technique has permitted elegant EM studies of the synaptonemal complex in carriers of structural chromosome rearrangements in man; these studies and their bearing on classical ideas of chromosome pairing are reviewed. Similar work on female meiosis in mice trisomic due to parental Robertsonian translocation is also reported. Lastly in this section observations on spindle structure and chromosome alignment in freshly ovulated and in post-ovulatory aged mouse oocytes are discussed in relation to the increase of aneuploid offspring associated with maternal age.

The section on Nucleolar Organisers is introduced by a comprehensive review of studies on the molecular organization of the human 18S and 28S ribosomal genes. EM studies on the ultrastructure of nucleoli in several different types of cell are then described. The nucleolar organizer region of the chromosome is present within the nucleolus, and there is some disagreement between studies based on immunocytochemical localization of RNA polymerase I and studies employing [^{3}H]-uridine incorporation as to where within the structure transcription takes place. A combination of NOR-silver staining and EM has previously shown that the NOR's of several chromosomes are associated at pachytene within the fibrillar centre of nucleolus. This work has been extended by using *in situ* hybridization to localize the ribosomal genes in human oocytes and the results are discussed with reference to the involvment of human acrocentric chromosomes in numerical and structural anomalies.

Marsupials are one of the three living lines of mammalian evolution. Australian marsupials are thought to have reached there about 50 million years ago and were the only mammals present in Australia until comparatively recent times. There is a comprehensive discussion of chromosome evolution in this group, and comparison is made with evolution of marsupials in South America. Also in the section on evolution, the various types of chromosomal change observed are discussed with particular reference to their effect on genetic recombination. Chromosome homology in mammals deduced from G-banded karyotypes must be confirmed by comparative gene mapping studies. There is an account here of such work in three key species in the study of primate evolution, i.e. gibbon, capuchin monkey and mouse lemur. Finally from many observations in many species a model is presented here in another important aspect namely the evolution of c-band patterns.

Under the heading of *Drosophila* chromosomes a study is described which aims to build up a complete genetic map of two regions of *Drosophila* chromosome each containing several genes, and to relate this map to other levels of chromosome organization. Another study in this section is of three exceptional sequences which are under-replicated and whose cytogenetic locations had previously been described as intercalary heterochromatin. This study leads to the hypothesis that polyteny occurs through loss of functions normally used in the diploid cycle rather than by gain of specialized functions. The final contribution to this section is a discussion of the structure and function of *Y* chromosome genes in *Drosophila* which leads the authors to the conclusion that the biological function of the *Y* chromosomal genes is to accumulate nuclear proteins with the aid of the *Y* chromosomal transcripts.

Finally the collection of three papers under the heading of Molecular Cytogenetics contains first a discussion of new cytogenetic data on heterochromatin of *Drosophila* and maize. Unfortunately the ordering of the text in this contribution was rather confusing. An interesting study on the integration of foreign DNA shows that this may be accompanied by changes in the chromosome recognizable at the cytogenetic level. The last paper in this section is a comprehensive report on Bkm sequences and the possibility is raised that hypervariable Bkm RFLP's might be used to monitor for chromosome changes in oncogenesis.

It is not possible to do justice to the contributions to this conference in a short review; the book is full of useful information. As with all volumes of this nature there is the occasional error of grammar and spelling, but overall the production is excellent, and at a cost of £40 the book represents very good value.

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Beyond the Gene: Cytoplasmic Inheritance and the Struggle for Authority in Genetics. By JAN SAPP. Oxford University Press. 1988. 266 pages. £32.00. ISBN 0 19 504206 9.

In times past there has been much argument about the relative importance of nuclei and cytoplasm in the control of heredity. In the 20s and 30s of this century the *Drosophila* and maize workers were very busy establishing the chromosome theory and most geneticists of that period, especially in the USA, came to accept the then rather crude mechanistic ideas of genes on chromosomes arranged like strings of beads, even though the material nature of genes was then completely unknown. In 1926 Morgan felt able to announce that 'cytoplasm may be ignored genetically'. However, some German geneticists were studying various plant characters which were inherited through the cytoplasm. Some biologists, especially those concerned with embryology, even thought that the role of the genes was quite trivial, and that control of the development of living organisms was directed by some kind of cytoplasmic system, the details of which were, needless to say, never specified.

In the years immediately following World War II, the nucleus *vs* cytoplasm controversy flared up again.

