dimensions; thus one nucleus measured 0.3 mm. long and 0.2 mm. broad. Sometimes these nuclei break up simultaneously into a large number of small nuclei, sometimes they become constricted in the middle, and after drawing out into the shape of an hour-glass divide into two equal daughter-nuclei. In another form of a direct division the nucleus forms a large number of bud-like projections from its surface which become separated from the parent nucleus. Ring-shaped nuclei were also often met with, which divide into two, three, or four daughter-nuclei according to the number of places in which the ring becomes attenuated.

It was in the smaller nuclei I observed transition-forms between direct and indirect fission. In these cases the nucleoli disappear and the nuclear thread breaks into a number of chromosomes; but without the nuclear membrane dissolving or the formation of a nuclear plate, the nucleus becomes constricted across the middle so that it appears dumbbell-shaped. The piece connecting the two daughter-nuclei usually lies more to one side than the other, and beside it is formed an apparently normal achromatic spindle. The solution of the nucleoli and the persistence of the nuclear membrane during these direct divisions prior to the formation of the spindle, supports the view that this latter structure is in part derived from the nucleolar substance. In these divisions I could not observe a longitudinal fission of the nuclear thread.

It is to be noted that the direct as well as the transition-forms of nuclear division were, in the cases observed, found in groups among nuclei exhibiting normal karyokinetic figures, from which we may conclude that the abnormal forms are not the result of imperfect fixing, and also that the same stimuli give rise to both kinds of division. Nearly all these forms of nuclear fission have been observed in animal cells, but so far as I am aware, they have not been recorded as occurring in plants.

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FURTHER INVESTIGATIONS ON SPORE-FORMATION IN FEGATELLA CONICA.—I have already (page 489 et seq.) described the chief points connected with the nuclear divisions in this plant. Since that paper was written my plants have fruited again, and as a large amount of material has rendered it possible to fill up some of the gaps existing in my previous account, I now briefly summarize the new results.

(1) As the spore-mother-cell approaches the period of division, the nucleus becomes oval, and the linin aggregates in the vicinity of the nucleolus, which is commonly situated at or near one end of the nucleus. Some portions of the linin however still protrude as threads or network from the aggregated portion.

(2) The nucleolus suddenly becomes vacuolated and often fragments, the linin is seen to consist of a tangle of double filaments, indicating that the longitudinal fission has already occurred. Frequent anastomoses are obvious.

(3) The nucleus becomes asymmetrical owing to the linin and nucleoli becoming massed about the middle of one side.

(4) The achromatic spindle next appears with extraordinary suddenness. It is bipolar, but of a peculiar form. The polar angles of the spindle are very wide, whilst the depth of the flat spore-mother-cell is comparatively slight. Thus the transverse section of the spindle at the equator becomes elliptical instead of circular, and the chromosomes are seen to be collected on one side, instead of being uniformly distributed around the equator (cf. par. 3). When observed from the flat side of the cell, the spindle is seen to present the form of a triangle, at two of the angles of which fine centrospheres are visible, whilst the chromosomes are grouped at the remaining angle. It must be stated that this appearance is seen both in sections, and also in uninjured cells teased out of the sporogonium and mounted in glycerine tinged with eosin. The general effect produced strongly recalls the development of the spindle during the division of the spermatocytes of Salamanders, as described by Hermann¹, and indeed his figures 8 and 9 would almost serve to illustrate these spindles in *Fegatella*. The origin of the structure is, however, different in the two cases, and the form in *Fegatella* is probably connected partly with the contour of the cell, and partly with the existence of the lateral aggregation already (3) referred to. The strand connecting the two centrospheres consists of *unbroken* threads, and it is weaker than those which run from these bodies to the chromosomes.

(5) Very extensive radiations extend from the centrospheres into the surrounding protoplasm, and they may often be traced *quite to the periphery* of the cell. Furthermore, weak radiations also extend from the equatorial patch of chromosomes towards the nearest wall. The latter filaments suggest the existence of an early tripolar spindle; and

¹ Hermann, Archiv für mikr. Anat., Bd. xxxvii.

though observation does not yet confirm this, and the regularly oval shape of the nucleus militates distinctly against it, it is not otherwise *a priori* improbable that a third centrosphere might be differentiated just outside the nucleolar mass referred to in par. 3, but in this case it must be excessively fleeting.

(6) The spindle next becomes longer by the wider separation of the centrospheres, and at the same time it loses its 'lop-sided' appearance. The division of the chromosomes conforms to the type of the first mitosis in the pollen-mother-cell of the Lily.

(7) After the separation of the elements of the daughter-nuclei, a cell-plate is formed, which does not extend to the peripheral walls. It subsequently shrinks somewhat, but remains suspended *transversely* within the cell.

(8) The two daughter-nuclei, after almost going into a condition of rest, divide with the formation of wide-angled spindles. The 'lopsided' arrangement of the chromosomes is however seldom met with, but when present, radiations also extend from the aggregation of chromosomes.

(9) The axis of these second division-spindles is variable, but from the axis of that pole which happens to lie nearest the primary cell-plate above alluded to, radiations are observed to branch off, and to connect with it. Thus the two spindle-poles which lie on opposite sides of the plate act as a 'couple,' and they cause it to rotate through an angle of 90° , so that it now lies *longitudinally* in the cell. During the rotation, the spindle-poles shift somewhat, and the fibres connecting them with the plate form the fifth spindle referred to on page 493. This rotation is perfectly constant, as is the position taken up by the four daughter-nuclei (see Pl. XVIII, Fig. 65). The formation of the new cell-plates, and their mode of attachment to the first one, have already been described. The whole process is susceptible of an obvious mathematical interpretation; soap-films introduced into a box, corresponding in shape to that of the spore-mother-cell, take up precisely similar positions. The arrangement of the spindle-fibres, and especially their mode of attachment to the cellulose framework, are in precise conformity with what, on mechanical considerations, might have been anticipated.

(10) The cells which form the elaters separate from each other by means of a mucilaginous degeneration which affects the entire wall except the innermost layers around each cell-cavity.

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Farmer, J. B. 1895. "Further investigations on spore-formation in *Fegatella conica*." *Annals of botany* 9, 666–668.

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