Comparative Embryology of Plants.[1]

IT is generally acknowledged that land-living plants have sprung from some algal source: that the land was invaded and that the invaders show form and structure adapted to sub-aerial life. If this be true, land-plants should still show features indicating their origin, and such characters should be expected to appear in their embryology. The higher algal structure is generally referable to the filament or row of cells with a free apex, and a base attached to the substratum. The individual commonly springs from such a source, amplified in various ways to form the adult. It is found that the comparative embryology of land-plants up to the seed plants themselves also suggest a filamentous origin. The apex is defined by the very first segmentation of the zygote: the base in bryophytes is the base of the sporogonium: in leafy plants it is the suspensor, recognised by Lang as a vestigial organ. He held that its presence is a last indication of the filamentous structure, a juvenile stage rapidly passed over in them, and often suppressed. The body thus visualised between apex and base may be called the primitive spindle.

Two distinct types of its orientation exist. In the first, the apex is directed to the neck of the archegonium (exoscopic). That is the characteristic of all bryophytes, and of Equisetum, Isoetes, and Tmesipteris. In the other, the apex is directed away from the neck (endoscopic), and it is found in lycopods, some primitive ferns, and in all seed-plants. An intermediate position is seen in certain ferns, including all the later types. In fact, with some exceptions, the distinction follows the major lines of affinity in the vegetable kingdom: therefore it is probably of high morphological importance. The interest will centre round the exceptions: and their explanation is probably to be found in the varying orientation of the archegonium.

The end of all higher embryology is the establishment of a leafy plant with its shoot pointed upwards. Where the archegonium points downwards, endoscopic orientation will lead directly to this result, but if the archegonium be inclined or inverted, the spindle will have to be inconveniently curved to secure that end. Many lycopods, selaginellas, and some ferns show awkward curvatures of the embryo to carry it out. But some of them have no suspensor: in these the awkward curves are absent. It is suggested that the inconvenience has been removed by abortion of the vestigial suspensor, which tied their ancestors down to the endoscopic orientation so inconvenient where the archegonium points obliquely, or actually upwards. The horsetails, Isoetes, and the leptosporangiate ferns would all be derivative in this respect. Having no suspensors, their initial polarity could be freely determined so that the apex would point from the first in the convenient direction.

Upon the spindle thus defined, whether complete or abbreviated by abortion, straight or curved, the appendages are attached. The leaves are possibly in phyletic origin, the results of distal dichotomy of the apex. But in fact they are attached laterally, and together with the axis they constitute the terminal bud. The first root is always of lateral origin in pteridophytes, and phyletically it is an accessory organ, absent in fact in the most primitive types. It is only in seed-plants that it appears to continue the axis downwards. Lastly, the "foot," which is so inconstant in its development, is clearly accessory also, in fact a sucker formed laterally where it is required. So the primitive spindle, defined by the apex of the shoot and with the tip of the suspensor as its base, appears to be a real and constant feature in the embryos of plants. But as it is liable to be abbreviated by the abortion of its base, and complicated at the apex and also lower down by the formation of lateral appendages of various sorts, it is often effectively disguised. Nevertheless, an adequate morphological and biological comparison of plants suggests that all their embryos are referable in origin to a filamentous source, such as is prefigured in the algæ.

[1] Abstract of the presidential address to the Royal Society of Edinburgh, delivered by Prof. F. O. Bower, F.R.S., on October 23, entitled "The Primitive Spindle as a Fundamental Feature in the Embryology of Plants" (Proc. Roy. Soc. Edin., vol. xliii. part i. p. 1).

Exploitation of South African Fisheries.[1]

By Prof. J. STANLEY GARDINER, F.R.S.

THE Union of South Africa has consistently endeavoured to pursue a far-sighted policy in reference to the exploitation of its seas. A survey with the S.S. *Pieter Faure* was made twenty years ago and resulted in the starting of a trawler industry, while a series of volumes were published dealing with the fauna of the grounds. In 1920 the Union hired a whaler, the *Pickle*, 102 feet long, 20 feet beam, and 11½ feet draught, equipped the vessel with trawls, warps, and sounding gear, and sent it to explore the fishing area, Dr. Gilchrist being the scientific adviser. The ship was commissioned for 20 months. It was singularly unsuited in many respects for trawling in commercial fashion, being of too shallow draught and not of the right build, only hauling an otter trawl of 40 feet head rope, whereas a trawler of its size could employ one of 120 feet with resulting catch at least six times as great. Notwithstanding these drawbacks excellent work was done, 543 stations having been investigated, generally by 1-hour trawls, distance traversed 4 miles. While the hauls are thus closely comparable, they are difficult to collate with commercial fishing. They deal entirely with unexplored grounds; we should have liked a few on the known grounds, already frequented by steam trawlers, for comparison.

Commercial trawling is now carried on down to 300 fathoms, and the total area within these depths off South Africa is about 120,000 square miles. The grounds may be divided into three areas—the eastern off the shores from Kosi River to Port Elizabeth, 625 miles; the southern from the latter to the Cape, 360 miles; and the western from the Cape to Cunina River, 1080 miles. The eastern is mostly a 10-mile belt, sloping off steeply from 60 fathoms; this is the region of the Agulhas Current, which causes in most places a roughness unsuited to trawling. The southern is that of the Agulhas Bank, a name given to the southern broad point of the continental slopes, its edge 150 miles from the shore. The western has a broad slope, not bounded by any marked steep, about 60 miles across, half within the 100-fathom line; it is on the whole smooth and regular ground, and lying on the colder side of the Cape—average difference 10° F.—should prove good trawling ground with fish of similar quality to those of our own shores.

