more in South India as well as those in the North. The workers are still very few. A band of young men must be trained in Universities on the various departments of the study of man, and sent out to collect materials from hitherto unexplored fields. Scientific work of this nature can be best done only by Universities which would give it, its proper place in the courses of studies. The Science of Anthropology with its many approaches and aspects will afford abundant opportunities for original research.

Polymegalous Spermatids in a Grasshopper.

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THE studies of Paulmier,[1] Zweiger,[2] Davies[3] and others have shown that in certain insects the spermatids exhibit double and quadruple complements of centrosomes, as a result of pathological dimegaly or polymegaly. The sizes of these abnormal spermatids vary according to the number of centrosomes present. Montgomery[4] has also described in *Euschistus* that the same testis produces sperms of three sizes varying with their positions in particular follicles. His observations have been confirmed by Bowen[5, 6, 7] who has studied a large number of Pentatomids.

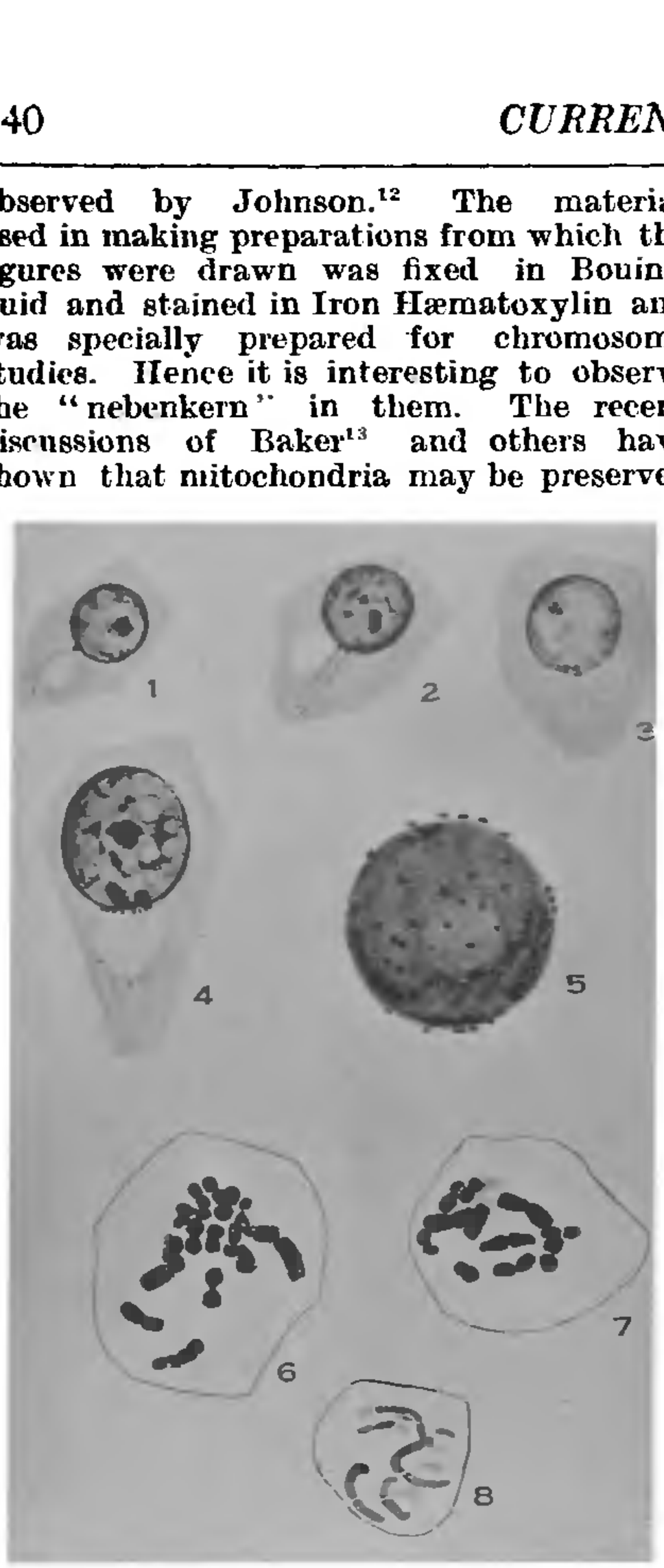
Two explanations have so far been offered for the occurrence of these abnormal sperms. For those of the first kind, *i.e.*, those with 2 or 4 centrosomes the usual explanation is that they are due to the suppression of one or both of the spermatocyte divisions. Wilson[8] writes: "It is practically certain that the double forms are due to a suppression of the second spermatocyte division, the quadruple ones to a suppression of both the divisions in respect to all the sperm-forming elements excepting the centrioles and the chondriosome apparatus. The latter have completed their allotted number of divisions and subsequent differentiations." Cannon[9] has discovered atypical sperms in the louse which he says are regularly provided with two axial filaments; Bowen suspects that here also the two tail filaments may arise from doubled centrioles, since in these forms only one spermatocyte division is said to occur.

