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DEPARTMENT OF BOTANY.

B. Sahni.

(1) *The present position of Indian palæobotany:* [Presidential Address to the Botany Section, Indian Science Congress, Calcutta. Proc. Asiatic Society of Bengal (New Ser.) Vol. XVII, pp. clii-clxxv, with two charts, 1922].

After giving a historical sketch of the previously published literature on Indian fossil plants the author describes briefly the nature of the material available and the physical conditions, climatic and topographical, during which the successive fossil floras of India lived and died. The bulk of the material comes from the rocks of the Gondwana System, a series freshwater sediments ranging in age from Upper Carboniferous to Cretaceous.

These strata, aggregating many thousands of feet in thickness, represent the sediments brought down by the rivers of a great Southern Continent (Gondwana Land) which is supposed to have once stretched across the southern

hemisphere, and of which South America, South Africa, Australia, and India are mere remnants.

The chief characteristics of the various fossil floras from the earliest to the most recent are briefly described. Nearly all the known species are enumerated in a stratigraphical table showing the homotaxial relations of the different strata. The vertical distribution of the chief genera of Indian Gondwana plants is shown in another table, which also illustrates the marked contrast between the floras of the Lower Gondwanas and those of the Upper. Thus the Cordaitales, Equisetales, and the Glossopterids, along with numerous fronds of uncertain affinity are concentrated in the Lower Gondwanas, while the Upper Gondwanas have practically monopolized the Cycadophyta and conifers, as well as the true Ferns.

In conclusion the author draws attention to the more important gaps in our knowledge. An intensive study of Indian fossil plants from the special view point of the botanist (as apart from that of the geologist) is urged. Emphasis is laid upon the importance of petrifactions, of which very few have been described from India. The tertiary and post-tertiary plant-remains are a practically virgin field. The investigation of specimens in which the cuticular or sporangial structure is preserved promises to yield a rich harvest of results.*

(2) *The cuticular structure of Glossopteris angustifolia Brongn*: (Records of the Geological Survey of India, Vol. LIV, pt. 3, pp. 277-280, pl. 17, 1923).

* During the several years that have elapsed since this address was delivered the author has been engaged chiefly in investigations on Indian fossil plants (see Nos. 2, 4, 7, 9, 10, 14-17 below). He has been entrusted by the Geological Survey of India, with a revision of their extensive collection of fossils preserved at the Indian Museum, Calcutta. The results are to be published in the Memoirs of the Survey (Palæontologia Indica) in a series of monographs, the first of which has recently been published. (See No. 9 below).

Glossopteris is a genus of extinct fern-like plants, the remains of which must have very largely contributed to the formation of some of our best Indian coal (Jharria, Raniganj, Giridih, etc.). The genus is also found widely distributed in the coalfields of the southern hemisphere, *e.g.*, in South Africa, Brazil, Queensland, and New South Wales, usually in the form of leaf-impressions on shale. Two of the best known species are *G. indica* and *G. angustifolia* but these are not easily distinguished from each other from their external appearance alone, and this is impossible when only small fragments of the leaf are available. In the present paper the author shows from a microscopic study of the epidermis that these two important species can easily be distinguished from each other even in minute fragments.

The present case is one of the few in which the application of modern methods of investigating fossil impressions has advanced our knowledge of Indian fossil plants.

(3) *On the theoretical significance of certain so-called abnormalities in the sporangiophores of the Psilotaceæ:* (Journal of the Indian Botanical Society, Vol. III, No. 7, pp. 185-191, 1923).

Deviations from the normal structure in plants have sometimes been regarded as being in the nature of reversions, that is, reminiscences of a time when they perhaps formed part of the normal organization of some remote ancestor. For this reason abnormalities are by some botanists attached considerable importance in determining the affinities of plants. Without committing himself to such a faith in their value the author describes certain hitherto unrecorded abnormalities found by him in the rare and primitive New Caledonian plant *Tmesipteris Vieillardi* and discusses their significance from the point of view of the relationships of the family Psilotaceae.

The view that this apparently decadent group is closely related to the long extinct race of the Sphenophyllaceae depended largely for support upon cases of "abnormal" repeated forking in the so-called "sporophylls" which were closely compared with those of *Sphenophyllum* and *Cheirostrobus*. Indeed some morphologists were so deeply impressed by the resemblance—and it was difficult to expect a more striking resemblance between plants so widely separated in time—that they did not hesitate to group the two families together.

But since the publication of Kidston and Lang's important work on the early Devonian land plants the lycopod affinities of the group have come into prominence, and it now seems more likely that the sporangiophores of the Psilotaceae are not fertile leaves (sporophylls) but sporangium-tipped branches. The abnormalities described in this paper appear to lend support to this view and to show the possibility that they have fundamentally a verticillate organization, a whorl of two (*Tmesipteris*) or three (*Psilotum*) sporangia succeeding an alternating whorl of sterile lobes, of which there are two in *Tmesipteris* and two (reduced from three) in *Psilotum*.

(4) *On the anatomy of some petrified plants from the Government Museum, Madras:* (Proc. Indian Science Congress, Bangalore, p. 142, 1924).

The anatomy of three silicified stems received on loan from the Madras Museum is here described. One of the specimens is a new species of palm (*Palmoxylon sp.*), another is a well preserved dicotyledonous stem provisionally identified as *Dipterocarpoxylon burmense* Hold., a type of fossil wood which is found commonly in the valley of the Irrawady River in Burma. The present specimen is exceptionally well preserved and shows a number of new features

which seem to confirm the reference to the Dipterocarpaceae, a family of forest trees well represented in the existing flora of Burma.

The third specimen is a fragment of coniferous wood from the well known locality Tiruvakkarai (Trivicary) west of Pondicherry, where large fossil tree trunks have long been known to occur. The preservation is poor.

