includes the studies of *Lundstroemia parthenogenetica* {=*Paratanytarsus grimmi*] previously published in Porter (1971). Also

studied a triploid (3n=12), thelytokous *Lauterbornia* species [=*Micropsectra sedna*] from the Canadian arctic, providing photographic maps of the salivary gland chromosomes of both the eight chromosome (considered ancestral) and more common seven chromosome forms. One diploid larva (2n=8) was also found. The apomictic restitutional oogenesis is described and illustrated. A further part of the work was on *Polypedilum nubifer*, forming the basis of the material published in Porter & Martin (1977). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes; Thelytoky - apomixis, :heterozygosity
Species: *Lundstroemia parthenogenetica* [=*Paratanytarsus grimmi*], *Lauterbornia* [=*Micropsectra*] *sedna, Polypedilum nubifer*

Porter, D.L. & Martin, J. 1977. The cytology of *Polypedilum nubifer* (Diptera: Chironomidae). *Caryologia* **30**: 41-62.
Drawn chromosome maps of the salivary gland chromosomes are provided, and the chromosomal polymorphism described. Comparison is made between Australian material and a sample from Israel. The species is female heterogametic and it appears likely the sex determining region is in the differential 41c-d end of arm G. Illustrated by numerous photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Polypedilum nubifer*

Poulson, D.F. & Metz, C.W. 1938. Studies on the structure of nucleolus forming regions and related structures in the giant salivary gland chromosomes of Diptera. *Journal of Morphology* **63**: 363-395.
Describes the structure of the nucleolus in the salivary gland chromosomes of two species of *Chironomus*, comparing them to the somewhat nucleolus-like puffs in *Sciara ocellaris*. Illustrated by good quality photographs. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus* species I [=*C. riparius*], *C.* species II [=*C. decorus* gp.]

Prostakova, T.M. 1968*a*. A study of the action of ribonuclease on RNA synthesis in giant chromosomes of *Tendipes plumosus*. *Tsitologiya* **10**: 157-161. (In Russian, English summary)
Incubation in ribonuclease induced the disappearance of the nucleolus and a reduction of uptake of labelled uridine or alanine into the chromosomes. There was no induction of puffing or any local activation of RNA synthesis in the chromosomes. RNA synthesis was not completely recovered even after prolonged incubation of the glands without ribonuclease. Illustrated by photographs and autoradiographs. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Tendipes* [=*Chironomus*] *plumosus*

Proviz, V.I. 1984. Karyotype of *Chironomus plumosus* forma larvalis reductus of the Posolsk sewerage. *In Systematics and evolution of the invertebrates of Baikal*, Nauka Siberian Division, Novosibirsk, pp.140-145. (In Russian)
This paper not seen but Kiknadze *et al*. (ATLAS, Nauka, Novosibirsk, 1991) note the species is *C. agilis*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus* (f. l. reductus) [=*C. agilis*]

Proviz, V.I. 1985. Karyotypic characteristics of two *Chironomus plumosus* L. populations (Diptera, Chironomidae) from the littoral zone of Lake Baikal. *Fauna Bajkal* **1**: 89-93.
This article has not been seen.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus, C. plumosus* (f. l. reductus) [=*C. agilis*]

Proviz, V.I. 1989. Karyotypes of *Chironomus plumosus* L. (Diptera, Chironomidae) of Lakes Baikal, Kotokel and Duhovoe, p.124-135. *In* Linevich, A.A. [ed.), *Fauna of Baikal. Part 4 - worms, molluscs and arthropods: collected scientific papers*. Nauka, Siberian Division, Novosibirsk, 135pp. (In Russian)
This paper not seen but Kiknadze (ATLAS, 'Nauka', Novosibirsk, 1991) notes reference to *C. agilis*.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus, C. plumosus* (f. l. reductus) [=*C. agilis*]

Puppels, G.J., de Mul, F.F.M., Otto, C., Greve, J., Robert-Nicoud, M., Arndt-Jovin, D.J. & Jovin, T.M. 1990 Studying single living cells and

chromosomes by confocal Raman micro-spectroscopy. *Nature* **347**: 301-303.
Use Raman microspectrophotometry to analyse a band, an interband and a telomere of chromosome II of *Chironomus thummi* [=*C. riparius*]. The DNA protein ratio was found to be highest in bands and lowest in the telomere. The ratio varies in interbands, although always lower than in bands. Illustrated by graphs and a photograph of chromosome II. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Pulver, U. & Fischer, J. 1980. Über eine Heterochromatin-Mutation aus einer Wildpopulation von *Chironomus nuditarsis*. II. Zum Replikationsverhalten des veränderten Genomabschnittes. *Genetica* **54**: 87-90. (English summary)
The G-knob mutant of *Chironomus nuditarsis* replaces the Balbiani ring by heterochromatin. This structure was shown to consist almost entirely of DNA and it can pass through two complete replication cycles during the fourth larval instar.

Specialised subjects: Heterochromatin - heterocycly
Species: *Chironomus nuditarsis*

Puvion, E. & Blanquet, P. 1971. Cytochimie ultrastructurale des groupements de point isoionique élevé. Application a la mise en évidence des protéins basiques. *Journal de Microscopie* **12**: 171-184. (English summary)
Details a technique which stains basic proteins and shows that the chromosomes are stained in the salivary glands of a chironomid. Illustrated by an electronmicrograph. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: ?*Chironomus* species

Quick, P., Weck, I., Koschnitzke, C. & Rombach, I. 1983. Different heat-induced changes in protein content of different isolated polytene chromosomes as revealed by microelectrophoresis. *Biology of the Cell* **47**: 265-274.
Isolated polytene chromosomes were subjected to heat shock. The changes in puffing pattern were similar to those detailed by other authors (e.g. Morcillo *et al*. 1982), although a number of other puffs also showed incorporation of tritiated uridine following heat shock. Illustrated by photographs and autoradiographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Rambousek, F. 1912. Cytoloické pomě y slinnyck ž laz a larver *Chironomus plumosus* Lin. *Sitzungsberichte der Königlich Böhmischen Gesellschaft der Wissenschaften, Matematisch-naturwissenschaftliche Klasse* **II**: 1-24.
Gives observations on the structure of the larval salivary gland chromosomes, well illustrated with drawings of the full complement. It is quoted in Beermann (1962a) as being the only one of the early papers recognising the chromosomal nature of the polytene elements.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Rasch, E.M. 1970. DNA cytophotometry of salivary gland nuclei and other tissue systems in dipteran larvae, pp. 357-397. *In* Weid, G.L. & Bahr, G.F. (eds.), *Introduction to Quantitative Cytochemistry - II. Second International Tutorial on Quantitative Cytochemistry, Chicago, 1968*. 551pp. Academic Press, New York.
Measurement of DNA values indicates that the large polytene nuclei of the Malpighian tubules have undergone 9 replications from the 2C value, and that the salivary gland nuclei have undergone 13 replications. In the various polytene classes, the values fit a 2^n geometric series of the 2C value, indicating that most or all chromatids of the polytene chromosome take part in the replication cycles. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*],

Rasmachnin, E.P. see Razmakhin, E.P.

Rathore, H.S. 1979. *Studies on the influence of various factors on puffing in dipteran giant chromosomes*. Ph.D. thesis, Vikram University, Ujjain, India.
Full contents not known, but includes the material published in Rathore, Bhasker & Swarup (1977) and Rathore & Swarup (1979, 1980).

Specialised subjects: Puffs - experimental induction

Species: *Chironomus* species

Rathore, H.S., Bhasker, C.R. & Swarup, H. 1977. The effects of oocyte supernate upon genome activity in *Chironomus*. *Bioresearch* **1**: 1-4.
Salivary glands of *Chironomus* larvae were incubated for varying times in the supernatant fraction obtained from either mature or immature eggs of *Heteropneustis fossilis*. In all four chromosomes the size of the puffs was greater in the supernatant of mature eggs than in the supernatant of immature eggs. The results indicate a role for the cytoplasm in regulating gene activity. No illustrations.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1979. Note on neomycin induced unusual puffs in *Chironomus* sps. (s.s. Diptera) salivary gland chromosome. *Indian Drugs* **16**: 216-217.
Incubation of salivary glands in neomycin sulphate leads to induction of two puffs comprising many adjacent bands of chromosome IV. Illustrated by a photograph.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1980*a*. The effects of neomycin on puffing in *Chironomus*. *Acta Histochemistry* **67**: 86-94.
Incubation of salivary glands in various amounts of neomycin sulphate led to puff induction. In higher concentrations the chromosomes became disorganised. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1980*b*. Effects of cupric (Cu^{2+}), ferric (Fe^{3+}) and magnesium (Mg^{2+}) ions on puffing in *Chironomus*. *Bangladesh Journal of Zoology* **8**: 15-20.
Larval salivary glands were incubated in media containing various concentrations of the three ions under study at pH7.2. The results confirmed the effect of magnesium in facilitating the action of hormones and additionally showed that cupric and ferric ions could induce new puffs and repress the Balbiani rings. Illustrated by 16 photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1981. Induced puffing patterns of salivary chromosome IV in *Chironomus* by oocyte supernate fraction of *Heteropneustis fossilis*. *Biologia* **27**: 57-59.
Salivary glands were incubated in the clear supernatant fraction, free of yolk and large protein molecules, derived from immature eggs of *Heteropneustis fossilis*. The efficiency of induction of puffs in chromosome IV of a *Chironomus* species appears to increase with time. This suggests a role for the cytoplasm in regulating nuclear activities. Illustrated by drawings of chromosome IV.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1982*a*. Cytogenetic investigations on *Chironomus* larva treated with cadmium chloride. *The International Journal of Environmental Studies* **19**: 209-214.
Study the effects of cadmium chloride on the banding and puffing of the salivary gland chromosomes. *In vivo* and *in vitro* treatments resulted in severe chromosomal disorganisation, with puff induction and regression. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species,

Rathore, H.S. & Swarup, H. 1982*b*. Influence of aspirin on gene activity in salivary chromosomes in *Chironomus*. *Pakistan Journal of Zoology* **14**: 108-112.
Incubation of salivary glands in aspirin solutions lead to disruption of the banding pattern, the regression of normal puffs and the induction of new puffs. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1982*c*. Toxicity of lead nitrate to *Chironomus* sp. larvae: a cytogenetic investigation. *Pakistan Journal of Zoology* **14**: 118-121.
Larvae or larval salivary glands were exposed to lead nitrate at various concentrations for a period of one hour (up to 3 hours in the case of some *in vitro* experiments). Effects were only noted in

dissected glands, where the chromosomes became elongated and specific puffs were induced. The induction of puffs is hypothesised to be due to the lethal effects of the lead on the mitochondria. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S. & Swarup, H. 1982*d*. Preliminary observations on the influence of thyroxine on puffing in *Chironomus*. *Pakistan Journal of Zoology* **14**: 243-248.
Salivary glands were incubated in thyroxine solutions of various concentrations. Chromosome structure became disorganised, normal puffs regressed and new puffs were induced. This is hypothesised to be due to the effect of thyroxine on cell membrane permeability. Illustrated by photographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* species

Rathore, H.S., Swarup, H. & Gopelan, H.N.S. 1985. Salivary gland chromosomes of *Chironomus* sps. *Biologia* **31**: 13-18.
Provide a combination drawn-photographic maps of the polytene chromosomes of the same unnamed *Chironomus* species as studied by Rathore (1979), Rathore *et al*. (1977), Rathore & Swarup (1979, 1980a, b, 1981, 1982a, b, c, d).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* species

Razmakhin, E.P., Kiknadze, I.I., Panova, T.M., Mertvetsov, N.P., Ammosov, A.D. & Sidorov, B.N. 1982. The in situ hybridization study of the nucleolus organizer functional activity in polytene chromosomes from different tissues of *Chironomus thummi*. *Tsitologiya* **24**: 863-868. (In Russian, English summary)
Used labelled rRNA to investigate the nucleolus organiser region in the salivary gland and Malpighian tubule polytene chromosomes. Changes in morphology and activity in these tissues are discussed. Illustrated by photographs.

Specialised subjects: Nucleolus - structure
Species: *Chironomus thummi* [=*C. riparius*]

Razmakhin, E.P., Kiknadze, I.I., Shilova, I.E., Zacharenko, L.P., Panova, T.M., Mertvetsov, N.P., Ammosov, A.D. & Sidorov, B.N. 1982. In situ hybridization study of the functional activity of *Chironomus thummi* nucleolus organizer. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 50.
Abstract of the work reported by Razmakhin *et al*. (1982).

Specialised subjects: Nucleolus - structure
Species: *Chironomus thummi* [=*C. riparius*]

Reiling, H. 1982. *Lichtoptische Darstellun gespreiteter Speicheldrüsenchromosomen bei* Chironomus tepperi. Staatsprüfung Diplom Report, Institut für Genetik, Ruhr-Universität, Bochum, Germany. 47pp.
Prepared photographic maps of surface spread salivary gland chromosomes of *Chironomus tepperi*. Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus tepperi*

Reinig, H.-J. 1953. Untersuchungen von Riesenchromosomen. *Mikrokosmos* **42**: 116-117.
A simple outline of the preparation of salivary gland chromosomes for examination under the microscope. Illustrated by a photograph.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*],

Rempel, J.G., Naylor, J.M., Rothfels, K. & Ottonen, B. 1962. The sex chromosome constitution of chironomid intersexes parasitised by nematodes. *Canadian Journal of Genetics and Cytology* **4**: 92-96.
Makes use of the existence of a cytologically recognisable sex chromosome pair, due to an inversion and DNA puff in most Y chromosomes, to investigate the occurrence of parasitism in *Chironomus rempelii*. As a result they were able to confirm that the adults which appeared to be females with a male terminalia were actually intersex males. Illustrated by a photograph of the whole salivary gland chromosome complement and by photographs of chromosome 3 from males and females.

Specialised subjects: Sex chromosomes - intersexes
Species: *Chironomus rempeli*

Resnik, N.A. - see Reznik, N.A.

Reznik, N.A., Gruzdev, A.D., Chirikova, G.B. & Kerkis, I.E. 1982. The effect of a brief-temperature shock on the structure of the salivary gland polytene chromosomes of *Chironomus thummi*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 52.
Essentially an abstract of the results reported by Reznik *et al*.(1985).

Specialised subjects: Polytene chromosomes - structure; Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Reznik, N.A., Gruzdev, A.D. & Shilova, I.E. 1985. Structural changes in the polytene chromosomes of *Chironomus thummi* following brief heat shocks. *Tsitologiya* **27**: 504-510. (In Russian, English summary)
Brief heating or cooling of larvae by more than 5^{O}C induces structural changes in the bands of the polytene chromosomes, in addition to changes in puffing patterns. It is suggested that these changes are due to weakening of bonds between interband fibrils and between chromomeres. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Reznik, N.A., Kerkis, I.E. & Gruzdev, A.D. 1982. Puffing changes following brief temperature shocks in the polytene chromosomes of *Chironomus thummi* salivary glands. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 53.
An abstract of the work published by Reznik *et al*.(1983).

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Reznik, N.A., Kerkis, I.E. & Gruzdev, A.D. 1983. The effects of brief temperature shock on the puffing pattern in the polytene chromosomes of *Chironomus thummi* salivary glands. *Tsitologiya* **25**: 918-927. (In Russian, English summary)
Following a brief temperature shock a puff was developed at 4-A1b, except in red pupae. The nucleolus and Balbiani rings were reduced in size, and changes were noted at ten other loci. The magnitude of changes was greatest at 2^{O}C and 32-34^{O}C.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Ringborg, U. & Rydlander, L. 1971. Nucleolar-derived ribonucleic acid in chromosomes, nuclear sap, and cytoplasm of *Chironomus thummi* salivary gland cells. *Journal of Cell Biology* **51**: 355-368.
Analysis of radioactively labelled high molecular weight RNAs from the nucleolus and from chromosomes revealed that 38, 30 and 23S RNA are present in the nucleolus while 30, 23 and 18S RNA are present in the chromosomes. It is concluded that the RNA is genuinely present on the chromosomes and is not an artefact. (Partim)

Specialised subjects: Nucleolus - RNA content
Species: *Chironomus tentans*

Ristow, H. & Arends, S. 1968. A system in vitro for the synthesis of RNA and protein by isolated salivary glands and by nuclei from *Chironomus*. *Biochimica et Biophysica Acta* **157**: 178-186.
Describe techniques for isolation of salivary gland nuclei. An illustration of polytene chromosomes from nuclei isolated in this manner is provided to show the normal appearance of banding and puffs. A photograph of an intact gland with the polytene chromosomes visible is also included. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Robert, M. 1964. *Activation des genes chez* Chironomus thummi *par injection de Trypsine dans le noyeau cellulaire*. Diploma Thesis, Eidgenössische Technische Hochschule, Zürich, Switzerland. 27 pp.
Reference not seen but assumed to include the material in Robert & Kroeger (1965).

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Robert, M. 1971. Einfluss von Ionenstärke und pH auf die differentielle Dekondensation der Nukleoproteide isolierter Speicheldrüsen-Zellkerne und -Chromosomen von *Chironomus thummi*. *Chromosoma* **36**: 1-33. (German & English summaries)
Studied the effects of ionic strength and pH of the medium on the state of decondensation of the bands of the polytene chromosomes in isolated nuclei of the salivary glands. The bands

decondense as ionic strength increases, dependent upon the pH and the ion species used. The effects are explained on the basis of the physico chemical properties of the chromosomes. Illustrated by numerous photographs and diagrams.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Robert, M. 1975*a*. Isolation and manipulation of salivary gland nuclei and chromosomes. *Methods in Cell Biology* **9**: 377-390.
Describes an improved technique for isolating salivary gland nuclei and chromosomes.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Robert, M. 1975*b*. Ergebnisse und Modellvorstellungen zur Wirkungsweise von Ionen auf die Genaktivität. *Regulationsmechanismen der Genaktivität und Replikation bei Riesenchromosomen. Nachrichten der Akademie der Wissenschaften in Göttingen. Mathematisch-Physikalische Klasse*: 166-169.
Reviews studies of the effects of ionic concentration and pH on the degree of condensation of the bands of isolated polytene chromosomes.

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Robert, M. & Kroeger, H. 1965. Lokalization zusätzlicher RNS-Synthese in Trypsin-behandelten Riesenchromosomen von *Chironomus thummi*. *Experientia* **21**: 326-327. (English summary)
Injection of trypsin into the nuclei of salivary gland cells causes enlargement of the puffs and an approximate three-fold increase in RNA synthesis. Illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Rosin, S. & Fischer, J. 1965. Geschlechts-gekoppelte Inversionen bei *Chironomus nuditarsis* Str. *Funfundzwanzigster Jahresbericht der Schweizerischen Gesellschaft für Vererbungs-forschung, S.S.G. Archiv der Julius Klaus-Stiftung für Vererbungsforschung, Sozialanthropologie und Rassenhygeine* **40**: 26-35.
Provide evidence that the sex determiner in *C. nuditarsis* is on the AB chromosome, near the centromere, although in some instances it appeared the Y-locus might be in a different position. Drawings and diagrams of the banding sequence and the inversion arrangements are also given. Includes some discussion concerning crossing over in the chromosome.

Specialised subjects: Inversions - sex linked
Species: *Chironomus nuditarsis*

Rosin, S. & Fischer, J. 1966. Über eine Translokation aus einer Wild-population von *Chironomus nuditarsis* Str. *Sechsundzwanzigster Jahresbericht der Schweizerischen Gesellschaft für Vererbungsforschung, S.S.G. Archiv der Julius Klaus-Stiftung für Vererbungsforschung, Sozial-anthropologie und Rassenhygeine* **41**: 37-44.
Provide an analysis of the frequency and fertility of a natural translocation between arms B and C in *C. nuditarsis*. The homozygous translocation is assumed to be associated with lethal factors. The sex determiner is not on the AB chromosome in these larvae as previously found (Rosin & Fischer 1965). Illustrated by a photograph of a translocation heterozygote, and a drawn map of the AB chromosome.

Specialised subjects: Reciprocal translocations - genetic effects
Species: *Chironomus nuditarsis*

Rosin, S. & Fischer, J. 1968. Zum Selektionswert verschiedener chromosomaler Strukturtypen von *Chironomus nuditarsis* Str. *Achtundzwanzigster Jahresbericht der Schweizerischen Gesellschaft für Vererbungsforschung, S.S.G. Archiv der Julius Klaus-Stiftung für Vererbungsforschung, Sozialanthropologie und Rassenhygeine* **43**: 31-40.
Investigated various sources of selective advantage for the carriers of the various inversion polymorphisms in *C. nuditarsis*. The only significant factor noted was that the heterozygotes sometimes showed more rapid development than the homozygotes.

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus nuditarsis*

Rosin, S. & Fischer, J. 1972*a*. Y-polymorphismus bei *Chironomus nuditarsis* Str. *Zusammenfassung der Schweizerische Gesellschaft für Vererbungsforschung, 1971. Archiv für Genetik* **45**: 100. (Abstract)
A summary of the studies on polymorphism of the location of the sex determiner in *C. nuditarsis*. Published in full by Rosin & Fischer (1972*b*).

Specialised subjects: Sex chromosomes - Y-chromosome evolution
Species: *Chironomus nuditarsis*

Rosin, S. & Fischer, J. 1972*b*. Polymorphismus des Realisators für männliches Geschlecht bei *Chironomus*. *Revue Suisse de Zoology* **79** (Supplement): 119-141. (German, French & English summary)
Studied the inheritance of inversion in larvae reared from egg masses to investigate the location of the sex determiner (M-factors) in three species of *Chironomus*. Two of these, *C. nuditarsis* and *C. plumosus*, proved to be polymorphic for M-factor location. Includes some notes on the effect of temperature on the frequency of crossing over in males.