The explanation offered for the polymegaly in Pentatomidæ is a physiological one. Montgomery suggested that the size differences may be due to variations in nutritional factors though the exact sources of these variations have not been traced. Bowen's view in respect to this is that the number of centrosomes varies with the size of the cytosome. Similar studies in plants of giant sperms have yielded very interesting observations, especially in the gigas forms of Solanum where the abnormal size of the pollen as well as of certain cytoplasmic inclusions were directly attributed to the tetraploid nature of the nucleus (Winkler).[10] Gates[11] has also come to similar conclusions in Oenothera. The experiments of Boveri, the Marchals and others have also led to similar conclusions, namely, that the size of a cell varies with the number of the chromosomes which enter into the constitution of the nucleus. The present position, as briefly stated above, shows that the problem is many-sided and requires further study.

In my study of the spermatogenesis of Pyrgomorphinæ I have come across certain giant spermatids which seem to provide us some interesting information. Fig. 1 shows a normal spermatid of *Aularches*. Here the nucleus is seen to have on one side a centrosome from which has arisen a tail fibre which bends around a mass of clear substance and is apparently attached to another dark body which may correspond to the centrosome derivative migrating to the periphery

[1] Paulmier, F. C., *Journ. Morph., Suppl.*, **15**, 1899.
[2] Zweiger, *Zeit. F. Naturw.*, **42**, 1907.
[3] Davies, H. S., *Bull. Mus. Comp. Anat. Harvard*, 1908.
[4] Montgomery, T. H., *Zool. Jahrb.*, 1898.
Montgomery, T. H., *Arch. Zellforsch.*, 1910.
[5] Bowen, R. H., *Proc. Amer. Acad. Arts and Sci.*, **57**, 1922.
[6] Bowen, R. H., *Biol. Bull.*, **42**, 1922.
[7] Bowen, R. H., *Journ. Morph.*, **39**, 1924.
[8] Wilson, E. B., *Cell in Dev. and Inherit.*, 1925.
[9] Cannon, H. G., *Quart. Journ. Mic. Sci.*, **66**, N. S., 1922.
[10] Winkler, *Zeit. Bot.*, **8**, 1916.
[11] Gates, R. R., *Bot. Gaz.*, **44**, 1909.

observed by Johnson.[12] The material used in making preparations from which the figures were drawn was fixed in Bouin's fluid and stained in Iron Hæmatoxylin and was specially prepared for chromosome studies. Hence it is interesting to observe the "nebenkern" in them. The recent discussions of Baker[13] and others have shown that mitochondria may be preserved



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in Bouin preparations and my slides offer confirmation of Baker's views, especially after staining with Altmann's triple with a previous treatment with potassium dichromate. Fig. 2 shows a spermatid with two centrosomal bodies from which two tail fibres have arisen. The size of the cytoplasm as well as of the nucleus is larger. Fig. 3 is that of a spermatid with four centrosomes and the size of the cytoplasm and the nucleus has increased proportionately. The double and the quadruple centrosomes have been reported by Davies in grasshoppers where he says they occur rarely. In my preparations they are very common; bnt spermatids such as are drawn in Figs. 4 and 5 have not been reported in grasshoppers and no mention of such forms in other animals has come under my notice. Fig. 4 shows a giant spermatid with a large nucleus and eight centrosomes attached to one of its sides. Tail fibres are seen arising from them. The "nebenkern" too has grown to a considerable proportion. Fig. 5 is that of another giant showing a very large nucleus surrounded by a large number of centrosomes (as many as 48). This figure is a composite drawn from three consecutive sections into which the nucleus has become divided. This spermatid seems to be in a slightly later stage of development as can be seen from the size of the individual centrosomes. Unfortunately, I could not trace any tail fibres in this spermatid or in others of similar size and constitution. It is obvious from such forms that polymegaly here is not due to a mere suppression of the two spermatocyte divisions, for in that case, we should meet only with two or four centrosomes. They confirm to some extent the opinion of Bowen that the cytosome as well as its components vary with the size of the nucleus, however induced. The main question now is how exactly the abnormal size of the nucleus has been brought about. While in plants the *gigas* forms are known to be due to increase in the chromosome numbers, the polymegalous spermatids of animals have always been regarded to be diploid in their chromosome constitution. If so, the large forms (Figs. 4 and 5) are indeed very extraordinary, the chromatin having increased enormously and the usual chromosome number being retained.