(5) *The ontogeny of vascular plants and the theory of recapitulation :* (Presidential Address to the Indian Botanical Society, Third Session, Bangalore, January 14, 1924. Journal of the Indian Botanical Society Vol. IV, No. 6, pp. 202-216, 1925).

In 1866 Haeckel propounded the doctrine that plants and animals during their individual development tend to pass through transient phases which more or less closely resemble their presumed ancestors. This well known " theory of recapitulation" owes its main support to the facts of animal life and, although not altogether unchallenged, has been widely accepted by zoologists. The theory has not received the same support from the botanical side, but the question has never been examined as a whole and in a comprehensive manner from the botanical point of view. In the present address an attempt has been made to see how far botanical evidence goes in support of this great generalisation.

The author starts with the assumption that a biological principle of such a fundamental nature, if it holds good in the case of animals, should apply also to the plant kingdom. He believes that much of the adverse criticism of the theory is due to the fact that more was read into it by enthusiastic advocates (and no less by its opponents) than was ever contemplated by Haeckel himself. Basing himself upon the well known dictum : " ontogeny tends to recapitulate phylogeny " he adduces evidence both from the published litera-

ture and from his own observations that the principle finds a wider application in the plant world than has generally been agreed to. The chief support is derived from the development of the vascular tissues of the cryptogams, especially those of the ferns, both living and extinct. The different phases of the stem stele in highly developed forms are well known to be permanent in some of the more primitive types ; while the intricate shapes of the leaf-trace among the extinct ferns of the group Zygopterideae are derived by stages which strongly recall the adult shapes in related forms of simpler construction. The development and comparative anatomy of the seeds of some of the primitive groups of gymnosperms (*e.g.*, the Cordaitales and the yews) reveals interesting facts in support of recapitulation ; while sporadic evidence of a similar nature, derived from other sections of the plant kingdom, has frequently been tacitly recognized as pointing in favour of the principle.

(6) *On Tmesipteris Vieillardi Dangeard, an erect terrestrial species from New Caledonia:* (Philosophical Transactions of the Royal Society of London, Ser. B Vol. 213, pp. 143-170, text-figs. 1-7, pls. 5-6, June 1925).

This rare species, native in New Caledonia, is exceptional in the genus owing to its erect habit, its terrestrial (instead of epiphytic) mode of life, and certain anatomical features which mark it out as probably the most archaic member of the family Psilotaceae. This aberrant family of rootless plants is of particular interest to botanists because its nearest known allies, the Psilophytales, which are among the earliest known land plants, became extinct as long ago as the Devonian age. The Psilotaceae thus present a remarkable instance of the survival of a primitive race of plants through an enormous interval of time.

Tm. Vieillardi may possibly represent the parent type which gave rise to the usually pendulous epiphytes grouped under the name *Tm. tannensis*. The whole genus appears to be gradually relinquishing its primitive terrestrial home, *Tm. Vieillardi* being one of the stragglers. The absence of roots in this land plant supports the view that the rootless character of the whole family is an original feature, and not due to the adoption of an epiphytic mode of life. In several other respects, too, the structure recalls that of the Devonian Psilophytales, while the stem anatomy shows a certain resemblance with *Lycopodium*, an important point being the presence of phloem internally to the xylem ring and of bundles of xylem and phloem in the pith itself. The author records internal phloem also in the other forms of the genus, but the medullary xylem (strictly comparable with the central cauline xylem of *Lycopodium*) is peculiar to *Tm. Vieillardi*.

The whole vegetative organization of the plants belonging to the genus *Tmesipteris* is extraordinary. Towards the apex of the plant the stem appears to be composed entirely of coalescent leaf-bases, affording a very striking illustration of the phytonic theory; and, as Dangeard observes the vascular anatomy confirms this impression. Further down the leaves become less important, and the stem begins to assert itself as an entity distinct from the decurrent leaf-bases, till in the rhizome it forms the entire axis by itself. In the middle region of the shoot the structure affords a remarkably good illustration of the " leaf-skin " theory of the stem. Chiefly on the basis of stelar anatomy, Professor Jeffrey of Harvard has divided vascular plants into two distinct categories, the Lycopsida and Pteropsida. But a careful re-investigation of *Tmesipteris* from the crucial point of view of the question of leaf-gaps shows that this genus cannot easily be assigned to either of these categories.

The main results of the present work have been to emphasize the aberrant nature of the genus *Tmesipteris* and to throw some further light upon the affinities of the family. The evidence now brought forward tends to bring the Psilotaceae even nearer to the Devonian genus *Asteroxylon* than has hitherto been suspected, at the same time supporting the old view of a lycopod alliance, sometimes expressed by merging the two groups into one. On the other hand, the relationship with the sphenophylls, once strongly upheld, does not appear to receive much support from recent work.

(7) *Palæontological description of a fossil tree trunk in the Lower Gondwanas near Asansol:* (Records of the Geological Survey of India, Vol. LVIII, pt. 1, pages 77-79, pl. 1, 1925).

About two miles west of Asansol, on the main E. I. R. line, several large petrified tree-trunks were unearthed a few years ago during operations for widening the railway cutting. The trees were lying prostrate, buried in loose sandrock, a few feet below the surface. Neither branches nor leaves were seen attached, and even the bark was absent, suggesting that the trees had drifted to their resting place along a flooded river before they were petrified. The largest tree, of which the greater part is now preserved in the Indian Museum at Calcutta, must have been well over 100 ft. in height. It is the largest fossil tree trunk so far discovered in India.

Fragments of the silicified wood, submitted for microscopic investigation by the Geological Survey, showed that the trees belong to the extinct Cordaitean genus *Dadoxylon*, of which the wood anatomy closely resembles that of the modern araucarians, although the reproductive organs of the two groups are very different. Well marked growth-rings are present, and the pith is cylindrical, not

discoid, features which indicate an alliance with species found in the southern hemisphere (Gondwana Land) rather than with the typical Cordaiteae of the north. The fossil was found in the Lower Gondwana beds of the Raniganj Coalfield ; the exact horizon is uncertain.