Specialised subjects: Sex chromosomes - Y-chromosome evolution
Species: *Chironomus nuditarsis*, *C. plumosus, C.* spec.1 [=*C. bernensis*]

Ross, R. 1989. *Klonierung und Analyse Tandem-Repetitiver DNA-Elemente from* Chironomus luridus. Diplomarbeit Thesis, Lehrstuhl für Genetik, Ruhr-Universität, Bochum, Germany.
Isolated a Cla element from *C. luridus* using a clone from *C. thummi* [=*C. riparius*] as a probe. The isolated DNA was used for *in situ* hybridisation to the salivary gland chromosomes and hybridisation was found at many sites including the centromeres. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus luridus*,

Rothfels, K.H. & Fairlie, T.W. 1957. The non-random distribution of inversion breaks in the midge *Tendipes decorus*. *Canadian Journal of Zoology* **35**: 221-63.
Describes the mitotic and salivary gland chromosomes of a member of the *T.* [=*Chironomus*] *decorus* group. Twenty five polymorphic inversions were described, 18 of them (54 of a total of 77 chromosome breaks) being in chromosome II. Also the distribution of break points within chromosome II was not random. Very detailed photomaps of the polytene chromosomes are provided.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Tendipes decorus* [=*Chironomus decorus* gp.(B)]

Rozynek, P. 1988. *Analyse von Hämoglobin-genen und ihrer Intergenenregion bei* Chironomus thummi. Diplomarbeit Thesis, Lehrstuhl für Genetik, Ruhr-Universität, Bochum, Germany. 71pp.
Analyses a clone, λpiHb1, isolated from *Chironomus piger* and shows by *in situ* hybridisation that it is situated on arm D. Illustrated by photograph. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi piger* [=*C. piger*]

Rubinstein, L. & Clever, U. 1972. Chromosome activity and cell function in polytenic cells: V. Developmental changes in RNA synthesis and turnover. *Developmental Biology* **27**: 519-537.
RNA synthesis in salivary gland chromosomes of larvae of different ages was demonstrated by autoradiography after short pulses of tritiated uridine. Illustrated by autoradiographs. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus tentans*

Ruch, F. 1951. Eine Apparatur zur Messung des Ultraviolet Dichroismus von Zellstrukturen. *Experimental Cell Research* **2**: 680-683.
Reports dichroism in bands of *Chironomus* polytene chromosomes but gives no other data. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Rudkin, G.T. 1972. Replication in polytene chromosomes. *In* Beermann, W.(ed.), *Developmental studies on giant chromosomes. Results and Problems in Cell Differentiation* **4**: 58-85.
Reviews replication in polytene chromosomes, largely in Drosophila but includes some supporting data from *Chironomus*. In "Notes added in Proof" the work of Rasch (1970) regarding successive doublings of the diploid DNA content in *Chironomus thummi* [=*C. riparius*] is recorded. (Partim)

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus* spp., *C. tentans*, *C. thummi* [=*C. riparius*]

Rueffel, P. 1962. A cytological and biochemical approach to the taxonomy of freshwater midges (Chironomidae). *Proceedings of the 99th Annual*

Meeting of the Entomological Society of Ontario. Proceedings of the Entomological Society of Ontario **93**: 130-131. (Abstract)
Discusses the use of salivary gland chromosomes to recognise species, subspecies or hybrids amongst larvae of Chironomidae. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Chironomidae spp.

Rydlander, L. 1981. *Expression of Balbiani ring genes in salivary gland cells of* Chironomus. Thesis, Department of Histology, Karolinska Institutet, Stockholm, Sweden. 48pp.
Some results published in Rydlander & Edström (1980) and Rydlander *et al*. (1980). Contains photographs of salivary gland and polytene chromosomes, as well as chromosome IV showing the effects of galactose treatment.

Specialised subjects: Puffs - Balbiani rings, gene product, experimental induction
Species: *Chironomus tentans*

Rydlander, L. & Edström, J.-E. 1980. Large sized nascent protein as dominating component during protein synthesis in *Chironomus* salivary glands. *Chromosoma* **81**: 85-99.
The data obtained support the view that component I of the *C. tentans* salivary gland cells is closely related to the primary translation product of 75S RNA from BR2. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Rydlander, L., Pigon, A. & Edström, J.-E. 1980. Sequences translated by Balbiani ring 75S RNA in vitro are present in giant secretory protein from *Chironomus tentans*. *Chromosoma* **81**: 101-113.
Sequences translated from the 75S RNA of BR1 and BR2 were translated and found to show a large degree of correspondence with giant secretory protein component I but less to that of components II+III. This suggests that the 75S RNA from BR1 and BR2 codes for component I. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus tentans*

Ryser, H.M., Geiger, H.J., Scholl, A. & Wülker, W. 1980. Untersuchungen ueber die Verbreitung der Zuckmuecken Gattung *Chironomus* in der Schweiz, mit Besonderer Berueksichtigung von drei Cytologisch nicht Beschreibenen Arten, pp.17-24. *In* Murray, D.A. (ed.), *Chironomidae: Ecology, systematics, cytology and physiology*. 349pp. Permagon Press, Oxford. (English summary)
The distribution of the genus *Chironomus* in Switzerland was investigated by cytological diagnosis. Three species with previously undescribed karyotypes are briefly described and the relationships of sp.3 and sp.7 to *C. plumosus* are indicated diagrammatically. Sp.3 and Sp. 7 were subsequently described by Ryser *et al*. (1983) and Sp.2 by Wülker *et al*. (1983). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus plumosus, C.* sp.2 [=*C. acutiventris*], *C.* sp.3 [=*C. muratensis*], *C.* sp.7 [=*C. nudiventris*]

Ryser, H.M., Scholl, A. and Wülker, W.W. 1983. Revision der Gattung *Chironomus* Meigen (Diptera) VII: *C. muratensis* n.sp. und *C. nudiventris* n. sp., Geschwisterarten aus der *plumosus*-Gruppe. *Revue suisse der Zoologie* **90**: 299-316. (English and German summaries)
Describe two closely related new species largely on the basis of differences in the banding pattern of the polytene chromosomes, and compare them to that of *C. plumosus*. Also describe the inversion polymorphism observed in these two species. Illustrated by photographic maps. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus muratensis*, *C. nudiventris, C. plumosus*

Ryser, H.M. Wülker, W. & Scholl, A. 1985. Revision der Gattung *Chironomus* Meigen (Diptera). X. *Lobochironomus* n. subg. (*C. montuosus* n. sp., *C. storai* Goetgh., *C. mendax* Stora). *Revue suisse de Zoologie* **92**: 385-404. (English & German summary)
Describe and provide photographs of the salivary gland karyotype of three species included in a new subgenus, *Lobochironomus*, of the genus *Chironomus*. The inversion polymorphism observed in *C. montuosus* and *C. mendax* is described. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus mendax*, *C. montuosus, C. storai*

Sachs, R.I. & Clever, U. 1972. Unique and repetitive DNA sequences in the genome of

Chironomus tentans. *Experimental Cell Research* **74**: 587-591.
Report that 95.5% of the DNA represents single-copy sequences. High molecular weight RNA synthesised by the salivary glands hybridises to the Balbiani rings. This DNA contains redundant sequences. Illustrated by a photograph and an autoradiograph of chromosome IV.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Saiga, H., Botella, L. & Edström, J.-E. 1988. Subrepeats within the BR1β repeat unit in *Chironomus pallidivittatus* can be classified into different types depending on codon usage. *Journal of Molecular Evolution* **27**: 298-302.
Three cDNA clones with homology to 75S RNA were found the *in situ* hybridise to BR1 on salivary gland chromosomes although they did not cross hybridise to the previously described BR1 units. Results not illustrated. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus pallidivittatus*

Saiga, H. & Edström, J.-E. 1985. Long tandem arrays of complex repeat units in *Chironomus* telomeres. *The EMBO Journal* **4**: 799-804.
Analysis of a sequence from the telomere of *Chironomus pallidivittatus* indicated that on average they contain 300kb of a 340bp repeat unit. The specificity of this unit to the telomeres was shown by *in situ* hybridisation to the salivary gland chromosomes. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes, Telomere - structure
Species: *Chironomus pallidivittatus*

Saiga, H., Grond, C., Schmidt, E.R. & Edström, J.-E. 1987. Evolutionary conservation of the 3' ends of members of a family of giant secretory protein genes in *Chironomus pallidivittatus*. *Journal of Molecular Evolution* **25**: 20-28.
The identity of two clones as representatives of the repeat sequences of BR1 and BR2 respectively was confirmed by *in situ* hybridisation to the salivary gland chromosomes. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus pallidivittatus*

Santa-Cruz, M.C. & Diez, J.L. 1979. Galactose induced Balbiani-ring-like structures in chromosome I and II of *Chironomus thummi*. *Experientia* **35**: 48-50.
Feeding with galactose induces Balbiani ring-like puffs in chromosomes I and II of some strains of *C. thummi* [=*C. riparius*]. Illustrated by photographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Santa-Cruz, C., Morcillo, G., Aller, P. & Diez, J.-L. 1981. Heat shock induced puffing changes in *Chironomus thummi*. *Cell Differentiation* **10**: 33-38.
Changes in the activity of the Balbiani rings following heat shock were observed. Besides the effects on the normal BRs of chromosome IV, Balbiani ring-like puffs were induced in the telomeric regions of chromosomes I and III. Illustrated by photographs and diagrams.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Santa-Cruz, M.C., Morcillo, G. & Diez, J.L. 1984. Ultrastructure of a temperature-induced Balbiani ring in *Chironomus thummi*. *Biology of the Cell* **52**: 205-212.
Examine the ultrastructure of a temperature-induced Balbiani ring, (T-BR III) of *C. thummi* [=*C. riparius*]. Although similar to a normal BR under the light microscope, T-Br III shows striking differences at the electron microscope level. Illustrated by photographs and electron micrographs.

Specialised subjects: Puffs - Balbiani rings, structure
Species: *Chironomus thummi* [=*C. riparius*]

Santa-Cruz, M.C., Villanueva, A. & Diez, J.L. 1978. Effect of galactose treatment in the puffing pattern of *Chironomus thummi* Balbiani rings. *Chromosoma* **69**: 93-100.
Compare the effects of galactose-feeding on the Balbiani rings of *C. thummi* [=*C. riparius*], in an expanded version of Santa-Cruz & Diez (1979), with those reported by other workers on *C. tentans* and *C. pallidivittatus*. They conclude that the BRs play the same physiological role in the three species. Illustrated by photographs of chromosome IV.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*, *C. tentans, C. thummi* [=*C. riparius*]

Sass, H. 1978. *Untersuchungen zur Struktur und Funktion der Balbianiringe von* Chironomus tentans. Dissertation, Universität Tübingen, Germany.
Thesis not seen but assumed to contain mostly the work published in Sass (1980*a* & *b*, 1981)

Specialised subjects: Puffs - Balbiani rings, structureSpecies: *Chironomus tentans*

Sass, H. 1980*a*. Features of in vitro puffing and RNA synthesis in polytene chromosomes of *Chironomus*. *Chromosoma* **78**: 33-78.
Reports that potential puff sites maintain a low rate of RNA synthesis even though they may not appear visibly puffed. Illustrated by numerous photographs and autoradiographs.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Sass, H. 1980*b*. Heirarchy of fibrillar organization levels in the polytene interphase chromosomes of *Chironomus*. *Journal of Cell Science* **45**: 269-293.
Salivary gland chromosomes of a number of species of *Chironomus* were examined under transmission or scanning electron microscope, either *in situ* or spread *in vitro*. The structure of bands, interbands, Balbiani rings and heterochromatin were investigated and a model of chromosome structure produced. Illustrated by numerous electron micrographs and by interpretative drawings or diagrams.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus melanotus*, *C. pallidivittatus*, *C. plumosus, C. tentans*, *C. thummi* [=*C. riparius*]

Sass, H. 1981. Effects of DMSO on the structure and function of polytene chromosomes of *Chironomus*. *Chromosoma* **83**: 619-643.
Exposure of fourth instar larvae of *C. tentans* results in a characteristic pattern of stimulation of the Balbiani rings. After removal of the drug all puffs collapse and then slowly become reestablished. This is useful in determining the site of formation of the BRs. Transcription of puffs is not completely shut off by the DMSO. Well illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

Sass, H. 1982*a*. RNA polymerase B in polytene chromosomes: immunofluorescent and auto-radiographic analysis during stimulated and repressed RNA synthesis. *Cell* **28**: 269-278.
Analysis of the salivary gland chromosomes under various conditions of stimulated or repressed RNA synthesis indicates that RNA polymerase B is associated not only with puffs such as the Balbiani rings but also with interband regions. Illustrated by numerous photographs.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Sass, H. 1982*b*. Distribution of RNA polymerase B in polytene *Chironomus* chromosomes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 55-56.
An abstract of the work published in Sass (1982*a*).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus pallidivittatus*, *C. tentans*

Sass, H. 1983. Localization of Balbiani ring 2 gene sequences in an interband and band of the DRB-repressed locus of *Chironomus tentans*. Abstracts of the Twenty third Annual Meeting, American Society for Cell Biology, San Antonio, Texas. *Journal of Cell Biology* **97**: 130a.
Essentially an abstract of the work published in Sass (1984).

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Sass, H. 1984. Gene identification in polytene chromosomes: some Balbiani ring 2 gene sequences are located in an interband-like region of *Chironomus tentans*. *Chromosoma* **90**: 20-25.
Used the experimental regression of BR2 to allow the demonstration that the gene sequences are in an interband region. *In situ* hybridisation of cloned BR2 sequences to treated salivary gland chromosomes shows hybridisation between bands IV-3B9 and 10, but not over the bands. Illustrated by photographs and autoradiographs.

Specialised subjects: Polytene chromosomes - bands and genes

Species: *Chironomus tentans*

Sass, H. & Bautz, E.K.F. 1982. Immunoelectron microscopic localization of RNA polymerase B on isolated polytene chromosomes of *Chironomus tentans*. *Chromosoma* **85**: 633-642.
By utilising the improved resolution of electron microscopy, it was shown that RNA polymerase B is present in decondensed sites, i.e. puffs and interbands, whereas no detectable amounts were present in bands. Illustrated by photographs and electron micrographs.

Specialised subjects: Polytene chromosomes - bands and interbands
Species: *Chironomus tentans*

Saxena, S. 1982. *Studies on the polytene chromosomes and chromosomal polymorphism of five Indian chironomid species*. Ph.D. Thesis, Zoology Department, University of Delhi, India.
Provides photographic maps and descriptions of the inversion polymorphism of *Kiefferulus biroi* (=*Kiefferulus barbatitarsis*), *Chironomus calipterus, C. plumatisetigerus* (=*C. circumdatus*) and two undescribed species. The *Chironomus* species are compared to those of Europe and of Australia, although some of the comparisons are incorrect. Part of this work subsequently published by Saxana et al. (1985). Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus calipterus, C. plumatisetigerus* [=*C. circumdatus*], *C.* species, *Nilodorum biroi* [=*Kiefferulus barbatitarsis*]

Saxena, S., Martin, J. & Dass, C.M.S. 1985. The polytene chromosomes of *Nilodorum biroi* (Kieffer)

(Diptera, Chironomidae). *Genetica* **66**: 213-221.
Describe and provide photographic maps of the salivary gland chromosomes of *Nilodorum biroi* [=*Kiefferulus barbatitarsis*] (2n=6). Inversion polymorphism is described, as are the banding differences between Indian and Australian populations. There is an unpaired region on arm D found only in males of the Australian populations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Nilodorum biroi* [=*Kiefferulus barbatitarsis*]

Schaller, L.M. 1972. An electrophoretic and cytogenetic study of *Chironomus utahensis* as found in northern Arizona. M.Sc. Thesis, Northern Arizona University, Flagstaff, Arizona, U.S.A. 52 pp.
Briefly describes the polytene chromosomes of *C. utahensis* and illustrates them as seen under Nomarski interference. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus utahensis*

Schaller, L. & English, D.S. 1976. Electrophoretic and cytogenetic studies of *Chironomus utahensis*. *Journal of Heredity* **67**: 300-302.
A brief published version of the description of the polytene chromosomes given in the M.Sc. thesis of Schaller (1972).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus utahensis*

Schin, K.S. & Clever, U. 1968. Ultrastructural and cytochemical studies of salivary gland regression in *Chironomus tentans*. *Zeitschrift für Zellforschung und Mikroskopische Anatomie* **86**: 262-279.
At the end of the prepupal stage the salivary glands begin to degenerate. The puffs in the polytene chromosomes begin to regress and uptake of ^{3}H-uridine can no longer be demonstrated. The cells become progressively more pyknotic and can no longer be analysed. It is possible that some of the puffs in the polytene chromosomes are transcribing RNA for processes involved in the subsequent cell degeneration. (Partim)

Specialised subjects: Puffs - pupariation
Species: *Chironomus tentans*

Schmidt, E.R. 1980. Two AT-rich satellite DNAs in the chironomid *Glyptotendipes barbipes* (Staeger). Isolation and localization in polytene chromosomes of *Glyptotendipes barbipes* and *Chironomus thummi*. *Chromosoma* **79**: 315-328.

Two AT-rich satellite DNAs, which together comprise 12-15% of the total DNA, were isolated from the genome of *G. barbipes*. These satellites do not appear to be underreplicated in polytene chromosomes. *In situ* hybridisation indicated differential distribution of the satellites in the centromeric regions of the chromosomes. Satellite II hybridises to various locations, mainly the centromere regions of *C. thummi* [=*C. riparius*].

Results with satellite I were not satisfactory. Illustrated by photographs and autoradiographs. (Partim)

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Schmidt, E.R. 1982. A repetitive DNA-sequence family in *Chironomus*: studies of base sequence, transcription and distribution in the genomes of chironomids. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 57-58.
A repetitive DNA sequence has different chromosomal distribution in different *Chironomus* species. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus piger*, *C. thummi* [=*C. riparius*]

Schmidt, E.R. 1984. Clustered and interspersed repetitive DNA sequence family of *Chironomus*. The nucleotide sequence of the Cla-elements and of various flanking sequences. *Journal of Molecular Biology* **178**: 1-15.
Cla-elements occur as small to medium clusters dispersed over more than 200 sites in *C. thummi* [=*C. riparius*], but at only the centromeres and three other sites on chromosome IV of *C. piger*. Illustrated by photographs of *in situ* hybridisation to chromosome I of an F1 hybrid between the two species. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Schmidt, E.R. 1988. Exonuclease digestion of chromosomes for *in situ* hybridization. *Nucleic Acids Research* **16**: 10381.
Describes a technique to use exonuclease for denaturation of polytene chromosomes, rather than heat denaturation. The exonuclease treatment is claimed to be less detrimental to the banding pattern. Illustrated by photographs.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Schmidt, E.R. 1989. Molecular biology of *Chironomus*: state-of-the-art. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 151-163.
Reviews work being carried out on molecular biology of *Chironomus,* much of which makes use of the good quality polytene chromosomes. Notes studies on Balbiani rings, puff I-18C in *C. tentans,* the repetitive DNA of the *C. thummi - C. piger* pair, and sex determination such as the single heterozygous band visible in males of *C. thummi*. Illustrated by photographs and a reproduction of an original drawing from Balbiani (1881). [Partim]

Specialised subjects: Puffs, Balbiani rings, DNA structureSpecies: *Chironomus melanotus, C. pallidivittatus, C. tentans, C. thummi piger* [=*C. piger*], *C. thummi thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Schmidt, E.R. & Godwin, E.A. 1983. The nucleotide sequence of an unusual non-transcribed spacer and its ancestor in the rDNA in *Chironomus thummi thummi*. *The EMBO Journal* **2**: 1177-1183.
The non-transcribed spacer of the ribosomal DNA of *C. thummi* [=*C. riparius*] contains a Cla element cluster, not present in *C. piger*. The Cla element is present at many sites on the chromosomes of *C. thummi* [=*C. riparius*]. (Partim)

Specialised subjects: Nucleolus - DNA sequences
Species: *Chironomus thummi piger* [=*C. piger*], *C. thummi thummi* [=*C. riparius*]

Schmidt, E.R., Godwin, E.A., Keyl, H.-G. & Israelewski, N. 1982. Cloning and analysis of ribosomal DNA of *Chironomus thummi piger* and *Chironomus thummi thummi*. The nontranscribed spacer of *Ch. th. thummi* contains a highly repetitive DNA sequence. *Chromosoma* **87**: 389-407.
The non transcribed spacer of the ribosomal DNA of *C. thummi* [=*C. riparius*] contains Cla elements related to other repetitive sequences found at numerous sites in the genome. In *C. piger*, the Cla elements are found only in the centromeric regions, although other studies have indicated that a very low frequency of nontranscribed spacers may contain a Cla element. It is suggested that the insertion of Cla elements into the spacer of *C. thummi* [=*C. riparius*] has occurred relatively recently, i.e. since the two taxa have separated. (Partim)

Specialised subjects: Nucleolus - DNA sequences
Species: *Chironomus thummi piger* [=*C. piger*], *C. thummi thummi* [=*C. riparius*]

Schmidt, E.R. & Keyl, H.-G. 1981. In situ binding of AT-rich repetitive DNA to the centromeric heterochromatin in polytene chromosomes of chironomids. *Chromosoma* **82**: 197-204.
Highly repetitive DNA sequences from *Glyptotendipes barbipes* and *Chironomus thummi* [=*C. riparius*] were allowed to react in situ with DNA-depleted polytene chromosomes. The results provide evidence for the existence of heterochromatin specific DNA-binding proteins. Illustrated my numerous autoradiographs.

Specialised subjects: Polytene chromosomes - heterochromatin
Species: *Chironomus thummi thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Schmidt, E.R., Keyl, H.-G. & Hankeln, T. 1988. In situ localization of two haemoglobin gene clusters in the chromosomes of 13 species of *Chironomus*. *Chromosoma* **96**: 353-359.
Two clones, one containing genes for the monomeric haemoglobin proteins III and IV (lambdaCttG1) and the other containing genes for the dimeric VIIB proteins (λpiHb1), were *in situ* hybridised to the salivary gland chromosomes of 13 European *Chironomus* species. The monomeric genes were located near the end of arm E, while the dimeric genes were on arm D, in association with morphologically homologous bands. There was a small amount of binding of λCttG1 to the loci at which the dimeric genes were located. Illustrated by extensive photographs and diagrams.

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus annularius*, *C. cingulatus*, *C. commutatus*, *C. dorsalis*, *C. halophilus* [=*C. aprilinus*], *C. holomelas, C. luridus, C. melanotus, C. pallidivittatus, C. pseudothummi, C. tentans, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Schmidt, E.R., Keyl, H.-G. & Hankeln, T. 1989. Localization of genes and other conservative "single copy" sequences in the chromosomes of chironomids. *Acta Biologica Debrecina Supplementum Oecologia Hungarica* **2**: 165-171.
Repeats the studies in Schmidt *et al.* (1988) but also includes studies with an additional probe from the sex determiner region on arm F of *Chironomus thummi* [=*C. riparius*]. Shows that in different species the same probe goes to the same chromosome arm and in the same chromosomal map position, indicating that some conserved DNA sequences are useful for determining homologous chromosome arms or regions. Illustrated by photographs of two probes in one species.