I wish to record here certain cells in the testes of *Aularches* which seem to possess some bearing on these problems but which are not yet quite clear as to their exact significance. Figs. 6 and 7 are two cells in which may be seen apparently the diploid number of chromosomes in each of which can be noticed a transverse fissure, scattered in the cell without any definite orientation. They are cells which belong to cysts containing spermatids some of which seem to be normal and some to possess a larger size. Unfortunately the centrosomal bodies cannot be observed in these cysts; otherwise a definite relationship with the polymegalous forms could have been established. But the larger size of some spermatids in these cysts

[12] Johnson, H. H., *Science*, **56**, 1922.
[13] Baker, J., *Nature*, Nov. 12, 1932.

do indicate a sort of bearing on this question. The size relations of the chromosomes of these cells show almost the same features as seen in the normal spermatogonial metaphase where can be observed nineteen telomitic rod-shaped chromosomes. The transverse fissure in each chromosome is very difficult to explain. It may be due to either a division in the transverse plane of the chromosome or to the association of two separate chromosomes. In the first case, a transverse division will have to be accepted which is opposed to all known forms of normal mitosis. In the second case, the existence of tetraploid cells must have to be accepted in which the two spermatocyte divisions are suppressed and the homologues approach one another for a very belated association. The latter postulate, if true, is also very peculiar in that the chromosomes seem to be associated end to end which is quite different from the normal parasynapsis characteristic of all grasshoppers. Such transverse fissures can be observed even in slightly earlier stages of these abnormal cells as may be seen from Fig. 8 which shows a cell with a few of these chromosomes not yet condensed completely. The exact relationship of these cells with the giant spermatids remains to be determined.

Obituary.

Sir Alexander Houston.

BY the unexpectedly early passing of Sir Alexander Houston, the world will miss a great public servant and a finely tempered intelligence.

Having been privileged to maintain a friendly correspondence with him since the beginning of the present century, it seems right that I should add a brief tribute to his memory, with special reference to the bearing of his work on the purity of Indian water supplies.

We first became acquainted when he was engaged in studying the bacteriology of sewage treatment on behalf of the Royal Commission on Sewage Disposal.

This work was a fitting preparation for the great responsibility which later devolved upon him of safeguarding the London water supply as Director of Water Examination, Metropolitan Water Board. Annually for 27 years his Reports appeared, models of detailed and laborious investigation combined with a wide and sane critical judgment, the whole presented with a literary charm which held the interest of the ordinary citizen, for whose ultimate benefit the work had been done.

Among the outstanding results of his scientific studies may be mentioned an increased knowledge of intestinal flora and of the effect of storage on the viability of these forms of bacterial life.

This line of research was followed up by Clemesha in its application to Indian conditions, with important results in practice.

The influence of Indian sunlight on the bacterial population of reservoirs was observed in the rapid but selective elimination of organisms indicative of recent pollution.

Comparatively short periods of storage effect great improvement. Careful observations in the early days of the scientific control of the water supply of Jamshedpur, where conditions are exceptionally difficult, and where, as in the case of Shanghai, it was necessary to use a river polluted with sewage as a source of water supply, showed that 5 days storage was sufficient to bring about the "safety change".

The use of Chlorine as a final agent in water purification, now well known in India, owed much to Houston's initiative. He was, however, always ready to consider new methods and of late years had renewed his interest in Ozone, the use of which as an alternative to Chlorine had again become possible in many cases owing to the cheapening of electrical power. He was impressed by the freedom from taste troubles attending its use, and also by its remarkable decolorizing efficiency.

The curious "Catadyn" process, depending on the oligodynamic effect of finely divided silver, did not escape his attention.

That for more than a quarter of a century the vast and increasing population of Greater London has been practically free from waterborne disease, is sufficient tribute to the vigilance of this wise, simple and scrupulously faithful guardian.

This and the love and esteem of all who knew him have been his reward.

Central Hotel, GILBERT J. FOWLER.
Bangalore.
December 1933.