(8) *On the floatin island and vegetation of Khajiar, near Chamba, in the N. W. Himalayas:* (Journal of the Indian Botanical Society, Vol. VI, No. 1, pp.1-7, text-figs. 1-2, plates 1-2, 1927).

During a summer vacation walking tour to Leh (Ladakh) the author made a brief halt at Khajiar, a picturesque locality midway between Dalhousie and Chamba. In the midst of a dense conifer forest, about 6,400 ft. above sea level there is meadow about a mile and a half in circumference, with a small lake in the centre, surrounded by a marsh. A curious feature of the lake is a small islet thickly overgrown with tall reeds (*Phragmites*), which is known to glide over the water like a sailing vessel before a breeze. The vegetation of the marsh and surrounding meadow shows an unusually striking series of concentric zones round the lake, due to the preponderance of different species of herbs at varying distances from the water's edge.

A list of the plants collected in the different zones is given, and an explanation is offered of the origin of the floating fen. It is suggested that the lake was at one time much larger than its present size ; that as the result of the usual succession of phases seen in the Broads of East Anglia and in Kashmir (open water—submerged aquatics—floating leaf association—reed swamp association—reed fen association) an extensive reed-fen arose round the lake ; and that part of this fen broke off and now forms the floating island, in the same way that floating islands have

been formed in the delta of the Danube. Quite possibly the marsh is an overhanging centripetal growth from the banks, gradually closing in round the lake while its peripheral parts, continually encroached upon by the meadow plants, gradually became a *terra firma*. The absence of any fen plants round the lake is easily explained in view of human interference. If the conjectured history is correct we may say that the concentric zones of vegetation are even now steadily moving centripetally; that the meadow is growing at the expense of the lake; that the floating island will before long become stranded; and that, unless human agency protects it, the lake may be expected to disappear at no very distant date.

(9) *Revisions of Indian Fossil Plants—I Coniferales (a. Impressions and Incrustations)*: [Memoirs of the Geological Survey of India (Palæontologia Indica)—New Ser. Vol. XI, pp. 1-49, plates 1-6, Calcutta, 1928].*

During the last eight years the author has been engaged in a re-investigation of the extensive collection of fossil plants preserved at the Indian Museum, Calcutta. The greater part of the collection was described by the Bohemian palaeobotanist O. Feistmantel during the years 1877-1886 while employed as palæontologist to the Geological Survey of India. The result was a monumental work in four volumes, entitled the "Fossil Flora of the Gondwana System." Since then numerous specimens have been added to the collection, while many of the old ones now need revision in the light of recent advances, both in our knowledge of fossil plants and of the methods of investigation. Since the year 1902 a considerable amount of revision work as well as description of newly acquired material has been carried out in Europe, chiefly by the

*Sent to press in 1926, delayed in publication.

late Professor Zeiller of Paris and by Professor A. C. Seward, F.R.S., of Cambridge, with whom the present author had the privilege of being associated in part of the work. The present memoir is the first of a series of monographs which it is proposed to publish on the Indian collections, under the auspices of the Geological Survey who have entrusted the work to the author ; it represents the only comprehensive palæobotanical research on Indian plant-remains carried out in this country since Feistmantel's retirement over forty years ago.

In this memoir 41 species ranging in age from carboniferous to cretaceous have been described and figured ; of these 13 are new to science, several of them being fructifications, which are of special importance from the point of view of affinities. The employment of improved technique has resulted in a considerable advance in our knowledge of several of the old species ; while the geological ranges of several others have had to be revised chiefly in view of specimens recently discovered. Of the species now described as *Buriadia Sewardi* different parts had originally been described by Feistmantel under two distinct genera (*Voltzia* and *Albertia*). The paper also describes the first coniferous remains discovered in Burma.

Apart from the plants which cannot be assigned to any known sub-groups of conifers, the following existing families appear to be represented in the Indian fossil flora: Araucarineae, Taxineae, Cupressineae, Taxodineae. One of the interesting facts brought out is the occurrence, in the Indian jurassic rocks, of plants allied to the Podocarpineae. The further bearings of the work on Indian fossil conifers will be discussed at the conclusion of the second part of the memoir, now in course of preparation, in which the petrified coniferous woods as well as the seed-bearing cones will be described.

(10) *On some petrified cones of Indian fossil conifers from the British Museum, London:* (Proc. Indian Science Congress, Lahore, p. 22, 1927).

During the work of revising the Indian fossil conifers preserved at the Geological Survey's Museum in Calcutta the author wrote to several museums, both in India and abroad, in the hope of obtaining on loan any Indian fossil plants that might have escaped investigation. The three or four types of petrified seed-bearing cones of which an account was read before the Lahore Session of the Indian Science Congress were received from the Geology Department of the British Museum in London.

These are the first petrified cones to be described from the Indian strata. So far as the structure has been investigated they nearly all seem to belong to the pine family (Abietineae), for the cone-scales are woody and probably double, while there is constantly a pair of ovules on the upper surface of each scale. So far as known at present the species are all distinct from any yet described.

In addition to the above specimens from the British Museum there is an interesting fructification discovered in the so-called intertrappean beds of the Chhindwara District (C. P.). The rock in which this cone is embedded appears to be a silicified mud from a river or lake-bottom, for it contains, besides the shells of fresh-water mulluses, fragmentary remains of numerous plants preserved in various stages of putrefaction and lying in a disorderly manner: seeds, spores, and shreds of tissue being all jumbled together.

The plants and animals of which the relics are here preserved (in fresh water sediments interbedded with lava flows) afford a glimpse into the life of the country towards the close of the cretaceous period, when the whole of the

Deccan peninsula was repeatedly overwhelmed by volcanic outbursts of unprecedented severity.

(11) *On the occurrence of funnel-like leaves (ascidia) in Ginkgo biloba:* (Proc. Indian Science Congress, Lahore, p. 275, 1927).