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisationSpecies: *Chironomus annularius*, *C. cingulatus*, *C. commutatus*, *C. dorsalis*, *C. halophilus* [=*C. aprilinus*], *C. holomelas, C. luridus, C. melanotus, C. pallidivittatus, C. pseudothummi, C. tentans, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Schmidt, E.R., Vistorin, G. & Keyl, H.-G. 1980. An AT-rich DNA component in the genomes of *Chironomus thummi thummi* and *Chironomus thummi piger*. *Chromosoma* **76**: 35-45.
An AT-rich DNA fraction isolated from total *C. th. thummi* [=*C. riparius*] DNA was found by in situ hybridisation with salivary gland chromosomes to consist mainly of those sequences which represent the genetical differences between *C. thummi* [=*C. riparius*] and *C. th. piger* [=*C. piger*]. Illustrated by autoradiographs of in situ hybridisations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]

Schmidt, W.J. 1937. Zur Doppelbrechung der Chromosomen in den Speichel-drüsenkernen der *Chironomus* larven. *Die Naturwissenschaften* **25**: 506-507.
Used positive and negative polarised microscopy to further investigate the claim of Ullrich (1936) that the strands of the salivary gland chromosomes are doubly refractive after injury. The results indicate the presence of nucleic acids in the chromomeres which are negatively refractive. Illustrated by two photographs.

Specialised subjects: Polytene chromosomes - structure
Species; *Chironomus* species

Schmidt, W.J. 1939. Herstellung von Präparaten zur polarisationoptischen Untersuchung der Chromosomen in den Speicheldrüsenkernen der *Chironomus*larven. *Zeitschrift für wissenschaftliche Mikroskopie Anatomie und für mikroskopische Technik* **56**: 1-7.
Describes a technique for preparing salivary gland chromosomes for examination by polarised light microscopy.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Schmidt, W.J. 1941. Einiges über optische Anisotropie und Feinbau von Chromatin und Chromosomen. *Chromosoma* **2**: 86-110.
Further studies on the anisotrophy of salivary glands using polarised light microscopy, confirming the negative anisotrophy of the chromomeres. Illustrated by a number of photographs. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Schmitz, R.-P. 1982. *Elektronenoptische Darstellung von gespreiteten Polytänchromosomen aus verschiedenen Geweben bei* Chironomus tepperi. Staatsprüfung Diplom Report, Institut für Genetik, Ruhr-Universität, Bochum, Germany. 28pp.
Produced photographic maps for the comparison of surface spread chromosomes from salivary gland and Malpighian tubule cells. These indicated that homologous bands could be easily recognised.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tepperi*

Scholl, A., Geiger, H.J. & Ryser, H.M. 1980. Die Evolution der Gattung *Chironomus* aus Biochemisch-Genetischer Sicht, pp.25-33. *In* Murray, D.A. (ed.), *Chironomidae; ecology, systematics, cytology and physiology*. 349pp. Permagon Press, Oxford and New York. (English summary)
Compare the phylogeny derived from enzyme studies with that obtain by karyosystematics and find quite good agreement. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus* spp.

Scholl, H. 1956. Die Chromosomen parthenogenetischer Mücken. *Die Naturwissenschaften* **43**: 91-92.
Describes and figures the mitotic and polytene chromosomes, as well as giving some information on meiosis, in three parthenogenetic Orthocladiinae species. Two of the species were diploid, the other triploid.

Specialised subjects: Thelytoky - apomixis
Species: *Limnophyes biverticillatus*, *L. virgo*, *Pseudosmittia arenaria*

Scholl, H. 1960. Die Oogenese einigen parthenogenetischer Orthocladiinen (Diptera). *Chromosoma* **11**: 380-401.
Fully illustrated account of meiosis in the females of six parthenogenetic species of Orthocladiinae. Most were diploid, except for *Limnophyes virgo* which was triploid. Two species lacked k-chromosomes, the others showing from 4 to about 30 k-chromosomes.

Specialised subjects: Thelytoky - apomixis, germ-line limited chromosomes
Species: *Limnophyes biverticillatus*, *L. virgo*, *Pseudosmittia arenaria arenaria, P. arenaria flava, P. baueri, Smittia* sp. [?=*S. parthenogenetica*]

Sebeleva, T.E. 1968. Quantitative determination of DNA content during formation of one of the puffs and one of the Balbiani rings of *Chironomus dorsalis*. *Tsitologiya* **10**: 765-769. (In Russian, English summary)
Concludes on the basis of photometric and autoradiographic studies that there is no local synthesis of DNA during puff formation. Illustrated by photographs of the regions studied.

Specialised subjects: Puffs - DNA amplification
Species: *Chironomus dorsalis* [=*C. riparius*]

Sebeleva, T.E. 1972. The investigation of protein synthesis in salivary glands of *Chironomus*. *Tsitologiya* **14**: 46-52. (In Russian, English summary)
Amino acids are incorporated into the chromosomes within 1-3 min after injection into the salivary glands. On the same chromosome amino acids may be incorporated into some Balbiani rings but not into others, presumably depending upon the functional state of the chromosomes. Uncertainties concerning the experimental technique prevented further conclusions being reached.

Specialised subjects: Puffs - RNA synthesis
Species: *Chironomus dorsalis* [=*C. riparius*]

Sebeleva, T.E. & Kiknadze, I.I. 1977. The cytochemical analysis of mucopolysaccharide secretion in the salivary glands of *Chironomus thummi* larvae. *Tsitologiya* **19**: 147-153. (In Russian, English summary)
The mucopolysaccharide component of the salivary gland secretion was studied in cells from different parts of the salivary gland with different

numbers of functional Balbiani rings (2 or 3 BR). Staining of the two types differed and the secretion from cells with 3 BR appeared to be acid mucopolysaccharides.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus thummi* [=*C. riparius*]

Sebeleva, T.E., Kolesnikov, N.N., Karakin, E.I., Kopantsev, E.P. & Kiknadze, I.I. 1982. A comparative characteristic of the tissue-specific function of the cells in the larval salivary gland of *Chironomus thummi* differing in the number of Balbiani rings. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 59.
Provide some information, additional to that in Sebeleva *et al*.(1981), on the biochemical and morphological changes associated with the activity of BR 3 in the special lobe of the salivary glands.

Specialised subjects: Puffs - Balbiani rings, genetic control
Species: *Chironomus thummi* [=*C. riparius*]

Sebeleva, T.E., Kolesnikov, N.N. & Kiknadze, I.I. 1981. Comparative analysis of proteins of salivary gland cell secretion of larvae of *Chironomus thummi*, differing in number of Balbiani rings. *Doklady Akademii Nauk*, *S.S.S.R.* **256**: 975-978. (In Russian) [Translated in *Doklady Biological Sciences* **256**: 1-5]
By electrophoretic analysis of the secretion of the salivary gland cells it was shown that the presence of BR 3 in the special cells of the salivary gland of *C. thummi* [=*C. riparius*] is correlated with changes in the protein spectrum of these cells. Illustrated by photographs of chromosome IV from both the special cells and the main cells of the gland. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus thummi* [=*C. riparius*]

Sebeleva, T.E., Sherudilo, A.I. & Kiknadze, I.I. 1965. Quantitative estimation of DNA in puff formation in *Chironomus dorsalis*. *Genetika* **2**: 102-105. (In Russian, English summary)
Photometry was used to estimate DNA content in a segment of a salivary gland chromosome during puff formation. It was found that puff formation did not necessarily precondition an accumulation of DNA at the puff site. Illustrated by a photograph and drawings of the studied region.

Specialised subjects: Puffs - DNA amplification
Species: *Chironomus thummi* [=*C. riparius*]

Sengün, A. 1947. Über intraindividuelle Variabilität des IVten Chromosoms bei *Chironomus*. *Istanbul Üniversitesi Fen Fakütesi Mecmuasi, Series B* **12**: 289-305. (Turkish summary)
Made comparative studies on the banding pattern of the fourth chromosome of two unidentified species of *Chironomus* from various polytene tissues during development. Considered that the pattern varied from tissue to tissue as well as between species. Illustrated by numerous drawings.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* sp. I [=*C. riparius*], *C.* sp. II [=*C. plumosus*]

Sengün, A. 1948. Vergleichend-ontogenetische Untersuchungen über die Riesenchromosomen verschiedener Gewebearten der Chironomiden. I. *Communications de la Faculté des Sciences de l'Université D'Ankara* **1**: 187-248.
Reviews the literature of polytene chromosomes and makes comparative studies on the polytene chromosomes in different tissues and at different stages of development in two species of *Chironomus*. Reaches same conclusion as in previous papers (Sengün 1947, Sengün & Kosswig 1948). Illustrated by numerous drawings.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* sp. I [=*C. riparius*], *C.* sp. II [=*C. plumosus*]

Sengün, A. 1951*a*. Vergleichend-ontogenetische Untersuchungen über die Riesenchromosomen verschiedener Gewebearten der Chironomiden. II. *Istanbul Üniversitesi Fen Fakütesi Mecmuasi, Series B* **16**: 1-44. (Turkish and German summaries)
Further detailed descriptions, drawings and discussion on comparative morphology of polytene chromosomes of *Chironomus* sp. II [=*C. plumosus*]. Chromosomes were analysed from larvae collected from different times of the year, as well as in different tissues and at different developmental stages. Again emphasises the inconsistencies rather than constant factors.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* sp. II [=*C. plumosus*]

Sengün, A. 1951*b*. Meiotische und somatische Chromosomen von *Chironomus*-larven. *Istanbul Üniversitesi Fen Fakütesi Mecmuasi, Series B* **16**: 345-350. (Turkish and German summaries)
Studied and sketched the chromosomes at various stages of meiosis and in a variety of somatic tissues. Noted that chromosome size in the same individual varied from very small to very large in different tissues.

Specialised subjects: Chromosome structure - meiosis
Species: *Chironomus* species [=*C. riparius* or *C. plumosus*]

Sengün, A. 1952*a*. Über die Zahl der Spiralwindungen, der Blöckchen und der sekundären Querbänder. *Cytologia* **17**: 1-5.
Further studies of chromosome structure in the polytene chromosomes of *Chironomus* sp. II [=*C. plumosus*] during development. Discusses pairing of homologues and primary and secondary spiral structures with the assistance of photographs and drawings.

Specialised subjects: Polytene chromosomes - structure, tissue differences
Species: *Chironomus* sp. II [=*C. plumosus*]

Sengün, A. 1952*b*. Über die Wirkung der Temperatur auf die Riesenchromosomen der *Chironomus*-Larven. *Istanbul Üniversitesi Fen Fakültesi Mecmuasi, Series B* **17**: 357-361. (German and Turkish summaries)
Studied the effect of temperature on the salivary gland and Malpighian tubule polytene chromosomes of a *Chironomus* species. Rearing at different temperatures caused changes in the appearance of bands, these changes being reversible.

Specialised subjects: Polytene chromosomes - bands and interbands, tissue differences
Species: *Chironomus* species [=*C. plumosus*]

Sengün, A. 1954. The spiral structure of giant chromosomes. *Istanbul Üniversitesi Fen Fakültesi Mecmuasi, Series B* **19**: 169-179. (English and Turkish summary)
Compares the spiralisation patterns in the polytene chromosomes of young and old larvae of two species of chironomid, comparing them to the structures observed in Drosophila, to further expound his view that the polytene theory could not satisfactorily account for all aspects of polytene chromosome structure.

Specialised subjects: Polytene chromosomes - structure, tissue differences
Species: *Chironomus plumosus*, ?*Tanytarsus* species

Sengün, A. 1955*a*. Differente Chromosomenstruktur in verschiedenen Geweben. *Experientia* **10**: 175-176. (English summary)
As part of a discussion of the differences in chromatic configurations between tissues and at different developmental stages, the difference in the appearance of polytene chromosomes in younger and older larvae, and between different polytene tissues of *Chironomus* is mentioned. Notes that some of these differences are of a cyclic nature and appear to be related to cell function. (Partim)

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* spp.

Sengün, A. 1955*b*. Weitere vergleichende Untersuchungen über die Riesenchromosomen der Chironomiden II. Über das unterschiedliche Vorkommen der Ribonucleinsaeure in Chromosomen verschiedener Gewebe. *Istanbul Üniversitesi Fen Fakütesi Mecmuasi, Series B* **20**: 267-280. (Turkish and German summaries)
An unillustrated account of the relationship between the development of spiralisation of the polytene chromosomes and RNA content as noted in different tissues and different species.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* sp. nr. *plumosus* [=*C. plumosus*], *C.* sp. nr. *thummi* [=*C. riparius*]

Sengün, A. 1961. Incorporation of tritiated thymidine into the giant chromosomes of larvae of "*Chironomus*". *Pathologie et Biologie* **9**: 753-755.
Autoradiographic studies of DNA replication in the polytene chromosomes of the salivary glands and Malpighian tubules. Identical pattern were not obtained over the whole chromosome, indicating asynchronous duplication of the various regions. Illustrated by numerous autoradiographs.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus plumosus, C. thummi* [=*C. riparius*]

Sengün, A. 1962. The existence of two kinds of deoxyribonucleic acid (DNA) and chromosomal secretion as demonstrated by mean of autoradiography using tritiated thymidine. *Pathologie et Biologie* **10**: 1701-1705. (English, French, German and Spanish summary)
Autoradiographic studies of DNA in and around the polytene chromosomes of *Chironomus plumosus*. Concludes that there are two kinds of DNA, the hereditary material of the chromonemata and non-genetic material which may be produced by the chromosomes and released into the cytoplasm. Illustrated by photographs and autoradiographs.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus plumosus*

Sengün, A. 1964. Asynchronous behavior of the giant chromosomes. *Istanbul Üniversitesi Fen Fakültesi Mecmuasi, Series B* **29**: 73-79. (Turkish summary)
In a lecture the difference in the appearance of polytene chromosomes of different tissues and at different stages of development is again emphasised. The changes may be due to physiological differences and various parts of the chromosomes can function independently. Illustrated by drawings, photographs and autoradiographs. (Partim)

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus plumosus*

Sengün, A. & Kosswig, C. 1948. Weiteres über den Bau der Riesenchromosomen in verschiedenen Geweben von *Chironomus*-larven. *Chromosoma* **3**: 195-207.
Studied the structure of the polytene chromosomes in larvae of two species of *Chironomus* at different stages of larval development and in different tissues. They conclude that the banding pattern of the polytene chromosomes is not constant from stage to stage or from tissue to tissue. This is considered to be due to the insertion of intercalary material into the chromosome as they grow. The resulting patterns depend on physiological conditions and the banding pattern is considered to differ so much, even between different cells of the same tissue, that there is no possibility of identification of any chromosome by its pattern. Illustrated by numerous line drawings.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus* sp. 2 nr. *plumosus* [=*C. plumosus*], *C.* sp. 3

Sengün, A. & Kosswig, C. 1953*a*. Einwände gegen die Polytäntheorie des Baus der Riesenchromosomen. *Verhandlungen der deutsche Zoologische Gesellschaft, 1952. Zoologisches Anzeiger Supplement* **17**: 269-275.
Criticises the polytene theory of the structure of giant chromosomes, proposing again the theories presented in their earlier work (Sengün 1947, Sengün & Kosswig 1948). Illustrated by photographs and drawings. The work was criticised by Bauer (1953).

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* spp.

Sengün, A. & Kosswig, C. 1953*b*. Erwiderung zu Bauers Kritik. *Verhandlungen der deutsche Zoologische Gesellschaft,* 1952. *Zoologisches Anzeiger Supplement* **17**: 278-279.
Rejoinder to the criticism of Bauer (1953), claiming his argument is too dependent on details visible only in unusually stretched regions.

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus* spp.

Serfling, E. 1968. *Die Induktion funktioneller Veränderungen an Riesenchromosomen*. Diploma Thesis, Martin-Luther-University, Halle-Wittenberg, Germany.
This work has not been seen but it is assumed to contain the studies published in Serfling (1970).

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E. 1970. Die Induktion von Funktionsstrukturen der Riesenchromosomen durch Stoffwechselinhibitoren, pp.17-19. *In* Pfister, C.L. (ed.), *Ergebnisse der Experimentelle Medizin. Band 2. Beitrage zur Molekulargenetik*. 74pp. Veb Verlag & Gesundheit, Berlin.
Reports on the induction of puffs by antibiotics such as Actinomycin. These induced puffs at the centromere regions of all three long chromosomes of *Chironomus thummi* [=*C. riparius*]. These puffs were concentration and temperature dependent. Illustrated by photographs of chromosome III.

Specialised subjects: Puffs - experimental induction

Species; *Chironomus thummi* [=*C. riparius*]

Serfling, E. 1976. The transcripts of Balbiani rings from *Chironomus thummi*. Giant RNA molecules with messenger characteristics. *Chromosoma* **57**: 271-283.
RNA from the two Balbiani rings of the main lobe of the salivary gland of *C. thummi* [=*C. riparius*] was collected and studied. BR2, the most active puff produced a single RNA fraction, while BR1 produced two different RNA fractions. *In situ* hybridisation of BR RNA to the salivary gland chromosomes revealed accumulation of silver grains only over the BR from which the RNA fraction was derived. Illustrated by photographs and autoradiographs of chromosome IV and the BRs. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E. & Huth, A. 1978. Balbiani ring RNA in the cytoplasm of *Chironomus thummi* salivary gland cells. *Chromosoma* **66**: 205-223.
Cytoplasmic RNA of salivary gland cells of *C. thummi* [=*C. riparius*] contains two large fractions which correspond to those produced by the two Balbiani rings (BR1 & BR2). *In situ* hybridisation of the two cytoplasmic fractions to the salivary gland chromosomes resulted in the labelling of both BR1 and BR2. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Huth, A. & Meyer, L. 1982. Gene activity and protein synthesis in salivary gland cells of *Chironomus thummi*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 61.
The relationship between Balbiani ring activity and the production of secretory proteins was demonstrated by showing the correlation between change in BR activity under galactose treatment and the alteration in secretory protein patterns.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Majorov, V.I., Mikichur, N.I., Popova, T.G. & Sandakchiev, L.S. 1975. DNA and RNA content of *Chironomus thummi* polytene chromosomes determined by micro column gel filtration. *Cell Differentiation* **3**: 361-370.
UV-microspectrophotometry was used to simultaneously determine the DNA and RNA content of single, microdissected polytene chromosomes. The RNA and DNA content of chromosomes I-III roughly corresponds to their relative lengths. The RNA content of chromosome IV, which carries the nucleolus and Balbiani rings, is relatively much greater than its relative length or DNA content. During one of the last replication steps there is a duplication of the DNA and RNA content of chromosomes I-III, but a much smaller increase in the nucleolar RNA. Illustrated by a photograph of microdissected chromosome complements. (Partim)

Specialised subjects: Polytene chromosomes - DNA replication; Nucleolus, Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*],

Serfling, E., Maximovsky, L.F. & Wobus, U. 1974. Synthesis and processing of ribosomal ribonucleic acid in salivary gland cells of *Chironomus thummi*. *European Journal of Biochemistry* **45**: 277-289.
RNA content and RNA base composition were determined from micro-isolated chromosomes, nucleoli and Balbiani rings of larval salivary gland cells. The base composition of Balbiani ring RNA differed from the other chromosomal RNAs in that it had a lower G+C content. The RNA species present were also determined. Illustrated by photographs of the whole salivary gland chromosome complement and of micro-isolated chromosomes. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - Balbiani rings, Nucleolus - RNA structure
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Meyer, L., Rudolph, A. & Steiner, K. 1983. Secretory proteins and Balbiani ring gene activities in salivary glands of *Chironomus thummi* larvae. *Chromosoma* **88**: 16-23.
Galactose treatment indicates that the production of the main secretory proteins of the salivary gland, spIa and spIb, is governed by the Balbiani rings BRb and BRc. Illustrated by photographs of chromosome IV. (Partim)

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Panitz, R. & Wobus, U. 1969. Die experimentelle Beeinflussung des Puffmusters von Riesenchromosomen. I. Puffinduktion durch

Oxytetracyclin bei *Chironomus thummi*. *Chromosoma* **28**: 107-119. (English summary)
Treatment of larvae and prepupae of *C. thummi* [=*C. riparius*] with oxytetracycline (OTC) lead to enlargement of existing puffs and induction of about 30 additional puffs, while larvae of *C. strenzkei* showed no response. Some of the puffs induced by OTC were heterozygous. The time course of the response and the effects of genetic background were investigated. Well illustrated by photographs and autoradiographs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus strenzkei, C. thummi* [=*C. riparius*]

Serfling, E., Wobus, U. & Panitz, R. 1972. Effect of alpha-amanitin on chromosomal and nucleolar RNA-synthesis in *Chironomus thummi* polytene chromosomes. *FEBS Letters* **20**: 148-152.
Autoradiographic experiments were conducted on explanted larval salivary glands of *C. thummi* [=*C. riparius*] to confirm the alpha-amanitin inhibits RNA labelling in the polytene chromosomes but not in the nucleolus. The results are taken as confirmation of the existence of more than one type of RNA polymerase in insects. Illustrated by two small autoradiographs. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - Balbiani rings, Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Wobus, U. & Panitz, R. 1973*a*. Selective effects of alpha-amanitin on RNA labelling in explanted salivary glands of *Chironomus thummi* larvae. *Biochemistry of Cell Differentiation. Federation of European Biochemical Societies Seventh Meeting, Varna,* 1971. **24**: 143-145.
Essentially the same content as Serfling, Wobus & Panitz (1972). Illustrations include autoradiographs to demonstrate the effect of alpha-amanitin treatment. (Partim)

Specialised subjects: Polytene chromosomes, Puffs - Balbiani rings, Nucleolus - RNA structure
Species: *Chironomus thummi* [=*C. riparius*]

Serfling, E., Wobus, U. & Panitz, R. 1973*b*. RNA synthesis in salivary gland chromosomes of *Chironomus thummi*. *Biochemistry of Cell Differentiation. Federation of European Biochemical Societies Seventh Meeting, Varna,* 1971. **24**: 147-149.
Provide data on the profiles of RNA species obtained from the nucleoli or salivary gland chromosomes after incubation in a synthetic medium.