A number of cases of extra-nuclear heredity were described, and these were thought to be controlled by cytoplasmic units called 'plasmagenes'. In the USA a leading part in this controversy was played by T. M. Sonneborn, who discovered the cytoplasmically inherited 'kappa' particles in the ciliate protozoan *Paramecium*; while in France B. Ephrussi showed that some yeast types ('petites') were also cytoplasmically inherited. Even in *Drosophila*, the organism *par excellence* of the Morgan school, another French scientist – Ph. L'Héritier – discovered that CO_2-sensitivity was controlled by a factor (or génoïd) which was transmitted through the cytoplasm of the egg. All these findings, and much else, are discussed by Jan Sapp in his highly entertaining book, which is much enlivened by numerous personal details of the workers concerned. There are also lengthy discussions of the historical development of attitudes to biological theories in various European countries, as well as some account of the infamous Lysenko affair in the USSR.

Nowadays interest in these matters has rather died down, and they are not considered worthy of serious consideration by most teachers of genetics. It is clear that modern molecular biology has developed directly from the *mainstream* of classical chromosomal genetics, and most of the previously described cytoplasmic 'exceptions' have in the end turned out to be not so exceptional after all. They are all, or nearly all, controlled by DNA- or occasionally RNA-containing structures, which are exceptional only in their location in the cell. Sonneborn's kappa particles are now seen to be bacterium-like symbionts, while Ephrussi's 'petite' yeasts are controlled by mitochondrial DNA and L'Héritier's CO_2-sensitive 'génoïds' turn out to be RNA-containing viruses. Finally in green plants, the chloroplasts have their own quite elaborate DNA-containing genetic system. Of course all these 'cytoplasmic' factors are interesting in themselves, and add to our knowledge of cell biology, but in no way do they conflict with the basic principles underlying gene reproduction and expression.

So the question arises – especially for those like the present reviewer who formerly devoted much time and effort to the study of extranuclear genetics – was it worth while? Ephrussi evidently came to have some doubts for in 1958 he wrote in a letter to Sonneborn: 'I suddenly felt my life wasted'. He thereafter left the study of yeast to others (some of them, e.g. P. Slonimski reaped from them a magnificant harvest of knowledge about mitochondrial genes). Sonneborn however held out till the end of his life in 1981, maintaining his opposition to what German writers have called the 'Kernmonopol', and firmly maintained his belief in the existence of a cytoplasmic system, supplementary to that of the nucleus. Even though he eventually conceded that 'kappa' was not a plasmagene but a symbiont, he believed that certain structural patterns of ciliate cells were not governed by nuclear genes, but by some 'invisible unknown, guiding force', lying beyond the reach of current molecular principles. However ill-defined, that exception to the current molecular dogma is still valid.

Bench-working researchers may find Sapp's approach to these matters rather peculiar. All controversies are interpreted in terms of 'power relations' between rival scientists. This seems rather far-fetched. While there is no doubt that certain dominating figures, who were perhaps more common in scientific circles formerly than now, may have had an undue influence over their students and subordinates, in the end scientific controversies have been settled, not by gladiatorial contests between eminent personages, but by the more mundane procedures of laborious accumulation of evidence, publication of experimental data, and logical analysis. Only under very exceptional circumstances, such as those which enabled Lysenko to overcome his opponents by political pressure and terror, can deviant scientific views be imposed by brute force. Fortunately that is not the usual situation in the modern scientific world.

Leaving aside Sapp's unorthodox views on the importance of 'power conflicts', we can thoroughly recommend his book as an excellent account of the history of controversies concerning cytoplasmic genetics.

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Teratocarcinomas and Embryonic Stem Cells: A Practical Approach. Edited by E. J. ROBERTSON. Oxford: IRL Press, Practical Approach Series. 1987. xii + 268 pages. Subject index. Softbound £17.00/$US 32.00 (hardcover £26.00/$US 47.00).

Teratomas and teratocarcinomas arise spontaneously in the testes or ovaries of certain inbred strains of mice; they can also be produced experimentally by transplanting early mouse embryos to ectopic sites. For more than 30 years these tumours have been used in the study of developmental biology, cell biology, genetics and experimental oncology.

In the last few years molecular biologists too have shown a considerable interest in these objects. It has become clear that an understanding of the in vitro development of stem cells derived from teratocarcinomas (TSCs) can throw light not only on the molecular mechanisms of cell differentiation, but also on the mechanisms controlling gene expression during differentiation. Their relevance to gene engineering in mammals has been in no doubt since 1981, when two teams of scientists in the USA and in England independently succeeded in obtaining stem cells from early mouse embryos (ESCs) that resembled the stem cells of teratocarcinomas. ESCs could be cultured in