Describes the abnormal occurrence of funnel-like (instead of the ordinary flat) leaves in specimens of *Ginkgo biloba* at Lahore and Mussoorie. Such leaves have not been recorded before in this plant, although it is a type of great interest which has been investigated in detail. It does not seem possible at present to attach any special significance to the phenomenon.

(12) *The Southern Fossil Floras—A study in the plant geography of the past:* (Presidential Address to the Geology Section, Indian Science Congress, Bombay, pp. 229-254, 1 map, 4 charts, 1926).

For many years past it has been an almost universally accepted view among geologists that during the late palaeozoic and mesozoic eras most of the present land areas of the southern hemisphere, as well as the greater part of India, were connected together into a single huge continent, in such a way that it was possible for the land plants and animals to migrate freely from one end to the other. This view is almost forced upon us by the far-reaching similarities, often extending to details, in the geological structure and in the succession of extinct floras and faunas of countries now separated by wide stretches of ocean. The Indian name of "Gondwana Land" is applied to this great Southern Continent which, it is supposed, was separated from an equally extensive Northern Continent (Angara Land) by an equatorial ocean, of which the present Mediterranean Sea is a small remnant.

Hardly anyone now seriously questions the former existence of a Gondwana continent. But opinion is sharply divided upon the problem as to whether the now far separated southern countries (with which India is also to be linked, although it lies north of the equator) were connected together by bridging continents now lost in the sea, or whether, as advocated by Wegener and others, they were once directly in contact and fitted together like the parts of a picture puzzle, but have since drifted apart.

It was in an attempt to test this bold hypothesis of drifting continents with the evidence from fossil plants that the subject of the present address was chosen.

This involved a comparative review of all the more important fossil floras of late palaeozoic and mesozoic age recorded from the southern hemisphere and from India. In order to gain a bird's-eye view of the distribution of these floras in space and time, most of the recognizable species were tabulated in parallel columns for the different countries. It was thought that if the drift theory was correct a horizontal traverse through the correlation tables at any particular level would show a much closer affinity between the floras of two regions supposed to have been once adjacent, (say, *e.g.*, Eastern Brazil and the West Coast of the South African peninsula) than might be expected in view of migration across a land bridge several thousand miles long.

The result of this broad review has been to show that, so far as palaeobotanical facts are concerned, we are not yet equipped for such a direct attack upon the problem. For one looks in vain for two regions now on the opposite shores of the ocean, but supposed to have been once contiguous, of which the fossil floras are equally well-known to afford a fair basis for comparison. Thus, the present

southern coast of South Africa is supposed to have been contiguous with what is now Antarctica till the beginning of the jurassic period, but while from South Africa we know a fairly extensive permo-carboniferous flora and an equally well developed triasso-rhaetic one, Antarctica has yet little to offer in comparison, though the few types collected are otherwise of the greatest interest. What is now the east coast of Brazil, according to the displacement theory once fitted into the present west coast of the South African peninsula, and the connection is supposed to have persisted till cretaceous times; but our knowledge of the fossil floras of these two regions is too unequal to admit of any comparison at all. The same remark applies as between Australia and Antarctica.

The author concludes that while the evidence from the distribution of fossil plants in the southern countries points distinctly to the former absence of ocean barriers between them, this evidence is not of such a nature as to speak either in favour of land bridges now submerged, or of these countries having once fitted together like the parts of a picture puzzle in the way that their present coast lines temptingly suggest.

Other points dealt with in the address refer to the distribution of the cosmopolitan flora of pre-Gondwana times ; the advent of the Gondwana flora and its relation with the carboniferous glacial period; the relation of the Lower Gondwana flora especially of Kashmir, with that of Angaraland and possible means of communication between the two; the origin of the so-called "Northern" types in Gondwana Land; the recent discovery of a flora of the northern type in Sumatra, with a majority of typical European coal measure plants; the relation of New Zealand with the Gondwana continent; the geological age of the Parsora beds of India ; and the supposed conflict

between the evidence of fossil plants and of animals as indices of geological age.

(13) *On Clepsydropsis australis, a zygopterid tree-fern with a Tempskya-like false stem from the Carboniferous rocks of Australia :* (Manuscript submitted in November, 1927, and communicated by Professor A. C. Seward, F.R.S., to the Royal Society of London).*

The material here described was received for investigation partly from Professor Seward (Cambridge) and partly from Mr. G. D. Osborne, of the University of Sydney, who discovered most of the specimens in a fresh-water conglomerate of Carboniferous age near Mount Tangorin, in New South Wales.

C. australis is the only member of the zygopterideae known from the southern hemisphere; the genus has elsewhere been found only in Central Europe and Western Siberia. The chief point of interest about the newly discovered specimens is that they reveal an extraordinary type of stem-structure comparable, in its broad features, with that of the Cretaceous fern *Tempskya*, but not previously observed in any palaeozoic plant.

The trunk must have stood upright and attained a very considerable height, with a heavy crown of foliage at the top ; it was a " false stem " composed of numerous relatively weak, but erect, repeatedly forked leaf-bearing axes which, along with the stout erect petioles borne upon them, were embedded in a dense matrix of adventitious roots and aphlebiae. In cross-sections of the trunk the individual stems, petioles, and in the peripheral parts of the trunk even the roots, are all cut more or less transversely. The peripheral roots appear to have formed a felt round the

* The paper has since been published in the Philosophical Transactions of the Royal Society, Vol. 217, pp. 1-37, plates 1-6, July, 1928.

false stem, at least in its lower parts. Many of the roots are seen intruded into the old raches. It is likely that at the very base there was a single leaf-bearing axis, from which the numerous stems in the upper part of the trunk were derived by repeated forking.

The individual stems are radially symmetrical, with leaf-traces arising in 2/5 order from steles of the *Ankyropteris Grayi* type. There are no axillary branches: the only mode of branching observed is equal dichotomy, the angle of forking being extremely small.