Specialised subjects: Polytene chromosomes - gene activity, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Serra, J.A. & Queiroz-Lopes, A. 1944. Direkter Nachweis und Lokalisation von basischen Proteinen in den Chromosomen und im Nukleolus. *Chromosoma* **2**: 576-592.
Larval salivary gland chromosomes were stained by the arginine reaction to show the localisation of basic protein. This was strongly present in the bands, the centromeres and in the nucleolus. Illustrated by photographs of an unidentified species. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Shilova, I. E. & Zainev, G.A. 1982. Estimation of DNA length transcribed in Balbiani ring region of *Chironomus thummi*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, Novosibirsk: 63.
Estimated the length of DNA transcribed in the Balbiani rings by measuring the length of the sites in stretched chromosomes. The transcriptionally active regions were found to be 200-250microns but varied in chromosomes stretched to the same length.

Specialised subjects: Puffs - Balbiani rings, gene activity
Species: *Chironomus thummi* [=*C. riparius*]

Shobanova, N.A. 1990. *Systematics and biology of the genus* Chironomus *Meig. (Diptera, Chironomidae). Sister species of the group of* plumosus. Candidate's Dissertation, Leningrad, 22pp. [In Russian)
This thesis is only known from the quote in Ilyinskaya & Petrova (*Ent. Rev*. **72**: 135-147, 1993) which indicates that it contains a cytological key to the members of the *C. plumosus*-group. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus agilis, C. balatonicus, C. entis, C. plumosus*, *C.* (*forma larvalis bathophilus*)

Sigareva, L.E. 1981. Differential staining of the chironomid chromosomes. II. C-banding in polytene chromosomes of three *Chironomus* species. *Tsitologiya* **23**: 270-274. (In Russian, English summary)
The salivary gland chromosomes of three species of *Chironomus* were treated by the c-banding technique. Bands were formed mainly at the centromere regions, except in *C. thummi* [=*C. riparius*] where other interstitial or telomeric bands were observed. Illustrated by line drawings and photographs.

Specialised subjects: Polytene chromosomes - C-bands
Species: *Chironomus annularius*,*C. commutatus*, *C. thummi* [=*C. riparius*]

Sigareva, L.E. 1985. *Investigation of structural heterochromatin in differentially stained polytene chromosomes of chironomids*. Candidates Thesis, Biological Sciences, Saratova, Russia. 197pp. (In Russian)
This work has not been seen, but it is likely to include the studies published by Sigareva (1981).

Species: *Chironomus annularius*,*C. commutatus*, *C. thummi* [=*C. riparius*]

Sinoto, Y. & Yuasa, A. 1948. The theory of the spiral structure of the salivary chromosomes. *Kagaku* **18**: 98-106. (In Japanese)
Review the previous literature to support their claim that polytene chromosomes have a basic spiral structure. Illustrated by drawings and diagrams.

Specialised subjects: General Dipteran Cytogenetics;Polytene chromosomes - structure
Species: *Chironomus plumosus*, *C. thummi* [=*C. riparius*], *C.* spp., *Cryptochironomus defectus*, *Trichotanypus pectinatus*

Sirlin, J.L. 1960. Cell sites of RNA and protein syntheses in the salivary gland of *Smittia* (Chironomidae). *Experimental Cell Research* **19:** 177-180.
An autoradiographic study of sites of uridine, leucine and thymidine uptake in the larval salivary gland chromosomes. There was differential uptake of the substances by the cytoplasm, chromosomes, nucleoli and Balbiani rings. The implications of this differential uptake are mentioned. Illustrated by autoradiographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L. 1962*a*. The Nucleolus. *Progress in Biophysics & Biophysical Chemistry* **12**: 25-66.
A detailed review of the structure and function of the nucleolus which draws heavily on knowledge from polytene chromosomes of Diptera. Illustrated by two autoradiographs from *Smittia* sp. [=*S. parthenogenetica*]. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Nucleolus - structure
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L. 1962*b*. Addendum to 'The Nucleolus.' *Progress in Biophysics & Biophysical Chemistry* **12**: 319-326.
Records additional information on nucleolus associated chromatin and the biochemistry of a number of substances associated with the nucleolus. (Partim)

Specialised subjects: Nucleolus - structure
Species; *Chironomus tentans*, *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L. 1966. Synthesis of 45s RNA in the nucleolus of *Smittia*. *Proceedings of the International Symposium on Cell Nucleus: Metabolism and Radiosensitivity*, *Rijswigk*, *Netherlands*: 87-96. Taylor and Francis Ltd., England.
The synthesis of nucleolar RNA in the larval salivary gland was isolated by means of specific inhibition. Parallel biochemical work indicated that part of the newly synthesised RNA was of high molecular weight and part was 4S with the characteristics of transfer RNA.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L. & Jacob, J. 1962. Function, development and evolution of the nucleolus. *Nature* **195**: 114-117.
Discusses the function, development and evolution of the nucleolus based largely on the results of studies on Sciaridae and Chironomidae. No illustrations. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Nucleolus - development
Species: Chironomidae sp. [?=*Smittia parthenogenetica*]

Sirlin, J.L. & Jacob, J. 1964. Sequential and reversible inhibition of synthesis of ribonucleic acid in the nucleolus and chromosomes: the effect of benzamide and substituted benzamidazoles on dipteran salivary glands. *Nature* **204**: 545-547.
Larval salivary glands of *Smittia parthenogenetica* were cultured and benzamidazole or its derivatives DRB and TRB were added to the medium and the effect on RNA synthesis tested autoradiographically. Benzamidazole was not selective in its action but DRB and TRB selectively inhibited either chromosome or nucleolar RNA synthesis. Illustrated by autoradiographs.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Sirlin, J.L., Jacob, J. & Birnstiel, M.L. 1965. Synthesis of different species of nucleolar ribonucleic acid. *Biochimica et Biophysica Acta* **108**: 716-718.
Demonstration that the nucleolus synthesises 28S and 4S RNA. The 4S RNA has the characteristics of transfer RNA.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Sirlin, J.L., Jacob, J. & Birnstiel, M.L. 1966. Synthesis of transfer RNA in the nucleolus of *Smittia*. *International Symposium on the Nucleolus, its Structure and Function, Montevideo, Uruguay, 1965. National Cancer Institute Monographs* **23**: 255-270. (English and Spanish summary)
Reviews evidence that 4S and >28S RNA is synthesised in the nucleolus of *Smittia*, using a DNA primer. One illustration. (Partim)

Specialised subjects: Polytene chromosomes,
Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Sirlin, J.L., Jacob, J. & Kato, K.I. 1962. The relation of messenger to nucleolar RNA. *Experimental Cell Research* **27**: 355-359.
Inhibition studies indicated that nucleolar RNA is primed by extrinsic messenger RNA of chromosomal origin, not by DNA in the nucleolus. Illustrated by autoradiographs. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L., Jacob, J. & Tandler, C.J. 1963. Transfer of the methyl group of methionine to nucleolar ribonucleic acid. *Biochemical Journal* **89**: 447-452.
Inhibition and autoradiographic studies indicated that a methyl group is transferred to nucleolar RNA in the synthesis of transfer RNA. This aspect of the synthesis is not directly dependent on the chromosomes. Puromycin inhibits incorporation of methylated methionine more in the chromosomes than in the nucleolus. The accompanying autoradiographs show the polytene chromosomes. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L., Kato, K.I. & Jones, K.W. 1961. Synthesis of ribonucleic acid in the nucleolus. *Biochimica et Biophysica Acta* **48**: 421-423.
Autoradiographic studies of the uptake of various ribonucleosides in the nucleolus compared with the chromosomes in the salivary gland cells of *Smittia* sp. [=*S. parthenogenetica*]. Tracer accumulates initially around the nucleolar organiser and is greater in the nucleolus than in all chromosomes combined. Thymidine is occasionally incorporated in discrete chromosomal bands during short incubation. No illustrations of chromosomes. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia* species [=*S. parthenogenetica*]

Sirlin, J.L. & Leoning, U.E. 1968. Nucleolar 4s ribonucleic acid in dipteran salivary glands in the presence of inhibitor. *Biochemical Journal* **109**: 375-387.
Used autoradiography and inhibition studies to determine that the precursor transfer RNA found in the nucleolus probably originates in the chromosome and is methylated in the nucleolus. Maturation of precursor ribosomal RNA is blocked in the nucleolus during inhibition. No illustrations of chromosomes. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Sirlin, J.L., Tandler, C.J. & Jacob, J. 1963. The relationship between the nucleolus organizer and nucleolar RNA. *Experimental Cell Research* **31**: 611-615.
Autoradiographic and inhibition studies were used in an attempt to determine whether RNA synthesis begins in the nucleolus or the organiser, or perhaps in some other chromosomal DNA. The results indicated that the synthesis did begin in the nucleolus itself, contrary to the conclusion of Pelling (1962) in studies of *Chironomus tentans*.

It is suggested that the difference may lie in the difficulty of interpreting results in *C. tentans*, where the strands of the organiser penetrate the nucleolus itself, unlike the situation in *Smittia parthenogenetica*. Illustrated by autoradiographs. This paper appears to have inadvertently introduced the name *Smittia parthenogenetica* as a nomen nudem.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Smittia parthenogenetica*

Skaer, R.J. & Whytock, S. 1975. Interpretation of the three-dimensional structure of living nuclei by specimen tilt. *Journal of Cell Science* **19**: 1-10.
The polytene chromosomes in the salivary glands of a number of species of Diptera, including *Chironomus dorsalis*, were investigated for their three-dimensional arrangement within the nucleus. It was shown that the telomeres of the chromosomes are attached to the nuclear membrane. Other than this, different nuclei of the same gland did not resemble each other closely in the arrangement of the chromosomes. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis*

Skoglund, U., Andersson, K., Björkroth, B., Lamb, M.M. & Daneholt, B. 1983. Vizualization of the formation and transport of a specific hnRNP particle. *Cell* **34**: 847-855.
The region of the Balbiani rings of *Chironomus tentans* was sectioned and examined under the electron microscope, permitting the growth and maturation of the transcription products to be characterised. Illustrated by electron micrographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, ultrastructure
Species: *Chironomus tentans*

Slizynski, B.M. 1950. *Chironomus* versus *Drosophila*. *Journal of Genetics* **50**: 77-78.
Reviews the findings of Sengün & Kosswig (1948) on the constancy of the banding pattern in *Chironomus* before comparing these findings to his own on polytene chromosomes in *Drosophila*, in which he considers there is no doubt as to the constancy of the banding pattern. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* spp.

Smirnov, A.F. 1972. Microfluorometric analysis of melting curves of chromosomal DNA. *Vestnik Leningrad Universimem Ser. Biologiya* **27**(2): 140-143. (In Russian)
Studied the melting curves of the DNA from salivary gland chromosomes of *Chironomus plumosus*.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Smirnov, A.F. & Smaragdov, M.G. 1972. A study of the state of DNA in the giant chromosomes by luminescent microscopy. *Tsitologiya* **14**: 1205-1211. (In Russian, English summary)
Nuclei isolated from the larval salivary glands of *Chironomus plumosus* were incubated in different solutions and stained with acridine orange. NaCl and trypsin shifted the fluorescence spectra to green and destroyed the chromosomes. Very high or very low pH denatured the DNA and induced red fluorescence. The results were discussed in relation to chromosome structure.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Smirnov, A.F. & Tsirulnikov, M.M. 1970. A study of thermal denaturation of chromosomal DNA by fluorescence microscopy. *Tsitologiya* **12**: 182-186. (In Russian, English summary)
Heating of salivary gland chromosomes stained with acridine orange showed that the chromosomal DNA was more stable than DNA in solution. It was concluded the effect is related to the action of chromosomal proteins, since trypsin treatment lowered the temperature of denaturation.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. riparius*], *C. plumosus*

Sokolova, N.J. 1989. Basic results of studies on *Chironomus plumosus* L. in the Soviet Union. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 355-362.
Notes that the karyotype of *C. plumosus* is polytypic, with an great variety of karyotypes amongst morphologically similar material. Notes that some consider these sibling species and others as subspecies. Also notes that the polytene chromosomes undergo seasonal changes in morphology indicative of a change in their activity. No illustrations. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes, seasonal changes
Species: *Chironomus plumosus*

Sorsa, V. 1988. *Polytene Chromosomes in Genetic Research*. Ellis Horwood Books in Biological Sciences, Chichester. Halstead Press. 289pp.
Reviews the variety of studies using polytene chromosomes of Chironomidae. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus* spp. [incl. *C. annularius, C. crassimanus, C. dorsalis, C. luridus, C. melanotus, C. pallidivittatus, C. plumosus, C. striatus, C. tentans, C. tepperi, C. thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*]]

Srivastava, M.D.L. & Misra, J.S. 1971. Puffing in polytene chromosomes of various cell types at different stages of larval development of *Chironomus* sp. (Family Chironomidae: Order Diptera). *Proceedings of the National Academy of Science, India* **41**(B): 113-124.
The banding pattern and puffing patterns of the polytene chromosomes were investigated in salivary glands, Malpighian tubule and rectum cells at various stages of the life cycle in an unidentified *Chironomus* species. Conclude that the banding pattern of homologous chromosomes is consistent in the various tissues. Findings with respect to puffing patterns were similar to those of other workers on other species (e.g. Beermann 1952*a*, 1956*b*, 1961, 1965, 1967). Illustrated by numerous rather poor drawings.

Specialised subjects: Polytene chromosomes - tissue differences; Puffs - developmental sequence
Species: *Chironomus* species

Staiber, W. 1982. Induction of a special Balbiani ring by position effect in the salivary gland chromosomes of *Acricotopus lucidus*. *Experientia* **38**: 1490-1491.
An X-ray induced mutation which rearranged centromeric heterochromatin of chromosome I into euchromatin. In some cells of this mutant a Balbiani ring is expressed. Illustrated by photographs.

Specialised subjects: Puffs - position effects
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. 1986. Intermediate puffing patterns as evidence of spontaneous fusions of two different polytene cell types in the *Acricotopus* salivary gland. *European Journal of Cell Biology* **42**: 171-175.
In a small number of salivary glands of *A. lucidus* [=*A. lucens*] an aberrant puffing pattern is observed, intermediate between that observed in the main and anterior lobes of the gland. These cells are thought to arise by partial or complete fusion of cells from the two lobes. The results point to a complex regulation of puffing pattern. Illustrated by photographs.

Specialised subjects: Puffs - tissue differences
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. 1987. Unusual germ line limited chromosomes of *Acricotopus lucidus* (Diptera, Chironomidae). *Genome* **29**: 702-705.
Describes two unusual germ line limited (L-) chromosomes, one of which sometimes appears in the salivary glands as a supernumerary chromosome. These suggest that the origin of the L-chromosomes is from the somatic chromosomes. Illustrated by photographs.

Specialised subjects: L-chromosomes - origin
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. 1988. G-banding of germ line limited chromosomes in *Acricotopus lucidus* (Diptera, Chironomidae). *Chromosoma* **97**: 231-234.
Spermatogonial metaphases were G-banded. These showed that there were nine different types of germ line limited chromosomes (L-chromosomes). The L-chromosomes present varied with animal or cell and some types were missing or present up to five times. It is concluded that none of the different types can be essential. Illustrated by photographs.

Specialised subjects: L-chromosomes - function
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. 1989. Multivalent formation and pairing behavior of germ line limited chromosomes in male meiosis of *Acricotopus lucidus* (Diptera, Chironomidae). *Genome* **32**: 941-945. (English & French summary)
Investigates the pairing behaviour of the germ line limited (L- chromosomes) during male meiosis. The nine different chromosomes may be absent or present in up to ten copies. Multivalents were observed, sometimes involving non-homologous chromosomes. Crossing over in such non-

homologous pairings is postulated to give rise to new L-chromosome types.

Specialised subjects: Meiosis - germ-line limited chromosomes, crossing over
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. & Behnke, E. 1985. Developmental puffing activity in the salivary gland and Malpighian tubule chromosomes of *Acricotopus lucidus* (Diptera, Chironomidae). *Chromosoma* **93**: 1-16.
Provide drawn and photographic maps of the salivary gland chromosomes. Gene activity is compared between the two lobes of the salivary gland and in the Malpighian tubules. There is as great a difference in puffing pattern between the lobes of the salivary gland as there is between the salivary gland and the Malpighian tubules. Illustrated by photographs and diagrams.

Specialised subjects: Puffs - developmental sequence, tissue differences
Species: *Acricotopus lucidus* [=*A. lucens*]

Staiber, W. & Thudium, D. 1986. X-ray induced rearrangements between germ-line limited and soma chromosomes of *Acricotopus lucidus* (Diptera, Chironomidae). *Genetica* **69**: 149-156.
X-rays were used to obtain rearrangements between the germ line limited (L-chromosomes) and somatic chromosomes, so that portions of the L- chromosomes would be present in the polytene chromosomes. Examination of the resulting chromosomes suggests that the L-chromosomes are derived from the somatic chromosomes by rearrangements, and by formation and accumulation of heterochromatin. Illustrated by photographs.

Specialised subjects: L-chromosomes - origin
Species: *Acricotopus lucidus* [=*A. lucens*]

Stalker, H.D. 1954. Banded polytene chromosomes in the ovarian nurse cells of adult Diptera. *Journal of Heredity* **45**: 259-264.
In a survey of over 40 families of North American Diptera, 6 unidentified species of Chironomidae were examined but found to lack well developed polytene chromosomes in the ovarian nurse cells. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - tissue differences
Species: Chironomidae spp. (probably includes some *Chironomus* spp.)

Stefanelli, A. 1939*a*. Sul comportamento dei colloidi nucleari delle ghiandole salivari di *Chironomus plumosus*. Esperienze di micro-manipolazione combinate con esperienze chemico-fisiche. *Bolletino di Zoologia* **10**: 149-162.
Describes micromanipulation experiments on the salivary gland chromosomes. Notes that the chromosomes are not sticky in the nucleus but only become so when the nuclear membrane is ruptured. The cross bands become less distinct when the chromosome is under tension but reappear when the chromosome contracts. If the chromosome is overstretched it exceeds the elastic limit and irreversible deformation occurs. This deformation is greatest in the interband regions. The chromosomes disperse in highly hydrated nuclei. Illustrated by photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Stefanelli, A. 1939*b*. Esperienze di micromanipolazione del nucleo e dei constituenti nucleari di cellule di ghiandole salivari di *Chironomus plumosus* in solution ipo-iso-e ipertoniche. *Bolletino Societa Italiana* **14**: 652-653.
A brief further report on the micromanipulation of salivary gland chromosomes following treatment with hypo-, hyper- and isotonic solutions. Such solutions affect the nature of the chromatin causing it to change from colloidal to a gel, or vice versa. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Stefanelli, A. 1940. Ulteriori ricerche di microdissezione e chimico-fisiche sul gomitolo cromatinico delle ghiandole labiali di *Chironomus plumosus*. *Bolletino Societa Italiana di Biologia Sperimentale* **15**: 675-676.
A brief, unillustrated report of studies on the effect of various chemicals on the properties of the chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus plumosus*

Steffan, A.W. 1963. Chromosomenevolution und Verwandtschaftsbeziehungen bei Zuckmücken. *Naturwissenschaftliche Rundschau* **16**: 481-482.
Reviews the published studies on chromosome evolution in the genus *Chironomus*, indicating the importance of whole arm translocations and

paracentric inversions. One figure, reproduced from Keyl (1962).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Camptochironomus* spp. [=*Chironomus pallidivittatus* & *C. tentans*], *Chironomus annularius, C. commutatus* complex, *C. obtusidens, C. parathummi* complex, *C. pseudothummi, C. thummi piger* [=*C. piger*], *C. thummi* complex

Steffan, A.W. 1966. Zur Bedeutung der Chromosomen-Forschung für die Systematik der Chironomidae (Diptera). *Gewässer und Abwässer* **41/42**: 22-37.
Reviews the use of polytene chromosomes in systematic studies of the Chironomidae. No illustrations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Anatopynia* species, *Chironomus acidophilus*, *C. annularius, C. commutatus* complex, *C. obtusidens*, *C. pallidivittatus*, *C. parathummi* complex, *C. pseudothummi*, *C. tentans, C. thummi* [=*C. riparius*], *C. uliginosus*, *Cryptochironomus defectus* gp., *Sergentia coracina*

Steinemann, M. 1978. Co-replication of satellite DNA of *Chironomus melanotus* with mainband DNA during polytenization. *Chromosoma* **66**: 127-139.
The buoyant densities and GC content were determined for the DNA from five *Chironomus* species. Only in *C. melanotus* were distinct satellite DNA bands resolved. The two satellite DNAs comprised 15% of diploid DNA content and 11% of the polytene DNA, indicating they are not significantly underreplicated as had been reported in *Drosophila*. Illustrated by photographs of the whole chromosome complements of *C. melanotus* and *C. plumosus*.

Specialised subjects: Chromosomal replication - DNA replication, satellite DNA
Species: *Camptochironomus* [=*Chironomus*] *pallidivittatus, Chironomus melanotus, C. nuditarsis, C. plumosus, C. thummi thummi* [=*C. riparius*]

Stepanova, N.G., Valeeva, F.S., Nikitin, S.M., Zhuze, A.L. & Zelenin, A.V. 1982. Fluorescence-microscopical study of *Chironomus thummi thummi* and *Drosophila lummei* (Hackman) polytene chromosomes with the use of 7-amino-actinomycin D. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 66.
Found that fluorescence is greater in regions with higher GC content. Therefore the method can provide useful information about the distribution of GC base pairs in chromosome regions.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi thummi* [=*C. riparius*]

Stevens, B.J. 1964*a*. The effect of actinomycin D on nucleolar and nuclear fine structure in the salivary gland cell of *Chironomus thummi*. *Journal of Ultrastructure Research* **11**: 329-353.
Treatment with actinomycin D leads to changes in the appearance of the nucleoli and Balbiani rings of the salivary gland chromosomes. The peripheral zone of the nucleolus disappears and there is accumulation of a dense, basic protein at the periphery. RNA is lost from the peripheral zone but remains in the central zone. The change in the appearance of the Balbiani rings may result from the degradation of the RNA-protein complexes. Illustrated by numerous electron micrographs, plus a diagram of the changes in nucleolar appearance.

Specialised subjects: Puffs, Nucleolus - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Stevens, B.J. 1964*b*. L'action de l'Actinomycin D sur le nucléole de la glande salivaire chez *Chironomus thummi*. *Abstracts of Communications des Membres Biologistes, Colloque de Strasbourg*. *Journal de Microscopie* **3**: 54.
A summary of the work published in Stevens (1964*a*).

