none which can be reasonably regarded as angiospermous plants. If we compare the Wealden flora with that of the preceding Jurassic epoch, and again with the flora of overlying beds, we find in the former case a very striking similarity, and in the latter an almost equally well-marked difference. In short, the Wealden vegetation seems to be of essentially the same character as that which is so well represented in the Jurassic rock of the Yorkshire cliffs. Questions of climate and geographical distribution are of considerable interest when we are dealing with geological floras, but speculations as to climatal conditions are as a rule far from satisfactory when the evidence is furnished by extinct species. So far as it is possible to draw any conclusions of scientific value, our extended knowledge of Wealden plants supports the view of more or less tropical conditions of growth. A detailed comparison of the English species with those from other parts of the world, shows very clearly an exceedingly wide distribution of some characteristic forms, and points to a distinct uniformity in the vegetation of this period in widely separated regions. As points of some botanical interest, brought out by an examination of the English plants, mention may be made of the evidence obtained in support of the generic identity of *Williamsonia* and *Bennettites*, and the discovery of fertile pinnae in *Sphenopteris Mantelli* and other ferns; but limits of space preclude any discussion on these and other matters of greater or less botanical importance. A. C. SEWARD, Cambridge.

THE NUCLEI OF LILIUM LONGIFLORUM.—If the chromosomes of the dividing nuclei in the growing-point of the stem of this Lily are counted, it is found that their number is variable; thus nuclei with sixteen or twenty-four chromosomes are the most usual, and of these the former number is the most frequent. Besides these nuclei there are others which very probably contain intermediate numbers, e. g. eighteen, twenty, twenty-two. Again, in the divisions taking place in the pollen-mother-cells and in the upper nuclei of the embryo-sac a variation occurs. Some pollen-mother-cells contain nuclei with eight, others with twelve or ten chromosomes and that too in the same pollen-sac. In the upper nuclei of the embryo-sac eight, ten, or twelve chromosomes are found.

Before entering on the early stages of karyokinesis, the nucleus of the pollen-mother-cells of this plant possesses a very delicate and complexly coiled nuclear thread. Portions of this thread lie parallel

to one another, and in some places these parallel portions present the appearance of a single thread which has undergone longitudinal fission. That this is not the case, however, appears probable from the sudden divarications of these portions of the thread and the way in which they often lie across each other, and also from the fact that in later stages the divarications are not so conspicuous. As the thread thickens the parallel portions become more regular in their disposition, and finally transverse fission divides it into a number of chromosomes, each composed of two portions lying more or less exactly parallel to one another. Sometimes the two portions of a chromosome form a loop which is possibly derived from a loop in the original thread, and sometimes they are twisted round one another. Thus it appears that the double form of the chromosomes before the formation of the nuclear plate is in this case not due to longitudinal fission of the nuclear thread, but to the lateral approximation of portions of it in pairs.

As the chromosomes arrange themselves at the equator, they become simultaneously shorter and thicker, and they dispose themselves so that the plane of division between their two short rod-like parts is vertical and is not in the equatorial plane. These two parts are in close contact with one another and seem fused together at their inner extremities, while their outer or peripheral ends are often slightly parted. So that when seen from the poles at this stage they appear triangular, quadrate, or ring-shaped. Viewed from the equatorial plane each chromosome has the characteristic humped form. In the nuclear plate each undergoes horizontal longitudinal fission beginning at the inner end (so that seen in profile each chromosome now appears T-shaped), and as this proceeds two daughter-chromosomes are formed. As these latter separate from one another, the rod-like portions, which form them, diverge from one another, so that a diamond-shaped space is enclosed between the two daughter-chromosomes. When the latter are approaching the poles their two rod-like portions part asunder from one another, so that at the poles there appear twice as many short, straight chromosomes as there were at the equator.

From the process described it appears probable that each chromosome in this karyokinesis represents two of previous nuclear divisions, which have become more or less completely united end to end. Their double nature is shown in their mode of origin of the two parallel portions of the chromosomes which exist prior to the formation of the nuclear plate and in the separation of the two parts of the

daughter-chromosomes as they approach the poles. Thus the reduction in number is effected by an end-to-end fusion of the chromosomes, as Strasburger has already suggested.

The next division by which the pollen-tetrads are formed takes place probably according to the normal karyokinesis in plant-cells, as it is found to do so in *Lilium Martagon* and *L. chalcedonicum*. In these two species not only were the slender chromosomes forming the equatorial plate observed, but also their longitudinal fission which is similar to that which takes place in vegetative cells.

Before signs of approaching karyokinesis are apparent in the primary nucleus of the embryo-sac, fibres of great distinctness develop in the protoplasm of this cell, forming a spindle above and completely outside the nucleus, in position and appearance recalling Hermann's figure of the sperm-mother-cell of *Salamandra maculata* preparing for division (Archiv f. Mikrosk. Anat. 37). During division this nucleus behaves, so far as has been observed, with complete similarity to that of the pollen-mother-cells. In the later nuclear divisions in the embryo-sac, the doubling of the nuclear thread before the formation of the chromosomes, and the fission in the nuclear plate into V-shaped daughter-chromosomes, were not to be observed; in a few cases, however, the nuclear plate was seen to be composed of the humped chromosomes characteristic of the first division in this cell and in the pollen-mother-cells. But in the great majority of cases which were observed of these later divisions, the equatorial plate was formed of the usual slender bent chromosomes, which cleave longitudinally when in this position. Another point of interest connected with this embryo-sac is the fact that even without fertilization its central portion becomes occupied by a large number of nuclei. These nuclei arise by *direct* division and are formed as far as, at present, can be made out from the lower polar nucleus¹. H. H. DIXON.

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ABNORMAL NUCLEI IN THE ENDOSPERM OF FRITILLARIA IMPERIALIS.—In some material which was fixed during the spring of 1894, I have found some very peculiar forms of direct nuclear division, as well as intermediate forms between direct and indirect division. Nuclei before direct fission often attain monstrous

¹ Fuller details of this and the following note were laid before the Royal Irish Academy on Nov. 11, 1895, and will be published with illustrations in their Proceedings, Vol. III, Pt. 4.

Dixon, Henry Horatio. 1895. "The nuclei of *Lilum longiflorum*." *Annals of botany* 9, 663–665. <https://doi.org/10.1093/oxfordjournals.aob.a090764>.

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