The origin of the leaf-trace and its subsequent changes, the pinna-trace and the aphlebiae are described. The aphlebia trace often bifurcates precociously and the twin strands, lying in the tangential plane, recall the paired " pinna " traces of the Dineuroideae. Nothing is known of a leaf-lamina.

Tetrahedral spores of three different sizes have been found caught among the roots ; but whether any of them belonged to the *Clepsydropsis* is an open question. Among the transversely cut roots in one specimen there is a cross-section of a small cylindrical axis with a stele showing well developed secondary wood, and traces of a periderm in the outer cortex. The primary xylem consists exclusively of tracheides. The number and position of the protoxylems cannot be ascertained. The cortex contains the vascular supply to lateral appendages of unknown morphological nature. In the absence of further material the nature and attribution of the organ remains a mystery ; a suggested possibility is that it is the root or rhizome of some delicate vascular cryptogam which grew as an epiphyte upon the " false stem, " somewhat like *Ankyropteris scandens* on a permian *Psaronius*, or *Tmesipteris*, *Trichomanes* or other epiphytes on the trunks of modern tree-ferns.

C. australis forms an important and interesting addition to the known pre-Gondwana flora of Australia, and provides a further link with the contemporaneous European flora.

(14) *Some petrified palms from the Central Museum, Nagpur:* (Proc. Botany Section, Indian Science Congress, Calcutta, 1928).

Three species of petrified palm stems (*Palmoxylon* received on loan from the Nagpur Museum, are here described. At least two of them are new to science. A full description will be published in a special monograph dealing with all the known fossil palms of India.

(15) *On a collection of petrified tree-trunks discovered in the Eden Gardens, Calcutta:* (Proc., Botany Section, Indian Science Congress, Calcutta, 1928).

The author, while spending a vacation in Calcutta during the summer of 1922, discovered about a dozen petrified trunks of different sizes, lying on one of the rockeries in the Eden Gardens, not far from the Pagoda.

Most of the specimens were lying flat, but a few were standing erect and partly buried in the ground. There can be no doubt that the specimens had been purposely placed there long ago but apparently all records or recollection of them had vanished.

Considering that the Eden Gardens are one of the most frequented spots in Calcutta it is surprising that these large relics should so long have escaped notice. There can be no question of their having been originally on the spot where they were found, and their association with the Pagoda, which was brought over as a trophy of the

Second Burmese War, suggests that they may also have been imported from Burma at the same time.

The wood is dicotyledonous and fairly well preserved. The anatomy is described in one of the best preserved specimens.

Two of the smaller specimens are now in the Museum of the Botany Department of the Lucknow University.

(16) *On a fossil pentalocular fruit from Pondicherry, South India:* (Proc. Botany Section, Indian Science Congress, Calcutta, 1928).

The specimen was received for investigation from the Department of Geology, British Museum, London. The fruit is about the size of a walnut and is embedded in a calcareous matrix in which a few shells of gasteropods are also preserved. The horizon, although not known with certainty, is probably the Cuddalore Sandstone (Tertiary); from this series no angiospermous plant remains have yet been recorded. In fact, the author is not aware of any fossil fruit of a similar type from any part of India. The affinities cannot be determined without an extensive comparison with modern dicotyledonous 5-locular fruits.

(17) *Dicotyledonous plant-remains from the tertiary beds of Assam :* (Proc. Botany Section, Indian Science Congress, Calcutta, 1928).

Describes two small collections of leaves and twigs, including one fruit, submitted for investigation by the Geological Survey of India. Collection (1) includes, among other unrecognizable plant-remains, one valve of a fruit of one of the Juglandaceae.

Collection (2) comprises several types of leaf-impressions, among which *Phyllites kamarupensis* Seward and at least two other species are represented.

B. Sahni and T. C. N. Singh.

(18) *On the vegetative anatomy and female cones of Fitzroya patagonica Hook. f:* (Proc. Indian Science Congress, Benares, page 105, 1925).

The monotypic genus *Fitzroya*, confined to Patagonia and Chile, is one of the little known conifers, generally referred to the same family as the juniper and cypress. Our knowledge of this rare plant has remained incomplete, chiefly owing to the difficulty of obtaining adequately preserved material. In this preliminary account the authors describe the external features as well as the anatomy of the vegetative organs and female flowers. Several of the features are now recorded for the first time, and in others the present account differs from those previously published.

A curious feature of the rather fleshy, spreading leaves is that the palisade tissue is chiefly developed on the under side, the stomata being almost confined to the upper, a peculiarity which may be due to the pendulous character of the terminal shoots. The stomata are occluded by a waxy secretion which forms a thin membrane over the upper surface of the leaf; the cuticle is very markedly thickened in the region of the stomata and there are other xerophytic adaptations.

The female cone consists of five alternating whorls of three scales each (not three whorls as stated by other authors); the lower three whorls are sterile with only slight indications of the ovuliferous scale so that they form a transition to the vegetative leaves below. The most peculiar feature of the cone is the presence of three (rarely four)

hollow cylindrical or club-shaped gland-like organs at the apex, in positions alternating with the top whorl of scales and suggesting a much reduced sixth whorl. In their structure, however, these gland-like organs somewhat resemble the nucellus: hence they may possibly be naked nucelli.

B. Sahni and T. C. N. Singh.

(19) *On some specimens of Dadoxylon Arberi Sew., from New South Wales and Queensland:* (Journal of the Indian Botanical Society, Vol. V, No. 3, pp. 103-112, plates 1-3, 1926).

During the late palaeozoic era (upper carboniferous and permian) the vegetation appears to have been fairly uniform over the greater part of the southern hemisphere, for the same characteristic types of fossil plants have been found in such widely separated regions as South America, South Africa, Australia, and even the Antarctic Continent, which at that remote period must have enjoyed a much warmer climate.