Specialised subjects: Puffs, Nucleolus - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Stevens, B.J. & Swift, H. 1966. RNA transport from nucleus to cytoplasm in *Chironomus* salivary glands. *Journal of Cell Biology* **31**: 55-77.
An electron microscope cytochemical study of the Balbiani rings of *C. thummi* [=*C. riparius*]. Show that the granules observed in the Balbiani rings are produced by the chromatin threads and released into the nucleoplasm, from where they pass to the cytoplasm. Illustrated by photographs of chromosome IV. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Stevens, B.J., Swift, H. & Adams, B.J. 1965. Fine structure and cytochemistry of Balbiani ring granules in *Chironomus* (Diptera). *Abstracts of the Fifth Annual Meeting of the American Society for Cell Biology, Philadelphia. Journal of Cell Biology* **27**: 100A-101A.
An abstract of the studies reported in Stevens (1964*a*) and Stevens & Swift (1966).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Stich, H. 1956. Bau und Funktion der Nukleolen. *Experientia* **12**: 7-14. (English summary)
Surveys the structure, chemical composition and metabolism of the nucleoli of various cells including the larval salivary glands of *Chironomus thummi* [=*C. riparius*]. A diagram of nucleolar structure of the polytene chromosomes is provided, and autoradiographic studies indicate a rapid synthesis of RNA and protein in the nucleolus which subsequently disappears. (Partim).

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Stich, H.F. 1959. Changes in nucleoli related to alterations in cellular metabolism, pp. 105-122. *In* Rudnick, D. (ed.), *Developmental Cytology,* Ronald, New York.
An autoradiographic and X-ray quantitative analysis of nucleolar material attached to larval salivary gland chromosomes of an unidentified *Chironomus* species. It was shown that the incorporation of ^{32}P differed at the top and base of the chromosome, where the nucleoli differed in respect of the presence of RNA. It is possible he is not distinguishing between nucleoli and Balbiani rings. Illustrated by photographs of differentially stained fourth chromosomes. (Partim)

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus* species

Stich, J.F. 1964. Genetics and Entomology. *Canadian Entomologist* **96**: 429-436.
Discusses some problems of common interest to geneticists and entomologists, including the use of polytene chromosomes for studies of taxonomy, chromosomal polymorphism and, particularly, gene regulation.
The different arrangement of nucleoli and Balbiani rings on the fourth chromosome of various *Chironomus* species is illustrated and electron micrographs of nucleolar and Balbiani ring structure are included. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Puffs - Balbiani rings, Nucleolus - structure; ytotaxonomy - polytene chromosomes
Species: *Chironomus annularius, C. anthracinus*, *C. crassimanus*, *C. dorsalis*, *C. luridus*, *C. plumosus*, *C. salinarius*, *C. striatus*

Stich, H.F. & Naylor, J.K. 1958*a*. Variations of the DNA, RNA and protein content of specific chromosome regions during development. *Proceedings of the 10th International Congress of Genetics, Montreal* **2**: 276. (Abstract)
A summary of the studies on *Glyptotendipes* published in Stich & Naylor (1958*b*).

Specialised subjects: Polytene chromosomes:structure, Puffs - structure
Species: *Glyptotendipes* species [?=*G. barbipes*]

Stich, H.F. & Naylor, J.M. 1958*b*. Variation of desoxyribonucleic acid content of specific chromosome regions. *Experimental Cell Research* **14**: 442-445.
A microphotometric determination of DNA amounts in specific regions of the polytene chromosomes of the larval salivary glands, particularly where puffing is involved. Indicated that the DNA content is not constant in some puffed regions. Illustrated by photographs of the studied regions.

Specialised subjects: Puffs - DNA amplification
Species: *Glyptotendipes* species [?=*G. barbipes*]

Stockert, J.C. 1975. Nucleic acid metachromasy by toluidine blue in Epon thick sections. *Microscopica Acta* **76**: 433-436. (English & German summary).
On staining with toluidine blue at pH5 RNA containing structures, such as the Balbiani rings, show metachromasy in the cells of larval salivary glands. The technique allows simultaneous localisation of both RNA and DNA in a simple way. (Partim)

Specialised subjects: Techniques; Polytene chromosomes, Puffs - RNA synthesis
Species: *Chironomus pallidivittatus*

Stockert, J.C. 1985. Cytological effects of berberine sulphate on *Chironomus* salivary gland nuclei. *Chromosoma* **93**: 21-25.
Treatment with berberine sulphate leads to a modification of the size of the Balbiani rings, depending upon the concentration. However, regardless of the concentration, there is an accumulation of droplets in the BRs. Illustrated by graphs and photographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*

Stockert, J.C. & Colman, O.D. 1975. Nucleolar patterns in *Chironomus* salivary glands. *Die Naturwissenschaften* **62**: 439-440.
Two structural types of nucleoli are found in *Chironomus* species. These two types are described and figured semi-diagrammatically. It is shown that the segregated type becomes more common in prepupae or could be induced by a variety of environmental conditions. Their characteristics are interpreted in terms of ultrastructure.

Specialised subjects: Nucleolus - structure
Species: *Chironomus pallidivittatus, C. tentans, C. thummi* [=*C. riparius*]

Stuart, W.D. & Porter, D.L. 1978. An improved in situ hybridization method. *Experimental Cell Research* **113**: 219-222.
Describe a modified technique for in situ hybridisation which is illustrated by use of an 18/28s ribosomal RNA probe to the larval salivary gland chromosomes of *Polypedilum nubifer*. Illustrated by photographs using a fluorescent probe.

Specialised subjects: Techniques; Nucleolus - RNA synthesis
Species: *Polypedilum nubifer*

Sublette, J.E. & Martin, J. 1980. *Yama tahitiensis* n. gen., n.sp. from Tahiti (Diptera: Chironomidae). *Pan-Pacific Entomologist* **56**: 221-237.
Along with the conventional taxonomic description, the larval salivary gland chromosomes are described and figured. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Yama tahitiensis*

Sümegi, J., Wieslander, L. & Daneholt, B. 1982. A hierarchic arrangement of the repetitive sequences in the Balbiani ring 2 gene of *Chironomus tentans*. *Cell* **30**: 579-587.
The identity of a cloned gene, pCt63, as a part of the BR2 gene was confirmed by *in situ* hybridisation to the salivary gland chromosomes. Illustrated by a photograph. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation , Puffs - Balbiani rings, structure
Species: *Chironomus tentans*

Tänzer, E. 1922. Die Zellkerne einiger Dipterenlarven und ihre Entwicklung. *Zeitschrift für wissenschaftliche Zoologie* **119**: 114-153.
Describes the cell nucleus at different stages of development in a number of tissues of a number of dipteran larvae. Figures the salivary gland nuclei of an unidentified *Chironomus* species (which could be *Ch. plumosus*) and illustrates segments of the polytene chromosomes and the nucleolus. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus* species [?=*C. plumosus*]

Tamura, O. 1923. Morphologische Studie über Chromosomen und Zellkerne. *Archiv für Zellforschung* **17**: 131-164.
General studies of the structure of chromosomes in a variety of organisms including unidentified *Chironomus* larvae, possibly *C. plumosus*. Notes the banded nature of the chromosomes and the presence of a large nucleolus in the salivary glands. Illustrated by a rather diagrammatic drawing. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species [?=*C. plumosus*]

Tanguay, R.M. & Nicole, L.M. 1977. Synthesis and intranuclear distribution of non-histone proteins in microdissected nuclei of *Chironomus tentans*. *Chromosomes Today* **6**: 227-235.
Analysed the non-histone proteins of a number of fractions from microdissected salivary gland nuclei. These fractions included chromosomes I-III, chromosome IV and the nucleoli. There was no difference in the protein content of the chromosomes despite the presence of Balbiani rings in chromosome IV. The nucleoli contained numerous specific bands. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Tanguay, R.M. & Vincent, M. 1979. Intracellular distribution of heat shock proteins in *Chironomus tentans*. *Abstracts of Papers presented at the 1979 Meetings of the Genetics Society of America, Edmonton, Alberta*. *Genetics* **91** (Supplement): s126-s127.

After treatment at 39^{o}C there is a reduction in normal protein synthesis, e.g. in the nucleolus, and two new proteins are found in the chromosomal fraction. The function of the heat shock response is discussed. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - protein synthesis
Species: *Chironomus tentans*

Tavcar, V. 1966. Grada zlijezda slinovnica i gorostasnih kromosoma nekih licinaka hironomida, njezin odnos prema nacinu zivota i vaznost za determinacijn vrsta. *Bioloski Glasnik* **19**: 11-17. (English summary).
Studied the structure of the larval salivary glands of 11 species of Chironomidae, and described two types of gland structure, those with large nuclei (usually having a visible lumen to the gland) and those with small nuclei. The polytene chromosomes of five species with type I glands are drawn. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Brillia* gp. *modesta*, *Microtendipes* gp. *chloris, Polypedilum* gp. *pedestre, P.* species, [Tendipedinae "genuinae No.3"], *Sergentia* gp. *longiventris*

ten Tusscher, B. & Derksen, J. 1982. The fourth chromosome of *Chironomus tentans* Malpighian tubules. An ultra structural study. *Chromosoma* **85**: 643-658.
Studied chromosome IV of *C. tentans* from the Malpighian tubules by electron microscopy. Demonstrated an increase in the number of bands recognised and comment of the structure. A photographic and drawn chromosome map of the chromosome is provided. Illustrated also by electron micrographs.

Specialised subjects: Polytene chromosomes - tissue differences, structure
Species: *Chironomus tentans*

Thoday, J.M. 1967. Summing up: uses of genetics in physiological studies. *Endocrine Genetics. Proceedings of a Symposium at the University of Cambridge, 1966. Memoirs of the Society for Endocrinology* **15**: 297-311.
Summarises the studies of Karlson (1967) on hormonal control of puffs. (Partim)

Specialised subjects: Puffs - ecdysone
Species: *Chironomus* spp.

Thompson, P.E. 1968. The duplication of hemoglobin genes in *Chironomus*. *Abstracts of Papers presented at the 1968 Meetings of the Genetics Society of America, Boston, Massachussets*. *Genetics* **60**: 230.
Using racial differences in chromosome sequence it was shown that the site of control for three larval haemoglobins in the German race of *C. tentans*, not present in a North American race, is on chromosome 3, linked with the structural loci. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus tentans*

Thompson, P.E. 1971. Male and female heterogamety in populations of *Chironomus tentans* (Diptera: Chironomidae). *Canadian Entomologist* **103**: 369-372.
Describes experiments which supposedly show that the population of *C. tentans* from Madison, Wisconsin is female heterogametic with the female sex determiner in the right arm of chromosome I. The experiments are not conclusive and the results are confused by the presence of lethals which obscure the parental and recombinant classes in experimental crosses. Subsequent work suggests that no such female heterogametic strains exist. Illustrated by photographs of chromosomes heterozygous for sex linked inversions.

Specialised subjects: Sex chromosomes - female heterogamety
Species: *Chironomus tentans*

Thompson, P.E. & Bowen, J.S. 1972. Interactions of differentiated primary sex factors in *Chironomus tentans*. *Genetics* **70**: 491-493.
Further North American populations are classed as female heterogametic although no evidence for the conclusion is given. Crosses between male-heterogametic-strain males and supposed female-heterogametic-strain females indicated that sex was determined by the male sex determiner. Although it is concluded that the male sex determiner is epistatic to the female sex determiner, this result is what would be expected if all strains possessed a male sex determiner.

Specialised subjects: Sex chromosomes - female heterogamety
Species: *Chironomus tentans*

Thompson, P.E. & Patel, G. 1972. Compensatory regulation of two closely related hemoglobin loci in *Chironomus tentans*. *Genetics* **70**: 275-290.
A factor which regulates two closely linked haemoglobins in *C. tentans* was found to be closely linked to one of these loci on chromosome 3 by means of crosses utilising different inversion sequences in the polytene chromosomes. The different sequences used are illustrated by photographs. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus tentans*

Thomson, J.A. 1968. The interpretation of puff patterns in polytene chromosomes. *Currents in Modern Biology* **2**: 333-338.
In a review of the significance of puffing in polytene chromosomes, the number, size and period of activity of the puffs in the larval salivary glands of *Chironomus tentans* are considered. (Partim)

Specialised subjects: Puffs - gene activity
Species: *Chironomus tentans*

Thudium, D. 1974. *Das verhalten von Soma- und Keimbahnchromosomen bei* Acricotopus lucidus *Staeger (Orthocladiinae, Diptera)*. Doctoral Thesis, Universität Hohenheim, Stuttgart, Germany.
At least part of the contents would include the work published in Staiber & Thudium (1986)

Specialised subjects: L-chromosomes - origin
Species: *Acricotopus lucidus* [=*A. lucens*,]

Tichy, H. 1968. Hemoglobins of *Chironomus tentans* and *C. pallidivittatus*: biochemical and cytological studies. *Fourth Wissenschaftliche Konferenz der Gesellschaft Deutscher Naturforscher und Ärtze:* 248-252.
The sequence differences between *C. tentans* and *C. pallidivittatus* were used in hybridisation crosses to map three of the larval haemoglobins to chromosome 3. Illustrated by a photographs of chromosome 3 from a hybrid, with the location of one locus indicated. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus pallidivittatus*, *C. tentans*

Tichy, H. 1970. Biochemische und cytogenetische Untersuchungen zur Natur des Hämoglobin-Polymorphismus bei *Chironomus tentans* und *Chironomus pallidivittatus*. *Chromosoma* **29**: 131-188.
In an extension of the work reported in Tichy (1968), seven haemoglobin loci of *C. tentans* and *C. pallidivittatus* were mapped to restricted regions of chromosome 3. Illustrated by numerous excellent photographs. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus pallidivittatus*, *C. tentans*

Tichy, H. 1973. Haemoglobin genes in the genus *Chironomus*. *Abstracts of Papers presented at the XIII International Congress of Genetics*, *Berkeley*, *California*. *Genetics* **74**: s276-s277.
A brief report of the work reported by Tichy (1968 & 1970) on the localisation of the species-specific larval haemoglobins of *C. tentans* and *C. pallidivittatus*. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus pallidivittatus*, *C. tentans*

Tichy, H. 1975. Nature, genetic basis and evolution of the haemoglobin polymorphism in *Chironomus*. *Journal of Molecular Evolution* **6**: 39-50.
A further report of the localisation of the species-specific larval haemoglobins of *C. tentans* and *C. pallidivittatus* to chromosome 3, and the evolutionary significance of these results. Illustrated by a photograph of chromosome 3 from a hybrid. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes
Species: *Chironomus pallidivittatus*, *C. tentans*

Tichy, H. 1980. Are different *Chironomus* hemoglobins of monophyletic origin? *Proceedings of the VI International Symposium on Chironomids*, *Prague*, *1976*. Acta Universitatis Carolinae - Biologica 1978: 253-257.
In a review of the evolutionary significance of the multiple haemoglobins of *Chironomus*, the localisation of the haemoglobin loci in *C. tentans* and *C. pallidivittatus* to chromosome 3 is mentioned and illustrated by a photograph of the chromosome from a hybrid. (Partim)

Specialised subjects: Linkage group - chromosome correlation, polytene chromosomes

Species: *Chironomus pallidivittatus*, *C. tentans*

Tiniakov, G.G. 1936. The inert regions and general morphology of the chromosomes in the salivary gland cells of Diptera. *Biologiceskii Zhurnal* **5**: 753-802. (In Russian, Russian and English summary)
Figures and discusses the structure of polytene chromosomes in an unidentified *Chironomus* species. Depicts the chromosome as having a basic tetrad structure of primary chromatids which each consist of a series of separate genonemes. However each chromatid is claimed to remain quite independent, participating as a unit in the intertwining that occurs along the length of the chromosome. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Topping, M.S. 1969. *Giant chromosomes, ecology and adaptation in* Chironomus tentans. Ph.D Thesis, University of British Columbia, Vancouver, Canada. 152pp.
Studied the ecology and distribution of *C. tentans* in a number of British Columbian lakes, including the effect of ecology on the frequency of inversion polymorphisms. This latter work was published in Topping & Acton (1976). An abstract of the thesis was in Dissertation Abstracts 31B: 453B-454B (1970). (Partim)

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus tentans*,

Topping, M.S. & Acton, A.B. 1976. Influence of environmental factors on frequencies of certain chromosomal inversions in *Chironomus tentans* Fabricius. *Evolution* **30**: 170-179.
Investigated the response of larval abundance and inversion frequency of *C. tentans* to 19 "abiotic" and 5 "biotic" environmental variables in 12 saline lakes. Inversion 1 Rad depended on only the abundance of larvae of other Chironomidae, but chromosome 1 frequencies changed when fish predators were added.. No illustrations.

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus tentans*,

Trepte, H.-H. 1988. Electron microscopic analysis of ribosomal transcription units in the *Chironomus* polytene salivary gland chromosomes. *Genome* **30** (Suppl. 1): 75. (Abstract)
Describes the ribosomal transcription units as observed in Miller spreads of polytene chromosomes of *C. pallidivittatus*. The sizes are in agreement with those obtained by other methods.

Specialised subjects: Polytene chromosomes, Nucleolus - structure
Species: *Chironomus pallidivittatus*

Trösch, W. 1977. Condensation states of giant chromosomes studied by electronbeam X-ray microanalysis. *Cytobiologie* **15**: 335-356.
Describes a technique for visualisation of isolated polytene chromosomes in the scanning electron microscope and determining their elemental content by electronbeam microanalysis. The content of elements and their exchangeability with each other vary with the degree of condensation of the chromosomes. A model of condensation - decondensation is proposed. Illustrated by SEM photographs, drawings and diagrams.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Trösch, W. & Lindemann, B. 1973. Examination of the giant chromosomes of larvae of *Chironomus thummi* in situ by scanning electron microscopy. *Micron* **4**: 370-375. English, French & German summary)
The features of the larval salivary gland chromosomes as seen on the scanning electron microscope while in situ in the nucleus, are described and illustrated by SEM photographs. No connections between the ends of chromosomes were observed, but fine connections between the chromosomal bands and the nuclear membrane were observed.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Trösch, W. & Lindemann, B. 1975. Electronbeam X-ray microanalysis of isolated, freeze-dried giant chromosomes. *Journal de Microscopie et de Biologie Cellulaire* **22**: 487-492.
An earlier account than Trösch (1977) of the use of electronbeam X-ray microanalysis of giant chromosomes to establish the elemental content of the chromosomes and the changes of these involved in condensation/ decondensation. Illustrated by photographs, an SEM photograph, and diagrams.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Ullrich, H. 1936. Einige Beobachtungen über Doppelbrechung am lebenden Protoplasten, an verschiedenen Zellorganellen sowie der Zellwand. *Planta* **26**: 311-318.
Studied the structure of the salivary gland chromosomes of *Chironomus* and found that the chromomeres were doubly refractive under polarised light following injury. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* :species

Vafopoulou, X., Steel, C.G.H. & Laufer, H. 1989. Selective stimulation of puffing activity in vitro with a juvenile hormone analogue by polytene chromosomes in the salivary glands of *Chironomus thummi* (Diptera). *Canadian Journal of Zoology* **67**: 2528-2532.
Salivary glands of prepupae were treated in vitro with methoprene. This was found to not only prevent regression of Balbiani rings BRb and BRc, but to cause an expansion of BRb. A similar effect was observed with in vivo treatment. Illustrated by photographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Valentin, M., Bollenbacher, W.E., Gilbert, L.I. & Kroeger, H. 1978. Alterations in ecdysone content during the post-embryonic development of *Chironomus thummi*: correlations with chromosomal puffing. *Zeitschrift für Naturforschung* **33c**: 557-560.
The ecdysone titre of larvae and pupae of *C. thummi* [=*C. riparius*] was found to be correlated to the activity of the ecdysone sensitive chromosomal site IIId1. (Partim)

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus thummi* [=*C. riparius*]

Valeyeva, F.S. 1975. Effect of pilocarpine on the puffing in polytene chromosomes of salivary glands in *Chironomus thummi*. *Tsitologiya* **17**: 1032-1036. (In Russian, English summary)
Under the influence of pilocarpine, which causes the salivary glands to be emptied of secretion thereby stimulating the larvae to secrete more, the size of four salivary gland chromosome puffs increased. This suggests these puffs are correlated with the secretory process of the salivary gland cells. Illustrated by diagrams and drawings of two of the puffs.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Valeyeva, F.S. & Kiknadze, I.I. 1971. Change in the mass of DNA in the nuclei of cells of the salivary gland of chironomids following polytenization. *Ontogenez* **2**: 406-410. (In Russian, English summary) [Translated in *Soviet Journal of Developmental Biology* **2**: 327-331]
Determination of the DNA content of salivary gland nuclei by absorption spectrophotometry reveals that nuclei may go through from nine to thirteen replications of the DNA during polytenisation. Nuclei with different degrees of polytenisation tend to be localised in definite parts of the salivary gland. Illustrated by graphs and a diagram of the distribution in the salivary gland.

Specialised subjects: Polytene chromosomes - differential polyteny
Species: *Chironomus thummi* [=*C. riparius*]

Valeyeva, F.S., Kiknadze, I.I., Panova, T.M. & Perov, N.A. 1979. Effect of high doses of actinomycin D on the structure, puffing and transcription in polytene chromosomes of salivary glands of *Chironomus thummi*. *Tsitologiya* **21**: 1411-1418. (In Russian, English summary)
Actinomycin inhibits RNA synthesis in the salivary gland chromosomes. On its removal the nucleoli and the Balbiani rings recover first. With continued exposure to high doses puffs, which do not synthesise RNA appear at the centromeres and some other locations.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Valeyeva, F.S., Stepanova, N.G., Kiknadze, I.I., Nitikin, S.M., Zhuze, A.L. & Zelenin, A.V. 1982. Effect of a fluorescent analog of actinomycin D (7-amino-actinomycin D) on the structure of the polytene chromosomes of *Chironomus thummi thummi*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes, Novosibirsk*: 72.
An abstract of the work published by Valeyeva *et al*. (1984).