The two most important deeper water fish proved to be the stockfish, or Cape hake, and Macrurus,

[1] Union of South Africa: Fisheries and Marine Biological Survey. Reports Nos. 1 and 2 for the years 1920 and 1921. By Dr. J. D. F. Gilchrist.

or Cape whiting, both of which have their centres of intensity at 150 fathoms, or even deeper. There is also the kingklip (in appearance like a ling), the dogfish, various soles and other flatfish, but the variety of economically valuable trawl fish so far obtained is not great. New fishing areas were discovered off Durban and off the Umvoti River, but neither of these are of sufficient size for steam trawlers. However, crayfish up to 12 inches occurred in immense numbers, a commercial trawler subsequently, in a haul of 1½ hours, taking more than 10,000. The results of the investigation indicate an abundance of life on all this eastern ground, and it must carry its due proportion of fish. Many small areas suitable for trawling appear likely to be disclosed by further survey, but it is not an area for steam trawlers, though, like the west coast of France, it should develop in time a considerable population of "longshore" men.

Turning to the south and west the reports give indications here of the possible development of an immense fishery. The *Pickle* demonstrated to the local trawlers the potentialities of deep-sea fishing, and new areas were found within a few hours' steaming of Cape Town. The most northerly trawlings were off Luderitz Bay, and it would seem probable that there is good ground right down to Cape Town; we should also expect similar ground further north as far as Union territory extends. Before such ground can be exploited commercially it must be surveyed, so that trawlers may avoid rough patches. To know the depth and nature of the bottom is not enough, and trawling tests are essential. Doubtless the fish migrate at different seasons, so that the latter tests will have to be undertaken at least twice over. It is an expensive business, of course—the running expenses of a trawler would be about 1000*l.* per month—but the encouragement of food production is a vital necessity to all States, while fish-meal is a bye-product of high value. In any event it is clear that South Africa has to the south and west an area more than capable of supplying all the fish that can at present be consumed; the western grounds alone may well prove as rich as those to the south of Ireland of about the same area, which in 1910 produced 1·35 million cwts.

With these potentialities in mind it is extraordinary to find that the fishery vessel is to be given up. In substitution a survey vessel, *Crozier*, is to be used at intervals for fisheries work. To employ a twin-screw vessel with a complement of 80 hands for such work is wretched economy, work which can be better done with a trawler and a crew of 14. The phase of using such Admiralty vessels for fishery work is one which nearly every country of Western Europe has passed through and abandoned; surely South Africa would be well advised to learn by their experiences. In any event we trust that the series of special reports on the fauna obtained by the *Pickle*, commenced in report 2, will be proceeded with; they are of high scientific value.

The Teaching of Elementary Geometry.[1]

THE Assistant Masters' Association recently appointed a committee to consider the teaching of elementary geometry; the report of this committee, backed by the authority of the Executive Committee of the Association itself, that of the Assistant Mistresses' Association, and that of the Educational Institute of Scotland, has now been published. The outstanding fact, and one of no little importance, is that the committee was appointed to produce an agreed sequence of propositions and has not done so. The terms of reference were:

(*a*) To examine the case for an agreed sequence;
(*b*) To suggest the best means of attaining the general adoption of the sequence agreed upon.

The most definite conclusions are:

VII. The committee does not feel that it is either desirable or possible at present to stereotype a sequence; and

I. No formal proofs should be required of Euclid I. 13, 14, 15, 4, 8, 26, 27, 28, 29. . . . The teaching of formal geometry should be based upon the quasi-axiomatic acceptance of these results.

The committee is unquestionably right in its belief "that the main difficulties due to variety of sequence will be removed if the first of its recommendations [*i.e.* I. just quoted] is generally accepted," and possibly the most valuable feature of the report is the extended currency it will give to this principle.

For the rest, the committee is concerned not so much with principles as with giving what help it can to the "very large number of teachers who do not claim to be experts in geometry" and who need "guidance amid the welter of sequences and methods . . . published during the last twenty years." From this modest and reasonable point of view little fault will be found with the detailed recommendations, though, as is freely admitted, there is room for difference of opinion on many points. A teacher who followed their scheme exactly would come to no harm.

The committee follows in the main the "Cambridge Schedule," with some expansions (which some will not think improvements) apparently designed to show exactly how it intends the propositions to be dealt with. For example, the section on areas begins with the rule for measuring the area of a rectangle and the section is more detailed than in the Schedule, clearly indicating a treatment different from Euclid's. It is pointed out at the end of Section VI. that Pythagoras's proposition and Euclid III. 35, 36 should be dealt with by the use of similarity as well as by Euclid's method. The report contains a needed warning (Recommendation IV.) against the slovenly use of the "method of limits" in dealing with tangency; and another (Recommendation V.) against ignoring the existence of incommensurables; "at the proper stage," the committee says, "the attention of the pupil should be called to the fact that the proofs given do not cover all cases."

A very important feature of the report is that certain propositions are marked with an asterisk, indicating that formal proofs of them should not be required in examinations. Some are marked also with a (†), indicating that no formal proof should be attempted in the class-room.

On this point the practice of Examining Bodies differs; most of them asterisk propositions, but some more, some less. It would undoubtedly be of great assistance to the schools if uniformity could be reached, and for this purpose the selection made by the committee might well be taken as the standard.

Altogether, the committee may be congratulated on its work; it has not set up obstacles to further progress, as with its terms of reference it easily might have done; on the other hand, the report will probably reach many teachers who need help and will give them much of the assistance they need.

[1] The Teaching of Elementary Geometry: Being the Report of a Special Committee appointed by the Incorporated Association of Assistant Masters in Secondary Schools. Pp. 15. (London: Oxford University Press, 1923.) 1s. net.