Dadoxylon Arberi is one of these widely distributed southern types, no doubt belonging to the same family as the big fossil tree of Asansol. Specimens have been recorded from Queensland, New South Wales, South Africa, and the Falkland Islands, but the type-specimens have never been adequately described. In the present paper the authors give a detailed and illustrated account of the most complete specimen (with branches) yet found in Australia, showing a large cylindrical pith and well preserved protoxylem. This specimen was received for investigation from the Geological Survey of India. They have also examined a fragment of the Queensland fossil originally described under the name *Araucarioxylon Daintreei*, (sent to them for comparison by the National Museum in Melbourne) and show that it is probably identical with *D. Arberi*.

B. Sahni and S. K. Pande.

(20) *Notes on the anatomy of a species of Niphobolus from Malay:* (Proc. Indian Science Congress, Bangalore, pp. 141-142, 1924).

Plants growing in situations where water is scarce or difficult of access are known as xerophytes or "desert" plants in the wide sense. Such plants usually adapt their structure in various ways to the exigencies of the environment. They may develop specially efficient means (1) of absorbing water, (2) of retaining large quantities of water whenever it becomes available, (3) of controlling the expenditure of the stored up water.

Epiphytes, that is, plants which merely grow upon other plants (usually trees) without being parasitic upon them, are "desert" plants in the broad sense of the word. The epiphytic fern *Niphobolus adnascens*, a native of the Malay Peninsula, shows an interesting combination of adaptive features. Of these the most remarkable is the structure of the water-storing tissue, which forms the greater part of the leaf and lends it a fleshy, turgid appearance. The cells of which this tissue is composed are constructed like the bellows of a camera or like a concertina, and are therefore collapsible into a small space. During a period of drought, as the store of water diminishes, these cells gradually fold up and the leaf appears thin; on the advent of the rainy season they again expand as they become filled up with water.

B. Sahni and A. K. Mitra.

(21) *Notes on the anatomy of some New Zealand species of Dacrydium:* (Annals of Botany, Vol. XLI, pp. 75-85, text-figs. 1-4, 1927).

This paper records the result of a research begun by one of the authors at Cambridge in 1918 and continued at Lucknow as a joint investigation. The New Zealand flora,

like that of other islands in the pacific, is well known to be rich in endemic species; five such plants are here described. There is a small group of species, *Dacrydium Bidwillii*, *D. biforme* and *D. Kirkii*, which have generally been regarded as forming a transition to the genus *Podocarpus*, chiefly owing to their completely inverted ovules and to the fact that the epimatium extends as far as the micropyle. Of these the female flowers of *D. Bidwillii* have been studied in some detail, and reasons have been advanced to show that this plant is really a species of *Podocarpus* wrongly referred to the genus *Dacrydium*. As in *Podocarpus* the epimatium is partly fused to the integument, there is a pair of descending ovular strands, and at least the micropylar part of the epimatium is fleshy being, in fact, swollen into a large and attractive aril. It is, therefore, proposed to call this plant *Podocarpus Bidwillii* (Hook. f.) and to place it in a new section of the genus, § *Bidwillii*.

The other species investigated were *D. Colensoi* and *D. laxifolium*, in each of which several new features have been noticed.

The interrelations of the genera *Dacrydium*, *Podocarpus* and *Acmopyle* are discussed.

(1) **S. K. Mukerji** was on study leave from August, 1925, till November, 1928, and submitted a thesis on the *Autecology of Mercurialis perennis L.* with special reference to soil factors, for the degree of Doctor of Science in the University of London.

(2) **Biological Relations of Mercurialis perennis L.*: (Proc. Linnean Society of London, 3rd November, 1927).

In this paper the author shewed *inter alia* the significance of the *calcicolous habit*. As a result of his analysis

* Work carried out during study leave in England.

of soil samples from over 300 localities in wild stations in Britain he was able to demonstrate with abundant data that although *M. perennis* grows in preference on calcareous soils, yet *it is not a Calcicole.* The plant grows in such situations not because it requires $CaCO_3$ as such but because of the favourable physical properties imparted to the soil by the presence of $CaCO_3$.

With the help of lantern slides the results of certain physiological experiments were described, which tended to establish the fact that the hydrogenion-concentration of soils exercises a profound influence on the growth of the plant, possibly through its effect on the absorption of ions of various organic and inorganic substances required for the healthy growth of the plant. The main results of this paper have since been incorporated in a monograph on the Autecology of *M. perennis* which was submitted for the degree of D.Sc. in the University of London.

(3) *The Forests of Kashmir:* (Journal of Scientific Transactions. British Association for the Advancement of Science, Leeds, 6th September, 1927).

This paper embodies the results of extensive ecological study of the Forest Communities of Kashmir up to an elevation of 14,000 feet. It deals with the geological, climatic, physiographic, edaphic, and biotic factors of the region.

Type of Forests :—

Winter-Deciduous Forests: Populus, Aesculus, Acer, Fraxinus, Ulmus, and Betula.

Coniferous Forests: Pinus excelsa, Cedrus Deodara, Cupressus torulosa, Taxus baccata, Picea morinda, Abies Pindrow, and A. Webbiana.

Undergrowth of forests and their ground flora. Succession of Forest Communities. Striking absence of the 'Oak-belt'

in the Kashmir Himalayas. Limestone rocks in relation to occurrence of special types of Forest Communities. Natural Regeneration of some valuable timber trees. Brushwood of Parrotia Jacquemontiana in relation to regeneration of Deodar and blue-pine. Effect of grasses on seedling regeneration and afforestation. Exploitation of Forests in Kashmir. Preservation of Forests—'The Rakhs.' Some useful Forest produce of Kashmir.

Vast field for developing scientific farming of important indigenous medicinal and economic plants including edible mushrooms and morchellas.

Suitable field for extensive cultivation of species of Populus for manufacture of wood-pulp.