Specialised subjects: Puffs - Balbiani rings, experimental induction

Species: *Chironomus thummi thummi* [=*C. riparius*]

Valeyeva, F.S., Stepanova, N.G., Nitikin, S.M., Zhuze, A.L., Kiknadze, I.I. & Zelenin, A.V. 1984. Fluorescence microscopic and autoradiographic analyses of differential reaction of various regions of polytene chromosomes to long-term 7-amino-actinomycin D and H-actinomycin D treatments. *Tsitologiya* **26**: 1255-1261. (In Russian, English summary)
Long term treatment of the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*] was found to result in regression of the nucleolus and Balbiani rings and the development of pseudo-puffs in the centromeric regions. The reasons for such effects are discussed.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Valkanov, A. & Michailova, P. 1974. Untersuchungen über den karyotypus und chromosomen polymorphisms bei *Thalassomyia frauenfeldi* Schiner (Diptera, Chironomidae) von der Bulgarischen Schwarzmeerküste. *Isvestia na Zoologischecki Institut s Musei, Bulgarska Akademiia na Naukite* **40**: 5-16. (Russian summary)
Describes the mitotic and polytene chromosome complement of *Thalassomyia frauenfeldi* from three populations, including the chromosomal polymorphisms which include inversions, trisomy and a B-chromosome. Illustrated by photographs and a drawn chromosome map.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Thalassomyia* [=*Thalassomya*] *frauenfeldi*

Van Valen, L. & Levins, R. 1968. The origins of inversion polymorphisms. *American Naturalist* **102**: 5-24.
A theory of the adaptive significance of inversion lengths is presented and applied to several families of Diptera, including Chironomidae. The observed distribution of inversions in the Chironomidae was similar to that in the Agromyzidae, but differed from that in Drosophilidae and Simuliidae. The only hypothesis found generally applicable is that several genes are required on the average for an inversion (or appreciably heterotic loci are rare but required) and that double crossing over subsequently removes many of the longer inversions. Position effect does not seem to be important in the establishment or maintenance of inversions. [See also Acton 1969 and Martin 1969*a*] (Partim)

Specialised subjects: General Dipteran Cytogenetics; Inversions - polymorphy
Species: *Chironomus dorsalis* [=*C. luridus*], *C. pallidivittatus*, *C. riparius* [=*C. luridus*], *C. tentans*, *Glyptotendipes barbipes*, *Tendipes decorus* [=*Chironomus decorus* gp.]

Vazquez-Nin, G. & Bernhard, W. 1971. Comparative ultrastructural study of perichromation and Balbiani ring granules. *Journal of Ultrastructure Research* **36**: 842-60.
Studied the ultrastructure of Balbiani ring granules from *Chironomus thummi* [=*C. riparius*] and compared them to perichromatin granules in the rat. These granules are generally around 450Å but in the vicinity of certain puffs the granules are smaller. The granules consist of irregularly coiled fibrils. There was no evidence that these granules contained DNA. Illustrated by an electron micrographs. (Partim)

Specialised subjects: Puffs - ultrastructure
Species: *Chironomus thummi* [=*C. riparius*]

Vest Pedersen, B. 1978. Comparisons of the inversion polymorphism in three populations of the midge *Chironomus plumosus* L.(Diptera; Chironomidae). *Hereditas* **89**: 151-162.
Studied inversion frequencies in three Danish lake populations. Qualitative as well as quantitative differences existed with respect to individuals heterozygous for certain inversions, with the frequency of heterozygotes for at least one inversion appearing to depend upon depth. Much data, graphs and other illustrations, as well as drawn chromosome maps and photographs of the alternative sequences for arm B.

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus plumosus*

Vest Pedersen, B. 1978. Studies on the taxonomy of *Chironomus islandicus* (Kieffer, 1913) (Diptera: Chironomidae). *Entomologica Scandinavica* **9**: 309-311.
As part of a redescription of *C. islandicus*, the salivary gland chromosomes are briefly described and figured. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus islandicus*

Vest Pedersen, B. 1984. The effect of anoxia on the survival of chromosomal variants in larvae of the midge *Chironomus plumosus* L. (Diptera: Chironomidae). *Hereditas* **101**: 75-77.
Found that heterozygotes for the BII inversion survived better under anoxic conditions than either homozygote. Frequencies observed in natural populations were discussed in the light of this finding.

Specialised subjects: Inversions - selection experiments
Species: *Chironomus plumosus*

Vest Pedersen, B. 1986. On microgeographic differentiation of a chromosomal polymorphism in *Chironomus plumosus* L. from Lake Tystrup-Bavelse, (Diptera: Chironomidae). *Hereditas* **105**: 209-219.
Heterozygotes for the inversion BII were found to be in excess in those parts of the lake with greatest depth, and in spring. These appears to be little gene flow between Lake Tystrup and Lake Bavelse.

Specialised subjects: Inversions - adaptive significance, seasonal changes
Species: *Chironomus plumosus*

Vest Pedersen, B. 1988. Mechanisms underlying the stable co-existence of two genetically distinct populations of *Chironomus plumosus* (Diptera: Chironomidae) in Lake Tystrup-Bavelse, Denmark. *Holarctic Ecology* **11**: 106-110.
The genetic differences between the populations of Lake Tystrup and Lake Bavelse, as reflected in the frequency of the inversion BII, are suggested to result from isolation due to differences in emergence times of the adults. (Partim)

Specialised subjects: Inversions - adaptive significance
Species: *Chironomus plumosus*

Vincent, M. & Tanguay, R.M. 1979. Heat-shock induced proteins present in the cell nucleus of *Chironomus tentans* salivary gland. *Nature* **281**: 501-503.
As a result of heat shock (39^{o}C), the normal low molecular weight proteins of the nucleolus disappear and two new proteins with MW of about 68000 and 34000. These two proteins are also present in chromosomes from the salivary glands. The heat shock response appears similar to that in *Drosophila*. (Partim)

Specialised subjects: Nucleolus, Chromosome structure - heat shock proteins
Species: *Chironomus tentans*

Vlasova, I.E. & Kiknadze, I.I. 1975. Effect of cyclohexamide on H^3-thymidine incorporation into the chromosomes of *Chironomus thummi* salivary glands at different stages of development. *Tsitologiya* **17**: 518-523. (In Russian, English summary)
Investigated the course of chromosome replication, as evidenced by uptake of tritium-labelled thymidine, in untreated larvae and larvae treated with cyclohexamide. Replication normally is initiated at the beginning of the instar. However, the repression of protein synthesis influences both the initiation and progression of DNA synthesis. Illustrated by photographs and autoradiographs.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Vlasova, I.E., Kiknadze, I.I. & Sherudilo, A.I. 1972. The course of DNA replication in polytenization of chromosomes in the ontogeny of *Chironomus thummi*. *Doklady Academiia Nauk, S.S.S.R.* **203**: 459-462. (In Russian) [Translated in *Doklady Biological Sciences* **203**: 159-162]
Investigated chromosome replication in, and the volume of, salivary gland nuclei during the course of larval development. The degree of polytenisation was not the same in all cells of the same gland, and there was no clear correlation between the degree of polytenisation and the volume of the nuclei.

Specialised subjects: Polytene chromosomes - DNA replication
Species: *Chironomus thummi* [=*C. riparius*]

Vogt-Köhne, L. 1961. Quantitative cytochemische Untersuchungen an Nukleolen aus Speicheldrüsen-kernen von *Chironomus thummi*. *Chromosoma* **12**: 382-397.
Investigated the normal development and the effect of environmental variables on the nucleolus of the fourth chromosome of *C. thummi* [=*C. riparius*]. Illustrated by a photograph of the fourth chromosome with its nucleolus.

Specialised subjects: Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Vogt-Köhne, L. & Carlson, L. 1963. Cytochemische Untersuchungen an Balbianiringen

des 4. Speicheldrüsenchromosoms von *Chironomus tentans*. *Chromosoma* **14**: 186-194.
Investigated the concentration of nucleic acids in the Balbiani rings of normal and cold shocked larvae of *Chironomus tentans*. The concentration of nucleic acid was almost doubled following cold shock. Illustrated by a diagram of chromosome 4 with its Balbiani rings.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus tentans*

von Borstel, R.C., Miller, O.L.Jr. & Bollum, F.J. 1969. Probing the structure of chromosomes with DNA polymerase and terminal transferase. *Genetics Supplement* **61**: 401-408. (English & Spanish summaries)
When polytene chromosomes of *Chironomus riparius* are denatured and used as a template for DNA polymerase or terminal transferase, every band acts as an incorporation site. For terminal transferase this confirms that ends or single-strand breaks of DNA molecules are present in nearly every band. (Partim)

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus riparius*

Vonwiller, P. & Audova, A. 1933. Mikrodissektion an der Speicheldrüse von *Chironomus*. *Protoplasma* **19**: 228-241.
Gives a technique for removal of salivary glands and the use of polytene chromosomes in cytogenetic research. In blood and 0.6% NaCl solution the polytene chromosomes were of high consistency, with pressure on one part being transmitted to all other parts. They were also elastic, springing back after being greatly stretched, the cross-banding was preserved if they were not stretched too far, and that breakage occurred at the boundary between single bands.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Walter, L. 1973*a*. Syntheseprozesse an den Riesenchromosomen von *Glyptotendipes*. *Chromosoma* **41**: 327-360. (English and German summaries)
Investigated DNA synthesis and protein incorporation in the salivary gland chromosomes of *G. barbipes*. Concluded that there is no difference in the number of replications in heterochromatic and euchromatic segments, but that replication begins more slowly in heterochromatin. Puffs can be induced in heterochromatic regions by temperature shocks and X-rays. There is no measurable RNA synthesis at theses puffs but small amounts of protein are produced. Illustrated by a number of autoradiographs. Drawn chromosome maps are provided which bear no relationship to the previously published maps of Miseiko, Minsarinova & Kiknadze (1971).

Specialised subjects: Polytene chromosomes - DNA replication, maps
Species: *Glyptotendipes barbipes*

Walter, L. 1973*b*. Speicheldrüsen-Chromosomen - experimentelle Untersuchungen in Schülerübungen. *Mathematische und Naturwissenschaftliche Unterricht* **26**: 359-365.
Briefly reviews the structure of polytene chromosomes and their use to illustrate gene activity. Illustrated by photographs and diagrams.

Specialised subjects: Techniques; Polytene chromosomes, Puffs - developmental sequence
Species: *Chironomus thummi piger* [=*C. piger*], *C. th. thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Walter, L. 1975. *Glyptotendipes*. *Handbook of Genetics* **3**: 279-282.
Reviews the laboratory culture and cytology of the polytene chromosomes of *Glyptotendipes barbipes*. Re-presents the chromosome maps of Walter (1973). Briefly describes the germ cell chromosomes from three species of *Glyptotendipes*.

Specialised subjects: Polytene chromosomes - maps
Species: *Glyptotendipes barbipes*, *G. cauliginellus, G.gripekoveni*

Webb, C.J., Cranston, P.S. & Martin, J. 1989. Congruence between larval ventromental plate ultrastructure and immature morphology in *Yama* Sublette & Martin and some Oceanian species of *Chironomus* Meigen (Diptera: Chironomidae). *Zoological Journal of the Linnean Society* **97**: 81-100.
Note that the material of *Chironomus samoensis* studied from American Samoa is cytologically distinct from the material referred to as *C. samoensis* from Japan. This latter species is probably *C. flaviplumus*. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes

Species: *Chironomus samoensis*

Weber, F., Mäher, R., Meyer, B., Eppenberger, H.M. & Lezzi, M. 1983. Cell-free translation of Balbiani ring RNA (75S) of *Chironomus tentans* salivary glands into high molecular weight products. *Wilhelm Roux's Archives of Developmental Biology* **192**: 200-203.
In order to demonstrate that the RNA produced by the genes in the chromosome regions forming Balbiani rings is the messenger for the silk-like secretion of the salivary glands, the RNA was translated in a cell free system. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus tentans*

Weirich, G. & Karlson, P. 1969. Distribution of tritiated ecdysone in salivary glands and other tissues of *Rhynchosciara* and *Chironomus* larvae: an autoradiographic study. *Wilhelm Roux' Archiv für Entwicklungsmechanik der Organismen* **164**: 170-181. (English & German summary)
Investigates the distribution of tritium labelled ecdysone in the salivary glands of *C. tentans* and finds no difference between the distribution of label in the cytoplasm and nuclei, with some indication of localisation at chromosomal loci. These results are considered to be inconsistent with those of Kroeger (1967), who denied a direct action on the chromosomes. Illustrated by autoradiographs. (Partim)

Specialised subjects: Polytene chromosomes - gene activity
Species: *Chironomus tentans*

Weiss, M. 1965. *DNS-Injektionen in Zellkerne der Speicheldrüsen von* Chironomus thummi. Diplomarbeit, Eidgenössische Technische Hochschule,
Zürich, Switzerland.
This reference has not been seen.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Wells, R., Royer, H.-D. & Hollenberg, C.P. 1976. Non *Xenopus*-like DNA sequence organisation in the *Chironomus tentans* genome. *Molecular and General Genetics* **147**: 45-51.
The DNA of *C. tentans* is 90% unique DNA, which is organised in the genome with 13.5kb to 36kb spacing between repeats of middle repetitive DNA. Thus the organisation is like that of the *Drosophila* genome rather than like the *Xenopus* genome. (Partim)

Specialised subjects: Chromosome structure - DNA arrangement
Species: *Chironomus tentans*

Wen, W.-N. & Hague, D.R. 1979. Localization of 5S gene loci on polytene chromosomes of *Glyptotendipes barbipes* (Staeger) and transcription of RNA from these sites. *Cytologia* **44**: 487-503.
Confirm the cytological location of only three of the 5S RNA loci previously reported on the polytene chromosomes of *G. barbipes* (Wen, León & Hague 1974). All are on arm F, with the heaviest concentration of silver grains over the site at F8a. However this site is not the most active in transcription. When treated with alpha-amanitin, the transcription of 5S RNA, but not 18+28S RNA, is inhibited. A fourth 5S locus was observed in some individuals, arising from an inversion break within the F8a tandem repeat. Illustrated by photographs and autoradiographs.

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Glyptotendipes barbipes*

Wen, W.-N., León, P.E. & Hague, D.R. 1974. Multiple gene sites for 5S and 18 + 28S RNA on chromosomes of *Glyptotendipes barbipes* (Staeger). *Journal of Cell Biology* **62**: 132-144.
The location of genes coding for ribosomal RNA (5S and 18+28S) were determined on the salivary gland chromosomes by in situ hybridisation. The 18+28S genes were associated with the nucleoli on chromosomes IR, IIL, and IIIL, while the 5S RNA hybridised to three sites on IIIR, two sites on IIR and to a Balbiani ring on chromosome IV. In a later paper (Wen & Hague 1979) only the sites on IIIR could be confirmed. No clear location could be determined for the gene for 4S RNA.

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Glyptotendipes barbipes*

Westermann, R. & Grossbach, U. 1984. Localization of nuclear proteins related to high mobility group protein 14 (HMG 14) in polytene chromosomes. *Chromosoma* **90**: 355-365.
A fluorescently-labelled antibody to HMG 14 was found to be associated with active puffs in the polytene chromosomes of *Chironomus pallidivittatus*. The Balbiani rings showed intense fluorescence, although BR6 showed no reaction with the antibody prior to its induction or after it

recondensed. It was therefore concluded that actively transcribed puffs contain HMG 14-related protein that is not present when there is no active transcription at that puff. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene activitySpecies: *Chironomus pallidivittatus*

Westermann, R. & Trepte, H.-H. 1988. Immunological localization of high mobility group (HMG) non-histone chromosomal proteins in cells and chromosomes. *Genome* **30** (Suppl.1): 75 (Abstract)
HMG-14 -like proteins were found to be localised at puffs and transcribed regions on polytene chromosomes, increasing as puffs increased activity and decreasing as they became inactive, unless inactivated by actinomycin-D or heat shock. (Partim)

Specialised subjects: Polytene chromosomes - structure; Puffs - Balbiani rings, gene activity
Species: *Chironomus pallidivittatus*

Wetzel, R., Buder, E., Schälike, W. & Zirwer, D. 1969. Linearer Dichroismus bei Riesenchromosoms von *Chironomus*. *Chromosoma* **26**: 201-207.
Measurements of linear dichroism on the salivary gland chromosomes of *C. thummi* [=*C. riparius*] indicate there is no uniform orientation of the nucleic acid molecules within the chromomeric disks. Illustrated by a UV-photograph of a small segment of chromosome.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Wetzel, R., Zirwer, D., Schälike, W., Gallkowski, H., Schmidt, J., Knüpffer, H. & Bonnke, H. 1969. An ultra-violet microspectrophotometer for measurements with polarized light. *Journal of Physics E. Scientific Instruments* (Series 2) **2**: 841-845.
Describe an ultra-violet microspectrophotometer and note its use to study orientation of nucleic acid molecules in the salivary gland chromosomes of *Chironomus*. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

White, M.J.D. 1945. *Animal Cytology and Evolution*. Cambridge University Press, Cambridge. First Edition.
This edition was not seen, but would probably include some of Bauer's work on polytene chromosomes.

Specialised subjects: General Dipteran Cytogenetics;Polytene chromosomes - structure
Species: Chironomidae spp.,

White, M.J.D. 1954. *Animal Cytology and Evolution*. 454pp. Cambridge University Press, Cambridge. Second Edition.
As part of a comprehensive review of all aspects of the cytogenetics of animals, studies on chironomids are discussed. Emphasis is given to the structure of polytene chromosomes and inversion polymorphism. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure; Inversions - polymorphy
Species: *Chironomus dorsalis, C. plumosus, C. riparius, C. thummi* gp.

White, M.J.D. 1973. *Animal Cytology and Evolution*. 961pp. Cambridge University Press, Cambridge. Third Edition.
A much expanded comprehensive review of all aspects of the cytogenetics of animals, with added areas on germ-line limited chromosomes, puffs, and banding patterns and their use in studies of speciation and evolution. Illustrated by drawings and diagrams from the original articles. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structureevolution; Puffs - structure; L-chromosomes; Cytotaxonomy - polytene chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus aberratus,* ;*C. acidophilus, C. annularius, C. anthracinus, C. attenuatus* [=*C. decorus* gp.(R&F)], *C. cingulatus, C. commutatus, C. crassicaudatus, C. crassimanus, C. dorsalis, C. duplex, C. halophilus* [=*C. aprilinus*], *C. holomelas, C.* [=*Kiefferulus*] *intertinctus, C. luridus, C.* [=*Kiefferulus*] *martini, C. melanescens, C. melanotus, C. nuditarsis, C. obtusidens, C. occidentalis, C. pallidivittatus, C. parathummi, C.* [=*Kiefferulus*] *paratinctus, C. piger, C. plumosus, C. pseudothummi, C. riparius, C. salinarius, C. staegeri, C. tentans, C. uliginosus,*

Cryptochironomus defectus gp. sp. 1, *C. defectus* gp. sp. 2, *Glyptotendipes barbipes, Lundstroemia parthenogenetica* [=*Paratanytarsus grimmi*:], Orthocladiinae spp., *Trichocladius* [=*Halocladius*] *vitripennis*

White, M.J.D. 1978. *Modes of Speciation*. 455pp.W.H.,Freeman and Co., San Francisco.
Discusses cytogenetic differences between species and the involvement of chromosomal rearrangements in speciation and evolution. (Partim)

Specialised subjects: Polytene chromosomes - evolution
Species: *Chironomus australis, C. duplex, C. oppositus, C. piger, C. tentans, C. thummi* [=*C. riparius*]

Whitmore, T. 1986. Localization of a 'housekeeping' gene by *Chironomus thummi thummi*. *Cytobios* **46**: 193-200.
Showed by *in situ* hybridisation that the D gene of the haemoglobin III/IV complex is localised near the tip of chromosome III at A1b, with weaker hybridisation at A1c on chromosome II and G3o on chromosome I. It was not possible to tell whether hybridisation was to the band or the interband region. Illustrated by photographs of chromosome III.

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi thummi* [=*C. riparius*]

Widmer, R.M., Lezzi, M. & Koller, Th. 1987. Structural transition in inactive Balbiani ring chromatin of *Chironomus* during micrococcus nuclease digestion. *The EMBO Journal* **6**: 743-748.
Digested the chromatin of Balbiani ring genes in an attempt to locate the position of nucleosomes. Once digestion reduced the length of DNA to below five repeats, the length of the repeat changed. This is interpreted as due to a loss of nucleosome-positioning constraint which may allow artefacts which will have to be taken into account in mapping nucleosome positions.

Specialised subjects: Chromosome structure - nucleosomes
Species: *Chironomus tentans*

Widmer, R.M., Lucchini, R., Lezzi, M., Meyer, B., Sogo, J.M., Edström, J.-E. & Koller, Th. Chromatin structure of a hyperactive secretory protein gene (in Balbiani ring 2) of *Chironomus*. *The EMBO Journal* **3**: 1635-1641.
When the gene in BR2 of *C. tentans* was made hyperactive by treatment with pilocarpine, differences were noted in the DNA compared to the inactive gene. The differences were interpreted as an absence of most nucleosomes in the hyperactive gene. The RNA produced in both states was used for production of cDNAs which were *in situ* hybridised to the salivary gland chromosomes. That from cells with an inactive gene went to many parts of chromosome IV, but not BR2, while that from hyperactive cells went specifically to BR2. Illustrated by photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, RNA synthesis, chromatin structure
Species: *Chironomus tentans*

Wieslander, L. 1975. The presence of 5s RNA genes in two consecutive chromosome bands in *Chironomus tentans*. *Molecular Biology Reports* **2**: 189-194.
Demonstrates that the 5S RNA genes of *C. tentans*, previously shown to be in region 2A of chromosome II (Wieslander, Lambert & Egyházi 1975), are located in two adjacent bands of this region. In heterozygotes for an inversion which covers this region of chromosome II, there is close association between the 5S RNA genes and the nucleolus organiser region. Illustrated by autoradiographs and a drawn map of chromosome II.

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Wieslander, L. 1979. Number and structure of Balbiani ring 75S RNA transcription units in *Chironomus tentans*. *Journal of Molecular Biology* **134**: 347-367.
75S RNA has been shown to be produced from a single transcription unit associated with the Balbiani rings, BR1 and BR2. There are between four and five of these units in the genome of *C. tentans*. Since the number of units in each Balbiani ring is not known, it was concluded that each may contain from one to four transcription units. The major part of each unit consists of highly repeated sequences and the rest consists of sequences present once or a few times in each unit. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product

Species: *Chironomus tentans*

Wieslander, L. 1980. *The relationship between repeated DNA sequences and chromosome structure in* Chironomus tentans with emphasis on a specific internally repeated gene. Thesis, Department of Cell Biology, Karolinska Institutet, Stockholm, Sweden. 53pp.
Contains the work published in Derksen *et al*. (1980), Lambert *et al*. (1972), Wieslander (1975), Wieslander (1979), Wieslander, Lambert & Egyhazi (1975) and Wieslander, Lambert & Wobus (1975), . Illustrated by photographs of polytene chromosomes.