(4) *Ramblings of a Naturalist in Kashmir and Switzerland:* (Proc. Centenary Celebrations of the University of London, University College, 28th June, 1927).

In this paper the author attempted to institute a comparison between the flora of Alpine Switzerland and that of Kashmir. He drew attention to the similarity of vegetation in the higher reaches of the Alps and those of the Kashmir Himalayas. It was pointed out that quite a large number of species were common to the two countries. Observations with regard to the ecological characters of some of the species growing in Alpine situations in these countries were also made.

(5) **Habitat Forms of M. perennis:* (Proc. Centenary Celebrations of the London University, University College, June, 1927).

Breeding experiments under varying climatic and edaphic conditions were carried out in order to find out whether

* Work carried out during study leave in England.

the so-called varieties of *M. perennis* were true varieties or merely habitat-forms. As a result of these experiments, it was established that the plant has three varieties and six habitat-forms ; and that some of the forms previously included under the category of varieties can no longer be regarded as such. They are merely habitat-forms, for they do not retain their varietal characters.

(6) **A new variety of M. perennis in the British Flora:* (Journal of Botany, London, February, 1927).

A new variety of *M. perennis* was discovered in the British Flora. It was named *M. perennis var. Salisburyana, Mukerji* in honour of Dr. E. J. Salisbury, Reader in Plant Ecology in the University of London. This plant was exhibited at the anniversary meeting of the Linnean Society of London in October, 1927, and was accepted as new to science by experts of the British Museum and Kew Herbarium.

(7) **Geographical Distribution of the genus Mercurialis:* (Proc. Linnean Society of London, October, 1926).

As a result of the close study of all the available species included in the genus *Mercurialis* which are preserved in some of the renowned Museums and Herbaria of Europe including those of Kew, British Museum, Botanical Institutes of Vienna and Berlin, the author has been able to work out in some detail the distribution of the eight species of *Mercurialis* in different parts of the world. Facts have been advanced to show that the discontinuity of the genus is more apparent than real. A map of the world showing the distribution of all the eight recognized species was exhibited at this meeting.

(8) *The Vegetation of Kashmir, a contribution to the Ecology of the Kashmir Himalayas.* (Illustrated with lan-

*Work carried out during study leave in England.

tern-slides): (Proc. Linnean Society of London, May, 1926).

(*a*) This paper is the outcome of an ecological investigation of the plant communities of the Kashmir Himalayas, the work having extended over a number of years from 1918-24.

It is divided into three parts :—

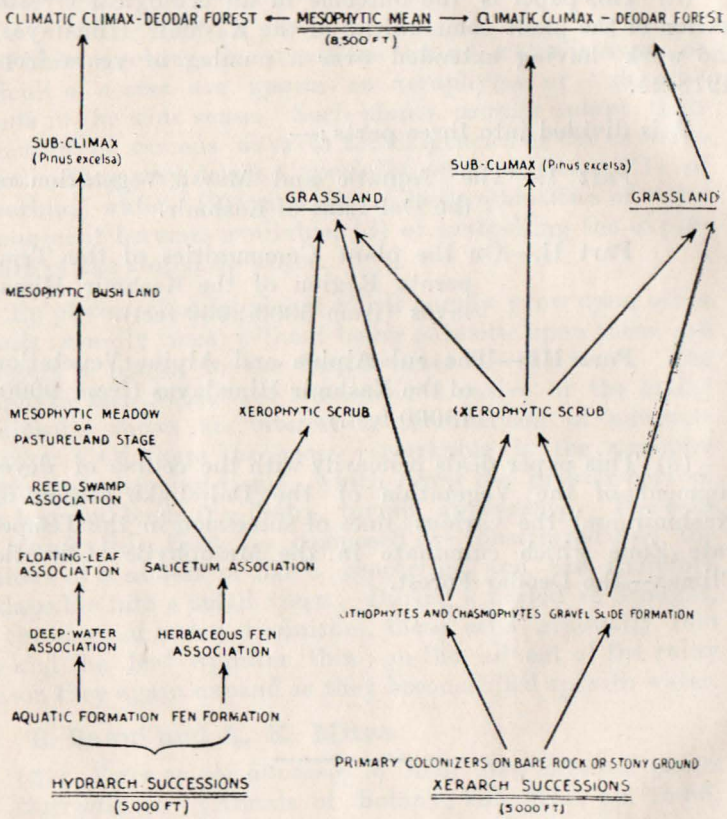
Part I.—The Aquatic and Marsh Vegetation of the Dal Lake of Kashmir.

Part II.—On the plant Communities of the Temperate Region of the Kashmir Himalayas (from 5000-9000 feet).

Part III.—The sub-Alpine and Alpine Vegetation of the Kashmir Himalayas (from 9000-18000 feet.)

(*b*) This paper deals primarily with the course of development of the Vegetation of the Dal Lake region of Kashmir and the various lines of succession in the Temperate Zone which culminate in the Mesophytic Climatic Climax—the Deodar Forest.

(*c*) The normal course of development, according to the writer, is as shown below :—



(9) *The Vegetation of the Dal Lake Region of Kashmir :* (Proc. British Ecological Society, Manchester, January, 1926).

This paper was read at the British Ecological Society Meeting held in Manchester in January, 1926. It deals with the geological, physiographic, climatic, and biotic factors of the region and their effect on the growth and development of the plant associations occurring in that region. Besides, a detailed study of the principal plant communities has been made, and it has been shewn that the flora of the Dal Lake varies in many essential respects from that of numerous other lakes of India. A study has also been made of the economic products of the Dal Lake and the great utility of the "*Floating-gardens*" as well as of the "*Dembland areas.*"

A warning has been sounded that the famous Dal Lake is gradually silting up owing to a number of causes, chief of which are: (*a*) the planting of willows and the centripetal encroachment of marsh vegetation, (*b*) Inward extension of *floating-gardens* and *dembland*, (*c*) the deposition of large quantities of silt by the Arrah river.