Specialised subjects: Puffs - Balbiani rings, gene product; Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Wieslander, L., Lambert, B. & Egyházi, E. 1975. Localization of 5S RNA genes in *Chironomus tentans*. *Chromosoma* **51**: 49-56.
Used in situ hybridisation to localise the 5S RNA genes to region 2A of chromosome II in *C. tentans*. 5S RNA from different sites in the nucleus hybridised to the same location, suggesting a common origin. It should be noted that this chromosomal location for the 5S RNA genes is on arm B under the scheme of Keyl (1962), and therefore does not correspond to the site reported by Bäumlein & Wobus (1976) for *C. riparius*, which is on arm C. Illustrated by autoradiographs.

Specialised subjects: Polytene chromosomes - bands and genes
Species: *Chironomus tentans*

Wieslander, L., Sümegi, J. & Daneholt, B. 1982. Evidence for a common ancestor sequence for the Balbiani ring 1 and Balbiani ring 2 genes in *Chironomus tentans*. *Proceedings of the National Academy of Sciences of the U.S.A.* **79**: 6956-6960.
Studied a cDNA clone which, when *in situ* hybridised to the salivary gland chromosomes, hybridised predominantly to BR1 but also to BR2. The sequence indicates that the BR1 and BR2 genes arose from the same ancestor sequence. (Partim)

Specialised subjects: Polytene chromosomes - bands and genes, in situ hybridisation; Puffs - Balbiani rings, evolution
Species: *Chironomus tentans*

Wobus, U. 1970. Chromosomale Differenzierung und Proteinmuster bei Chironomiden, pp23-26. *In* Pfister, C.L. (ed.), *Ergebnisse der Experimentellen Medizin*. Band 2. *Beitrage zur Molekulargenetik*. 74pp. Veb Verlag Volk & Gesundheit, Berlin. (English summary)
Studied the soluble proteins of the salivary gland and haemolymph in relation to puffing and band patterns of the salivary gland chromosomes. The staining intensity of only three of 11 salivary secretion proteins changed during development. Characteristic changes in haemolymph proteins were observed during development. In one line of *Acricotopus lucidus* [=*A. lucens*] with some shifts and inversions in the right arm of chromosome I, there were changes from the normal haemolymph protein pattern. No illustrations.

Specialised subjects: Puffs - developmental sequence
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus strenzkei, C. thummi* [=*C. riparius*]

Wobus, U. 1975. Molecular characterization of an insect genome: *Chironomus thummi*. *European Journal of Biochemistry* **59**: 287-293.
Analysis of the DNA from *C. thummi* [=*C. riparius*] indicated a G+C content of 28-29%, with a maximum of 80% unique sequences., Middle repetitive sequences were scattered throughout the euchromatin with an average length of 150-200 nucleotide pairs for the repetitive elements. (Partim)

Specialised subjects: Chromosome structure - DNA sequences
Species: *Chironomus thummi* [=*C. riparius*]

Wobus, U. 1976. Hybridisierung von Nukleinsäuren *in situ*. *Biologisches Zentralblatt* **95**: 1-23. (English summary)
Reviews studies of *in situ* hybridisation, particularly those involving nucleic acid sequences such as rRNA, hnRNA and 5S RNA. The techniques used are assessed. Illustrated by autoradiographs. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Techniques; Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus tentans, C. thummi* [=*C. riparius*], *Glyptotendipes barbipes*

Wobus, U., Bäumlein, H., Panitz, R., Serfling, E. & Kafatos, F.C. 1980. Periodicities and tandem repeats in a Balbiani ring gene. *Cell* **22**: 127-135.

The genes and transcripts of the *Chironomus thummi* [=*C. riparius*] Balbiani rings, BRc and BRb, do not cross hybridise. A clone pCthBRc-19, shown by in situ hybridisation to be from BRc (illustrated by photograph), contained 175bp or 1050bp repeats. Sequence homology between the repeats is proposed to permit constrained unequal crossing over, permitting evolution of the repeats from each other. (Partim)

Specialised subjects: Puffs - Balbiani rings, DNA sequence
Species: *Chironomus thummi* [=*C. riparius*]

Wobus, U., Panitz, R. & Serfling, E. 1970. Tissue specific gene activities and proteins in the *Chironomus* salivary gland. *Molecular and General Genetics* **107**: 215-223.
Studied the secretory proteins of the salivary glands of a number of *Chironomus* species biochemically and found no direct correlation between the number of main protein fractions and the number of Balbiani rings. It is suggested that the explanation for this lack of correspondence may lie in the existence of more than one transcription unit in the Balbiani rings. Illustrated by diagrams of the major protein pattern and the Balbiani ring arrangement on the fourth chromosome of the species studied. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus luridus*, *C. obtusidens, C. plumosus, C. strenzkei, C. thummi* [=*C. riparius*]

Wobus, U., Panitz, R. & Serfling, E. 1971. Alpha-Amanitin: its effect on RNA synthesis in polytene chromosomes. *Experentia* **27**: 1202-1203. (German summary)
α-amanitin was found to inhibit chromosomal RNA synthesis, but not nucleolar RNA synthesis, when explanted salivary glands were treated. However no effect was noted when larvae were kept in water containing α-amanitin for 22-24 hours. Illustrated by autoradiographs of chromosomes from treated and untreated glands.

Specialised subjects: Nucleolus - RNA synthesis; Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Wobus, U., Popp, S., Serfling, E. & Panitz, R. 1972. Protein synthesis in the *Chironomus thummi* salivary gland. *Molecular and General Genetics* **116**: 309-321.
Examined the possibility that puffs in salivary gland chromosomes encoded non secretory proteins. However they found that changes in puffing patterns did not lead to corresponding changes in protein patterns. They concluded therefore that much of the RNA produced by these puffs is involved in regulatory processes within the nucleus. (Partim)

Specialised subjects: Puffs - experimental induction
Species: *Chironomus thummi* [=*C. riparius*]

Wobus, U. & Serfling, E. 1977. The repetition frequency of DNA in Balbiani ring 2 of *Chironomus thummi*. *Chromosoma* **64**: 279-286.
Reassociation studies of RNA from BR2 and nucleoli indicate a repetition frequency in the range of 35 for the former, and 50 for the latter. The data were consistent with the gene in BR2 being internally repeated and containing only one type of DNA sequence. Illustrated by a photograph of chromosome IV and a comparative autoradiograph. (Partim)

Specialised subjects: Puffs - Balbiani rings, DNA sequence
Species: *Chironomus thummi* [=*C. riparius*]

Wobus, U. Serfling, E. Baudisch, W. & Panitz, R. 1971. Chromosomale Strukturumbauten bei *Acricotopus lucidus* korrelient mit Änderungen im Proteinmuster. *Biologisches Zentralblatt* **90**: 433-441. (German and English summary)
A new sibling species of *A. lucidus* [=*A. lucens*] is identified on the basis of a unique combination of sequences in chromosome I, and a different haemolymph electrophoretic pattern in some tissues. The possible primary role of the chromosomal rearrangements in the speciation process is discussed. Illustrated by photographs of the rearrangements of chromosome I. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Acricotopus lucidus* [=*A. lucens*]

Wobus, U., Serfling, E. & Panitz, R. 1971. Salivary gland proteins of a *Chironomus thummi* strain with an additional Balbiani-ring. *Experimental Cell Research* **65**: 240-245.
A strain of *C. thummi* [=*C. riparius*] with a large additional Balbiani ring produces large amounts of extra RNA, demonstrated by autoradiography (illustrated), but no difference in the protein fractions of the salivary gland was observed. The additional Balbiani ring was not due to a chromosomal rearrangement or duplication of part

of the nearby BR1. The results suggested its presence was genetically determined.

Specialised subjects: Puffs - Balbiani rings, gene product
Species: *Chironomus thummi* [=*C. riparius*]

Wolf, E. 1941. Die Chromosomen in der Spermatogenese einiger Nematoceren. *Chromosoma* **2**: 192-246.
Studied the details of meiosis in nine species of Nematocera, including *Tendipes* [=*Chironomus*] *plumosus* and *Glyptotendipes barbipes*. The descriptions are well illustrated by drawings of the various stages of meiosis observed. (Partim)

Specialised subjects: Meiosis - description of stages
Species: *Glyptotendipes barbipes*, *Tendipes* [=*Chironomus*] *plumosus*

Wolstenholme, D.R. 1965. The distribution of DNA and RNA in salivary gland chromosomes of *Chironomus tentans* as revealed by fluorescence microscopy. *Chromosoma* **17**: 219-229.
On the basis of the fluorescence patterns following acridine orange staining, both before and after treatment with ribonuclease, it is concluded that DNA is present in both interbands and bands of salivary gland chromosomes and is continuous through these regions. Illustrated by several photographs comparing fluorescence pattern with that of normal staining.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*

Wolstenholme, D.R., Dawid, I.B. & Ristow, H.-J. 1967. An electron microscope study of DNA molecules from *Chironomus*. *Abstracts of the Seventh Annual Meeting of the American Society for Cell Biology*. *Journal of Cell Biology* **35**: 145A-146A.
A summary of the work subsequently published in Wolstenholme, Dawid & Ristow (1968). No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Wolstenholme, D.R. Dawid, I.B. & Ristow, G. 1968. An electron microscope study DNA molecules from *Chironomus tentans* and *Chironomus thummi*. *Genetics* **60**: 759-770.
DNA was isolated from nuclei of *C. tentans* and *C. thummi* [=*C. riparius*] and examined under the electron microscope. The mean length of the DNA filaments produced indicated that the DNA must be continuous into the interband regions. Some regions with characteristics of single-stranded DNA were observed, consistent with the hypothesis that there are regions of single-stranded DNA in salivary gland chromosomes, corresponding to sites of replication and/or transcription. Illustrated by electron micrographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus tentans*, *C. thummi* [=*C. riparius*]

Wülker, W. 1973. Revision der Gattung *Chironomus* Meig. III. Europäische Arten des *thummi*-Komplexes. *Archiv für Hydrobiologie* **72**: 356-374. (English and German summary)
Redescribes four species and describes two new species whose chromosome arm combination is that of the thummi-complex. The salivary chromosome complements are described and illustrated by photographs, and the phylogenetic relationships examined. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus, C. anthracinus, C. melanotus, C. neglectus* [=*C. jonmartini*], *C. riihimäkiensis, C. sororius*

Wülker, W. 1980*a*. Basic patterns in chromosome evolution of the genus *Chironomus* (Diptera). *Proceedings of the Seventh International Symposium on Chironomidae*, p.51. *In* Murray, D.A. (ed.), *Chironomidae. Ecology, Systematics and Physiology*. 349pp. Permagon Press, Oxford.
An unillustrated abstract of the work published in Wülker (1980*b*).

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus alluaudi*, *C.* cf. *tenuistylus, C.* spec. Apple Valley

Wülker, W. 1980*b*. Basic patterns in the chromosome evolution of the genus *Chironomus* (Diptera). *Zeitschrift für zoologische Systematik und Evolutionsforschung* **18**: 112-123. (English and German summary)
Describes the cytology of three species of *Chironomus*, from widely separated places, with the ancestral banding pattern in arms A, E and F. The other chromosome arms show markedly

different banding patterns, suggesting they are less stable. The phylogenetic consequences are discussed. Illustrated by photographs of the chromosome arms and diagrams of phylogenetic relationships.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus aberratus, C. acidophilus, C. alluaudi, C. australis, C. cingulatus, C. crassimanus, C. cucini, C. frommeri, C. halophilus* [=*C. aprilinus*], *C. holomelas, C. jonmartini, C. luridus, C. melanescens, C. oppositus, C. piger, C. plumosus, C. pseudothummi, C. riihimäkiensis, C. riparius, C. sororius, C. staegeri, C.* cf. *tenuistylus, C. uliginosus, C. yoshimatsui, C.* spec. Apple Valley

Wülker, W. 1985. Karyosystematics and morphology of two north European species of the *Chironomus maturus*-complex (Diptera: Chironomidae). *Entomologica Generalis* **10**: 125-132. ((English and German summary)
Describes the salivary gland chromosomes of two unnamed European species with the chromosome arm combination of the maturus-complex. Their relationship to the North American representatives of this complex is discussed. Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus maturus*, *C.* species 1 [=*C. fundatus*], *C.* species 2 [=*C. wülkeri*]

Wülker, W. 1987. Der Karyotyp von *Chironomus* (*Chaetolabis*) *macani* (Diptera: Chironomidae). *Entomologica Generalis* **12**: 281-286. (English and German summary)
Describes and illustrates the polytene chromosome complement of *C. macani*, which has three chromosomes in the combination AB, CD, FEG. Comparison of bands to those of the subgenus *Chironomus* is difficult. Illustrated by photographs.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus macani*,

Wülker, W. & Butler, M.G. 1983. Karyosystematics and morphology of northern *Chironomus* (Diptera: Chironomidae): freshwater species with larvae of the *salinarius*-type. *Entomologica Scandinavica* **14**: 121-136.
Describe the salivary gland karyotype of six species of *Chironomus*, two of them new species, which share a *salinarius*-type larva. *C. major* n. sp., is however a junior homonym. The species all belong to the thummi-complex, with primitive sequences, heterochromatinised centromeres and little inversion polymorphism. Illustrated by photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus cucini*, *C. hyperboreus*, *C. islandicus*, *C. major*, *C. neocorax*, *C. tardus*

Wülker, W. Devai, G. & Devai, I. 1986. Chromosome evolution in the genus *Chironomus* (Diptera) - a computer assisted study. *Abstracts of the First International Congress of Dipterology*: 264.
Used a computer assisted method to assess the frequency and probability of band group neighbourhoods for arms A, E, and F of numerous species of the genus *Chironomus*. The combined values for the three arms gave a much clearer picture of relationships between species than just one arm. The work was incorporated into Wülker *et al*. (1989).

Specialised subjects: Phylogeny - polytene chromosomes
Species: *Chironomus* spp.

Wülker, W., Devai, Gy. & Devai, I. 1989. Computer assisted studies of chromosome evolution in the genus *Chironomus* (Dipt.). Comparative and integrated analysis of chromosome arms A, E and F. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 373-387.
Extend the computer analysis technique of Wülker *et al*. (1984) from one chromosome arm to three, and include data for 60 patterns in arm A, 34 in arm E and 67 in arm F, including at least two species from each continent. The Japanese *C. "samoensis"* is suggested to be *C. fulvipilus,* but this should be *C. flaviplumus*. Contains large tables of sequences and diagrams of the phylogenetic relationships.

Specialised subjects:Phylogeny - polytene chromosomes
Species: *Chironomus aberratus*, *C. acidophilus*, *C. acutiventris*, *C. alluaudi*, *C. annularius*, *C. anonymus*, *C. aprilinus*, *C. anthracinus*, *C. balatonicus*, *C. bernensis*, *C. cingulatus*, *C. cloacalis*, *C.*

crassicaudatus, *C. crassimanus*, *C. cucini*, *C. dorsalis*, *C. frommeri*, *C. holomelas*, *C. islandicus*, *C. maturus*, *C. maturus* gp. Europa sp. 1 [=*C. fundatus*], *C. maturus* gp. Europa sp. 2 [=*C. wülkeri*], *C. muratensis*, *C. neocorax*, *C. nuditarsis*, *C. nudiventris*, *C. obtusidens*, *C. oppositus*, *C. piger*, *C. plumosus*, *C. pseudothummi*, *C. riihimäkiensis*, *C.* "*samoensis*" [?=*C. flaviplumus*], *C. sancticaroli, C. staegeri, C. stigmaterus, C. tentans* [=*C. decorus* gp.], *C. transvaalensis, C. uliginosus, C. utahensis, C. whitseli, C. yoshimatsui, C.* spec. Apple Valley, *C.* spec. Arkansas, *C.* spec. Cali [=*C. columbiensis*], *C.* spec. Coyote Creek, *C.* spec. Meerenberg A, *C.* spec. Meerenberg B, *C.* spec. Michigan A, *C.* spec. Rio de Janeiro A, *C.* spec. Rio de Janeiro B, *C.* spec. WOC

Wülker, W. & Klötzli, A.M. 1973. Revision der Gattung *Chironomus* Meig. IV. Arten des *lacunarius*-(*commutatus*) Komplexes. *Archiv für Hydrobiologie* **72**: 474-489. (English and German summary)
The morphology and salivary gland chromosome karyotype is described, and illustrated by photographs, for three members of the lacunarius (=commutatus)-complex of the genus *Chironomus*. Two of these species, *C. bernensis* and *C. lacunarius*, are described for the first time. The phylogenetic relationships to other species are discussed. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus bernensis*, *C. commutatus*, *C. lacunarius*

Wülker, W., Lörincz, G. & Devai, G. 1984. A new computerized method for deducing phylogenetic trees from chromosome inversion data. *Zeitschrift für zoologische Systematik und Evolutionsforschung* **22**: 86-91. (English & German summary)
Describe a computer based method for establishing the relationships between inversion sequences based on probability estimations. The technique is demonstrated by the use of the data for arm A of 31 species of *Chironomus*.

Specialised subjects: Techniques; Phylogeny - polytene chromosomes
Species: *Chironomus aberratus*, *C. acidophilus*, *C. annularius*, *C. anthracinus*, *C. bernensis*, *C. cingulatus*, *C. commutatus*, *C. crassicaudatus*, *C. crassimanus*, *C. dorsalis*, *C. halophilus* [=*C. aprilinus*], *C. holomelas*, *C. lacunarius*, *C. luridus*, *C. maturus*, *C. melanescens*, *C. melanotus*, *C. muratensis*, *C. neocorax*, *C. nuditarsis*, *C. nudiventris*, *C. obtusidens*, *C. piger*, *C. plumosus*, *C. pseudothummi*, *C. sororius*, *C. staegeri*, *C. stigmaterus*, *C. thummi* [=*C. riparius*], *C. uliginosus*, *C. whitseli*

Wülker, W. & Martin, J. 1971. C. Karyosystematics of the *Chironomus staegeri* group. *Studies in Natural Sciences (Portales, N.M.)* **1**(1): 22-34.
Describe the salivary gland chromosome karyotype of three related North American *Chironomus* species belonging to the cytological thummi-complex, and provide photographs of all chromosome arms. The phylogenetic relationships are discussed.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus crassicaudatus*, *C. frommeri*, *C. staegeri*

Wülker, W. & Martin, J. 1974. A review of the genus *Chironomus* (Diptera, Chironomidae). VI. Cytology of the *maturus*-complex. *Studies in Natural Sciences (Portales, N.M.)* **1**(9): 1-21.
Describe the salivary gland chromosome karyotype of two North American species belonging to the cytological maturus-complex, providing photographs of all chromosome arms. The phylogenetic relationships of this complex to the other cytological groupings is discussed.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus maturus*, *C. whitseli*

Wülker, W. & Morath, E. 1989. South American *Chironomus* (Dipt.)-karyotypes and their relations to North America. *Acta Biologica Debrecina Supplementum Oecologica Hungarica* **2**: 389-397.
Examined the karyotypes of seven *Chironomus* species from different habitats in Colombia at heights ranging from 0 to 3200m above sealevel. Most of these, plus two from Rio de Janeiro belong to the cytological pseudothummi-complex and show close relationship to three North American species. They share certain key inversions and are amongst the most derived members of this complex. Four show heterochromatic centromeres, which have previously only been described for two other species in this complex. A single member of the

cytological thummi-complex was found at the highest sampling point, the first record of this complex in South America.
The final species had a unique chromosome arm combination and has subsequently been described as *C. columbiensis* by Wülker *et al*. (1989).

Specialised subjects:Phylogeny - polytene chromosomes
Species: *Chironomus anonymus*, *C*. spec. Cali [=*C. columbiensis*], *C*. spec. Coyote Creek, *C*. spec. Las Brisas, *C*. spec. Meerenberg A, *C*. spec. Meerenberg B, *C*. spec. Rio de Janeiro A, *C*. spec. Rio de Janeiro B, *C*. spec. Villa Paz, *C*. spec. WOC

Wülker, W., Ryser,H.M. & Scholl, A. 1981. Revision der Gattung *Chironomus* Meigen (Dipt.). VI. *C. holomelas* Keyl, *C. saxatilis* n.sp., *C. melanescens* Keyl. *Revue Suisse de Zoologie* **88**: 903-924. (English & German summary)
Redescribe two European species, and describes a new species belonging to the cytological pseudothummi-complex, providing photographs of all chromosome arms. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus holomelas*, *C. melanescens*, *C. saxatilis*

Wülker, W. Ryser, H.M. & Scholl, A. 1983. Revision der Gattung *Chironomus* Meigen (Diptera). VIII. Arten mit Larven des *fluviatilis*-Typs (*obtusidens*-Gruppe): *C. acutiventris* n. sp. und *C. obtusidens* Goetgh. *Revue suisse de Zoologie* **90**: 725-745. (English & German summary)
Describe and provide photographs of the salivary gland chromosomes of *Chironomus acutiventris* and of those arms of *C. obtusidens* not described by Keyl (1962) (i.e. arms B, C, & D). *C. acutiventris* is separated into two subspecies on the basis of inversion polymorphism and enzyme allele frequencies, but the name applied to one of these subspecies (*bavaricus*) is a junior homonym. It is also possible that one of the subspecies is a synonym of *C. heterodentatus* (Wülker, pers. comm.) (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus acutiventris acutiventris*, *C. acutiventris bavaricus*, *C. obtusidens*

Wülker, W. Sublette, J.E. & Martin, J. 1968. Zur Cytotaxionomie nord-amerikanischer *Chironomus*-Arten. *Annals Zoologici Fennici* **5**: 155-158.
Review previous cytotaxonomic work on Nearctic and Palaearctic *Chironomus* species, integrating these studies where possible. Note the existence of a species with only two polytene chromosomes. No illustrations.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: Species: *Chironomus aberratus*, *C. anthracinus*, *C. attenuatus* [=*C. decorus* gp.], *C. cingulatus*, *C. crassicaudatus*, *C. commutatus*, *C. halophilus* [=*C. aprilinus*], *C. holomelas*, *C. occidentalis* [=*C. duplex*], *C. pallidivittatus*, *C. plumosus*, *C. rempeli*, *C. riparius* gp., *C. salinarius*, *C. staegeri*, *C. tentans, C. tentans* [=*C. decorus* gp.], *C*. species (n=2), *Cryptochironomus defectus* gp., *Glyptotendipes barbipes*

Wülker, W. Sublette, J.E. Morath, E. & Martin, J. 1989. *Chironomus columbiensis* n.sp. in South America and *Chironomus anonymus* Williston in North America - closely related species. *Studies on Neotropical Fauna and Environment* **24**: 121-136.
Describe and compare the salivary gland chromosome karyotypes of *C. columbiensis* and *C. anonymus* and relates them to those of previously described species. *C. columbiensis* has the chromosome arm combination AG, BF, CD, E (columbiensis-complex), while *C. anonymus* has the arm combination of the pseudothummi-complex. Illustrated by photographs. (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus anonymus*, *C. columbiensis*

Wülker, W. Sublette, J.E. Sublette, M.F. & Martin, J. 1971. A review of the genus *Chironomus* (Diptera, Chironomidae). I. The *Staegeri* group. *Studies in Natural Sciences* (*Portales*, *New Mexico*) **1**(1): 1-89.
See under Wülker & Martin (1971). (Partim)

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus crassicaudatus*, *C. frommeri*, *C. staegeri*

Wuhrmann, P. Ineichen, H. Riesen-Willi, U. & Lezzi, M. 1979. Change in nuclear potassium electrochemical activity and puffing of potassium-sensitive salivary chromosome regions during *Chironomus* development. *Proceedings of the*

National Academy of Sciences, U.S.A. **76**: 806-808.

Measured nuclear K^+ electrochemical activity and total nuclear K^+ content in salivary glands, and the correlated change of decondensation of three potassium sensitive regions of the polytene chromosomes as oligopausing larvae developed into prepupae, and during *in vitro* culture. As K+ increased, so did the size of puffs. No illustrations.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus tentans*

Wyss, C. 1982. *Chironomus tentans* epithelial cell lines sensitive to ecdysteroids, juvenile hormone, insulin and heat shock. *Experimental Cell Research* **139**: 309-319.
Describes an epithelial cell culture in which the karyotype is normal and in which the two fourth chromosomes are normally closely associated. Illustrated by photographs. (Partim)

Specialised subjects: Karyotype - mitotic, Somatic Pairing - descriptive
Species: *Chironomus tentans*

Yamaguchi, S. 1978. Puffing patterns of polytene chromosomes in *Chironomus dorsalis*. *Journal of the Nara Medical Association* **29**: 586-606.
Provides a drawn chromosome map plus numerous photographs of the polytene chromosomes of *C. dorsalis* [?=*C. yoshimatsui*]. Describes the puffing pattern of salivary gland and Malpighian tubule cells, noting the existence of special secretory cells near the excretory duct of the salivary gland. These special cells contain an extra Balbiani ring.

Specialised subjects: Puffs - developmental sequence
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Yamamoto, H. 1970*a*. Puffing changes and droplet formation in the Balbiani rings of *Chironomus tentans* by hyperthermic shock. *Septième Congrès International de Microscopie Électronique*, *Grenoble*. *Paris*: *Société Francaise de Microscopie Electronique*: 255-256.
A brief report of the work published more fully in Yamamoto (1970*b*). Illustrated by two electronmicrographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*, *C. tentans*

Yamamoto, H. 1970*b*. Heat-shock induced puffing changes in Balbiani rings. *Chromosoma* **32**: 171-190.
Heat shock induced a characteristic sequence of puffing changes in the Balbiani rings of *Chironomus tentans* and *C. pallidivittatus*. The puffs first regress and then recover. Inhibition of the regression or recovery phases was investigated to understand the processes of puffing. The results are interpreted on the basis of a model postulating an equilibrium between RNA synthesis, RNA processing and release of RNP from the puff. Illustrated by photographs and electronmicrographs.

Specialised subjects: Puffs - Balbiani rings, experimental induction
Species: *Chironomus pallidivittatus*, *C. tentans*

Yamamoto, H. 1971. Mechanism and control of puffing in salivary gland chromosomes. *Acta Anatomica Nipponica* **46:** 39. (In Japanese) (Abstract)
A brief report of using heat shock to study the control of puff formation in polytene chromosomes. The species used are not specified. No illustrations.

Specialised subjects: Puffs - experimental induction
Species: *Chironomus* spp. [?=*C. pallidivittatus* & *C. tentans*]

Yamamoto, K.D. 1977. *A comparison of salivary gland chromosomes of* Chironomus *larvae of acid-polluted strip-mine lakes*. M.S. Thesis, Southern Illinois University, U. S. A. 24pp.
Describes the polytene chromosome complement of a species identified as *Chironomus maturus* on the basis of adult morphology. However the species belongs to the thummi-complex rather than the maturus-complex, and is an undescribed species. No chromosomal polymorphism was observed. Includes photographs of all chromosome arms.

Specialised subjects: Cytotaxonomy - polytene chromosomes
Species: *Chironomus maturus* [=*C. harpi*]

Yampol, G.P. 1982. A study of stable chromosomal RNA in the polytene chromosomes of *Chironomus thummi* salivary glands during the last larval instar. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 75.
Stable chromosomal RNA was found to have 3 patterns of distribution similar to those of

replicating DNA. A comparison showed that this stable RNA was synthesised mainly during the S-phase of the fourth instar.

Specialised subjects: Polytene chromosomes - DNA replication, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Yampol, G.P. Reznik, N.A. & Gruzdev, A.D. 1989. Morphological changes in the isolated salivary gland cells of *Chironomus* larvae induced by lesions in the cells. *Tsitologiya* **31**: 189- 194. (In Russian, English summary)
Detail some changes which occur in the morphology of the cells and of the polytene chromosomes in some cells of isolated salivary glands of *C. thummi* [=*C. riparius*]. It is argued that these changes arise from lesions of the basal cell envelope during the isolation procedure. Illustrated by photographs. (Partim)

Specialised subjects: Polytene chromosomes - tissue differences
Species: *Chironomus thummi* [=*C. riparius*]

Yampol, G.P. Shilova, I.E. & Zainiev, G.A. 1982. The localization of stable RNA in stretched polytene chromosomes of *Chironomus thummi*. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 76.
Prepared autoradiographs from stretched salivary gland polytene chromosomes in order to study the distribution of stable RNA. It was expected that this would be distributed discretely, corresponding to the base of DNA loops, but it was instead found to be uniformly distributed.

Specialised subjects: Polytene chromosomes - structure, RNA distribution
Species: *Chironomus thummi* [=*C. riparius*]

Yanagida, M. & Masuda, H. 1980. Polytene chromosomes isolated from nuclei of *Tokunagayusurika akamusi* (Diptera, Chironomidae): structural transformation caused by salt, detergent polyanions and enzymes. *Development Growth Differentiation* **22**: 1-10.
Polytene chromosomes were isolated from the salivary gland cell nuclei into a medium in which the normal morphology was maintained. They were then transferred to solutions of high salt concentration, polyanions, ionic detergents or enzymes. The morphological changes are described and classified in terms of combinations of the following characteristics: reversible or irreversible changes, expansion or no expansion, disappearance of bands, and appearance of new bands. Illustrated by numerous photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Tokunagayusurika akamusi*

Yang, Y.-Q. & Wu, H.-L. 1980. A preliminary study of the polytene chromosomes in Malpighian tubules and rectum cells of *Chironomus* sp. *Acta Genetica Sinica* **7**: 144-148. (In Chinese, English summary)
Investigates the puffing pattern and degree of polytenisation in the polytene chromosomes from different tissues of an unnamed *Chironomus* species, particularly emphasising the small fourth chromosome. Concludes that their is a definite pattern of puff development and that secretory cells are likely to have a higher degree of polytenisation than those along ducts. Illustrated by drawings.

Specialised subjects: Polytene chromosomes - tissue differences, Puffs - developmental sequence
Species: *Chironomus* species

Yoshimatsu, H. 1962. Electron microscopy of the salivary gland cells of the *Chironomus* larva. *Annotationes Zoologicae Japonenses* **35**: 89-94.
Notes that the nucleus contains chromosomes and one or two dense nucleoli. (Partim)

Specialised subjects: Nucleolus - structure
Species: *Chironomus dorsalis* [=*C. yoshimatsui*]

Yoshimatsu, H. 1967. The supravital staining of the band regions of *Chironomus* salivary gland chromosomes. *Yamaguchi Daigaku Kyoyobu Kiyo* **1**: 127-133. (In Japanese, English summary)
Isolated salivary glands were stained with trypan blue and other diazo dyes. Chromosome bands and the nucleoli were sometimes stained rather darkly. The staining is probably due to the presence of histones. Illustrated by photographs.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus dorsalis* [=*C. yoshimatsui*]

Yoshimatsu, H. 1971. Effect of pilocarpine on the excretory activity of the salivary gland system of the *Chironomus* larva. *Yamaguchi Daigaku Kyoyobu Kiyo* **5**: 69-83. (In Japanese, English summary)
Notes that the salivary gland of *C. dorsalis* [=*C. yoshimatsui*] contains four special cells, which produce a different product, as well as the normal

cells. Refers to the production of the secretion by the Balbiani rings and the polytene chromosomes are shown in the photographs. (Partim)

Specialised subjects: Puffs - Balbiani rings, gene product
Species: [=*C. yoshimatsui*]

Yuasa, A. 1950*a*. The flattened form of salivary chromosomes. *La Kromosomo* **7**: 304. (In Japanese)(Abstract)
Salivary gland chromosomes which were damaged during isolation become flat and fibres can be observed at these places or at places where the chromosome has been nicked. Speculates on the role of these fibres and their arrangement. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species

Yuasa, A. 1950*b*. Spiral structure of salivary chromosome of *Chironomus* treated with various chemicals. *Papers of the Coordinating Committee on Research in Genetics* **1**: 109.
This publication has not been traced. It is quoted by Fittkau *et al*. (1976) but it is possible that it exists only as a reference in another paper (primary source unknown).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus* species [?=*C. yoshimatsui*]

Yuasa, A. 1950*c*. Studies on the structure of salivary gland chromosomes. I. Spiral structure of salivary gland chromosomes in *Chironomus*, especially of chromosome IV. *Oguma Commemoration Volume on Cytology and Genetics*: 63-70. (In Japanese)
Investigates the structure of the polytene chromosomes in the larval salivary gland. Illustrated by drawings.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Yuasa, A. 1953. Studies on the structure of salivary gland chromosomes. III. The spiral structure of the salivary chromosome in *Chironomus* with special reference to their development. *Japanese Journal of Genetics* **28**: 195-204.
Investigates the structure of the chromosomes in the salivary gland nuclei in very young larvae, describing the changes from a spiral structure to the formation of bands as the larvae grow. Illustrated by drawings and photographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Yuasa, A. & Sinoto, Y. 1950. Spiral structure of salivary chromosomes of *Chironomus* treated with various chemical. *Iden-no Sogo-Kenkyu* **1**: 109-111. (In Japanese, English summary)
Describe the effects of various salt, acid or alkali solutions on the appearance of the salivary gland chromosomes when stained. Consider that these solutions soften the matrix and allow the chromonemata to be seen more clearly, revealing the basic spiral structure. No illustrations.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus dorsalis* [?=*C. yoshimatsui*]

Zacharias, H. 1979. Underreplication of a polytene chromosome arm in the chironomid *Prodiamesa olivacea*. *Chromosoma* **72**: 23-51.
Gives the chromosome number as 2n=6, in agreement with the finding of Michailova (1977). In mitotic cells the third chromosome comprises 20.8% of the genome while in salivary gland cells it is only 6.5%, appearing as a ball. This is due to underreplication of the long arm of this submetacentric chromosome during the first to third endoreplicative cycle. The heterochromatin of the third chromosome is not however underreplicated. Illustrated by excellent drawings, photographs and autoradiographs.

Specialised subjects: Polytene chromosomes - differential polyteny
Species: *Prodiamesa olivacea*

Zacharias, H. 1981. Sex-linked difference in DNA content of a polytene chromosome in *Prodiamesa* (Chironomidae). *Chromosoma* **82**: 657-672.
The underreplication of the third chromosome described by Zacharias (1979) is shown to relate to female larvae only and to occur in Malpighian tubule and hindgut polytene chromosomes also. However, in male larvae there is even greater underreplication, with the third chromosome representing only 3% of the polytene genome. The third chromosome is interpreted as representing the sex chromosome pair, the Y chromosome being totally suppressed in polytene tissues. Well illustrated by drawings and photographs.

Specialised subjects: Polytene chromosomes - differential polyteny; Sex chromosomes - allocycly
Species: *Prodiamesa olivacea*

Zacharias, H. 1984. Allocyclic behaviour and underreplication of the nucleolus chromosome in *Pseudodiamesa* (Chironomidae). *Chromosoma* **89**: 263-273.
P. branickii appears to have three polytene chromosomes in the salivary glands and in the Malpighian tubules, with no obvious nucleolus. However there are 4 pairs of chromosomes in mitotic metaphase plates, the small fourth pair carrying a nucleolus. Subsequent analysis, including *in situ* hybridisation of labelled rRNA, confirmed that the nucleolus is present in a non-banded network, with about 70% of the small fourth chromosome underreplicated in the polytene chromosomes. Illustrated by numerous photographs.

Specialised subjects: Polytene chromosomes - differential polyteny, Nucleolus, Heterochromatin, Karyotype
Species: *Pseudodiamesa branickii*

Zacharias, H. & Neumann, P. 1989. SIMREP: a program simulating differential DNA replication. *Computer Methods and Programs in Biomedicine* **28**: 235-242
Describe a computer program written in TURBO PASCAL 4.0 that can simulate differential endoreplications in cells with up to n=24 (max.). The situation of underreplication of the heterosomes of *Prodiamesa olivacea,* described by Zacharius (1979, 1981) is used as an example. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - differential polyteny; Sex chromosomes - allocycly
Species: *Prodiamesa olivacea*

Zaherenko, L.P., Onishchenko, A.M., Mikichur, N.I. & Maximovsky, L.F. 1976.
Microbiochemical analysis of nucleic acids in the structures of salivary gland cells of Diptera. *Tsitologiya* **18**: 975-980. (In Russian, English summary)
Study the amount of DNA and RNA, and the intensity of tritiated uridine incorporation, in the long chromosomes and the nucleolus in salivary gland cells of *Chironomus thummi* [=*C. riparius*] during development. The synthesis and content of nucleolar RNA was shown to decrease by the prepupal stage. No illustrations. (Partim)

Specialised subjects: Polytene chromosomes, Nucleolus - RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. 1982*a*. Chromosome stretching as an approach to mapping of all simultaneously functioning transcriptional units of the polytene chromosomes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 79.
Used stretched chromosomes to try to determine whether a puff changes in size because of an increase in the number of active transcriptional units or because of an increase in the efficiency in the transcription of the units. Some of the results were published in Zainiev & Shilova (1984).

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. 1982*b*. A review of methods developed for controlled stretching of isolated unfixed polytene chromosomes. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 80-83.
Briefly reviews and describes the techniques used in his laboratories for stretching polytene chromosomes and examining these chromosomes once stretched. Illustrated by drawings.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. 1984. Stretched polytene chromosomes, the method of microcloning DNA and the idea of an encyclopedia of genes. *Izvestiya Sibirskogo Otdeleniya Akademii Nauk, S.S.S.R. Seriya Biologicheskikh Nauk* **2**: 52-55.
A further description of the technique for microcloning from stretched polytene chromosomes and its use for obtaining clones of all genes in a region. Illustrated drawings.

Specialised subjects: Techniques; Polytene chromosomes - bands and genes
Species: *Chironomus thummi* [=*C. riparius*]

Zainev, G.A. 1985 Method of isolation of DNA from regions of stretched polytene chromosomes for susequent microcloning or electron microscopic investigation of DNA, pp.196-198. *In* Salganik, R.I. (ed.) *Organisation and expression of genes of tissue-specific functions in Diptera*. 237pp. Nauka, Siberian Division, Novosibirsk. (In Russian)

A further description of the technique for stretching polytene chromosomes and using these stretched chromosomes for microcloning specific regions of DNA, or for electron microscopic studies. Illustrated by line drawings.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A., Bäumlein, H., Wobus, U., Kolesnikov, N.N., Kiknadze, I.I., Zakharenko, L.P., Panova, T.M. & Blinov, A.G. 1985. Microcloning of DNA from the Balbiani ring A containing region A1-2 of polytene chromosome IV of *Chironomus thummi* salivary glands. *Tsitologiya* **27**: 528-534. (In Russian, English summary)
Detail simplified techniques for microcloning of polytene chromosome bands. Includes photographs of *in situ* hybridisations of clones obtained to the appropriate region of chromosome IV. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - bands and genes, in situ hybridisation
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. & Gruzdev, A.D. 1973. The formation of polytene chromosomes of Diptera and the polytenization model. *Tsitologiya* **15**: 1222-1228. (In Russian, English summary)
Present a model of the development of polytene chromosomes.

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes - structure
Species: *Chironomus tentans, C. thummi* [=*C. riparius*]

Zainiev, G.A. & Gruzdev, A.D. 1977. Stretched polytene chromosomes. *Abstracts of the Helsinki Chromosome Conference, Helsinki, Finland*: 73.
Largely an abstract of the contents of Zainiev, Gruzdev, & Reznik (1977).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. & Gruzdev, A.D. 1978. Preparation and properties of stretched polytene chromosomes. II. The mechanism of stretching. *Tsitologiya* **20**: 34-44. (In Russian, English summary)
Measurements of the stretching of isolated polytene chromosomes lead to the conclusion that three processes, viscoelastic deformation, viscous flow and crystallisation, are involved. Electron microscopy showed that the DNP fibres are oriented along the chromosome without detectable breaks. Illustrated by photographs, diagrams and electronmicrographs.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A., Gruzdev, A.D. & Reznik, N.A. 1977. Preparation and properties of stretched polytene chromosomes. I. A method. *Tsitologiya* **19**: 739-745. (In Russian, English summary)
Mechanical stretching of salivary gland chromosomes is used to improve the resolution of autoradiography and electronmicroscopy. Illustrated by diagrams and a photograph.

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. & Masich, S.V. 1982. Some new aspects of chromosomal DNA organization. *Abstracts of the International Symposium on the Organization and Expression of Tissue Specific Genes*, *Novosibirsk*: 84.
A review of the work published in Zainiev, Shilova & Gruzdev (1980).

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A. & Shilova, I.E. 1984. Estimation of the transcribed DNA length in the Balbiani rings - giant puffs in the polytene chromosomes of *Chironomus*. *Tsitologiya* 26: 196-202. (In Russian, English summary)
Measured the length of Balbiani rings of stretched chromosomes and found considerable variability, but following a pulse of labelled uridine the length could be greater.

Specialised subjects: Puffs - Balbiani rings, RNA synthesis
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A., Shilova, I.E. & Francke, C. 1979. A study of functional organization of giant puffs of chromosomes of chironomids by the method of stretching. *Doklady Akademii Nauk, S.S.S.R.* **249**: 1221-1224. (In Russian). [Translated in: *Doklady Biological Sciences* **249**: 1196-1199]
Use stretched salivary gland chromosomes to estimate the length of DNA involved in the

nucleolus and the Balbiani rings of *Chironomus thummi* [=*C. riparius*]. On the basis of these calculations they conclude that there are 150-200 transcription units in the nucleolus, 9-11 in BR1, and 11-13 in BR2. Illustrated by photographs and autoradiographs.

Specialised subjects: Techniques; Puffs, Nucleolus - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A., Shilova, I.E. & Gruzdev, A.D. 1980*a*. Mechanical properties of polytene chromosomes. I. Deformability and recovery of chromosome structure. *Tsitologiya* **22**: 631-639. (In Russian, English summary)
Tested the range of deformability possible in the salivary gland chromosomes of *Chironomus thummi* [=*C. riparius*]. The chromosome is capable of recovery from a 4-6 fold stretching. It is concluded that such stretching is provided mainly by interband elongation. When breakage of the links at the base of the chromomeric loops occurs, the chromosome can no longer recover from the stretching. Illustrated by graphs and by photographs of stretched and recovered chromosomes.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zainiev, G.A., Shilova, I.E. & Gruzdev, A.D. 1980*b*. Mechanical properties of polytene chromosomes. II. Tensile strength of polytene chromosome. *Tsitologiya* **22**: 715-717. (In Russian, English summary)
The tensile strength of a salivary gland chromosome from a fourth instar larva is 0.08-0.16 dynes. The force required to break a polytene chromosome is ten fold lower than the theoretical value. The reasons for this discrepancy are discussed.

Specialised subjects: Polytene chromosomes - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zbären, J. 1973. Chromosomenfärbung mit Nigrosin. *Mikrokosmos* **62**: 84-85.
Describes a technique for staining polytene chromosomes with nigrosine and illustrates with two photographs of an unidentified *Chironomus* species belonging to the pseudothummi-complex. (Partim)

Specialised subjects: Techniques; Polytene chromosomes - structure
Species: *Chironomus* species

Zelenin, A.V., Stepanova, N.G. & Kiknadze, I.I. 1977. Differential staining of *Chironomus thummi* giant chromosomes by treatment with acridine orange after mild acid hydrolysis. *Chromosoma* **64**: 327-336.
By adjusting the time of incubation of polytene chromosomes in HCl, it is possible to obtain fluorescence staining in which all transcriptionally active regions give green fluorescence while the non-active bands are red. The reasons for this difference and the uses for which this method can be applied are discussed. Illustrated by photographs.

Specialised subjects: Techniques; Puffs - structure
Species: *Chironomus thummi* [=*C. riparius*]

Zhimulev, I.F., Belyaeva, E.S. & Semeshin, V.F. 1981. Informational content of polytene chromosomes and puffs. *Chemical Rubber Company Critical Reviews in Biochemistry* **11**: 303-340.
Review the structure of polytene chromosomes and the evidence available for the informational content of puffs and bands, ending by formulating a model of the dynamic organization of polytene chromosomes. Information from Chironomidae is incorporated into the review. The model is illustrated by a diagram. (Partim)

Specialised subjects: General Dipteran Cytogenetics; Polytene chromosomes, Puffs - structure
Species: *Acricotopus lucidus* [=*A. lucens*], *Chironomus plumosus, C. tentans, C. thummi* [=*C. riparius*], *C. valkanovi*