(10) *Plant Succession of the Satpura Range* (*near Pachmarhi*). (Proc. Indian Botanical Society, Lucknow, 1923. Journal of the Indian Botanical Society, Vol. III, p. 262).

This is a preliminary investigation of the principal plant associations extending from the open flat country near Piparia to the top of the Pachmarhi plateaux. It deals with the succession of plant communities occurring in this part of the Central Provinces and culminating in the climatic climax—the Teak Forest. Edaphic formations occurring on the sand-stone and trap-rocks have also been studied.

Attention has been called firstly to the great possibility of supplying large quantities of 'match wood' to be used in the manufactures of match-boxes in India if organized plantation of 'salai' (*Boswellia serrata*) and some other suitable plants were to be undertaken, and secondly to the great

annual wastage of huge quantities of material suitable for wood pulp which can be obtained from bamboos.

(11) *Ecological Studies of the Vegetation of the Vindhayas:* (Proc. Indian Botanical Society, Lucknow, 1923. Journal of the Indian Botanical Society, Vol. III, p. 262).

Apart from dealing with the principal plant associations occurring on the Vindhayas in the vicinity of Jubbulpur, this paper sets forth the results of a new line of departure in botanical investigation in India, *viz.*, the application of *Raunkiær's statistical methods* to the study of the typical Monsoon Forests occurring in the tropical zones.

The author has reached the conclusion that Raunkiær's statistical methods may perhaps be successfully applied to the study of European or American plant communities, but so far as our Indian vegetation is concerned, it gives no tangible results. In fact serious difficulties are met with in the proper determination of the "degree of frequencies" of species composing a mixed formation. Hence the "biological spectrum" obtained by this method does not give us a correct idea of the nature of the vegetation, nor is it possible to establish a true "Isobiochore" (comparable to Isothermal lines) *i. e.*, a line which will connect places having the same type of vegetation.

Lastly it is suggested that Raunkiær's methods may be so modified, in the light of the present work, as to suit our Indian conditions. It could then be used with advantage, for it will introduce mathematical conceptions in the domain of ecological investigations.

S. K. Mukerji and T. C. N. Singh.

(12) *On the adaptation of some perennial plants of the Lucknow Flora to the marked periodicity of the climate:* (Proc. Indian Botanical Society, Lucknow, 1923. Journal of the Indian Botanical Society, Vol. III, p. 262).

A study has been made of five representative plants of the dry season with a view to find out the special features of adaptation by which they are able to tide over the marked seasonal variations prevailing at Lucknow. This study involved a close examination of the methods of perennation and vegetative propagation, changes in the external as well as internal characters of the ærial shoots, storage and utilization of reserve matter, and lastly the types of root systems, their 'working depths' and maximal penetration.

H. P. Chowdhury.

A contribution to our knowledge of the anatomy of Equisetum debile Roxb.: (Proc. Indian Botanical Society, Lucknow, 1923).

As very little is known regarding the anatomy of several species of *Equisetum* found in India, the writer undertook several years ago the investigation of the anatomy of *Equisetum debile Roxb.*, one of the commonest Indian species. Attention was mainly confined to the structure of the vegetative parts especially to the changes of the vascular bundles in the nodal regions and their transition from the embryonic stem to the root. The study threw a great deal of light on hitherto much contested constituents of leaf-traces (vascular bundles running through the leaves). It was found that though they consist of spiral, annular, and reticulate tracheids when they arise from the nodal ring of bundles, the reticulate tracheids lose their identity very soon so that the leaf-traces ultimately consist of spiral and annular tracheids. The examination, therefore, further confirmed Lady Browne's observations on some of the other species of *Equisetum* studied by her. Gwynne-Vaughan's statement that the leaf-traces consist only of spiral and annular tracheids at the point of origin does not hold good in all cases.

The stem structure revealed distinctly the centrifugal development of metaxylem. The lateral strands are not continued over or through the nodal ring as has been found in *Equisetum giganteum* by Lady Browne.

The sporeling anatomy did not differ much from that of *Equisetum arvense* as worked out by Barratt.

Another interesting feature observed during the cultures of spores of *Equisetum* was the fact that the spores are capable of germinating and producing prothalli which can lead an aquatic mode of life when submerged under water.

S. K. Pande.

(1) *Notes on the morphology and biology of Ricca sanquinea (Kash.):* [Journal of the Indian Botanical Society 4: pp. 117-128 (with 5 plates), 1924].

The present research was undertaken with a view to study the effects of external factors such as light and moisture on the form and colour of *Riccia sanguinea*, a common liverwort in Northern India, which is very variable in these respects. An investigation of this form was considered desirable also because none of the Indian species of *Riccia* have so far been studied in detail, and the genus is important as one of the types to be studied by the B. Sc. students in most of the Indian Universities.

Riccia sanguinea is one of those species of the genus which Professor Goebel calls "ephemeral." There are separate male and female plants. The latter are usually larger (up to 3. 5 cm.) in diameter than the former which are commonly red in colour.

Plants grown in different coloured lights produced green new parts alone. Some sporelings growing under blue glass produced green new thalli from the margins of the original thallus, and this process of budding was sometimes repeated.

In plants kept under dripping water the newly formed lobes of the thallus were thinner and narrower than is usually the case.

Apart from points of specific detail the mature structure of the thallus as well as the structure and development of the sex organs is similar to that of other investigated species.

(2) *Notes on Fossombronia himalayensis* (*Kash.*) (Proc. Thirteenth Indian Science Congress, pp. 24-25, Bombay, 1926).

Fossombronia includes about 60 species of world-wide distribution. The genus occupies an intermediate position between the purely thallose forms on the one hand and the foliose forms on the other.

Fossombronia himalayensis is one of the few Indian species of the genus. It is common at Mussoorie and Simla. Although the life history of the genus is fairly well known from the investigations of some foreign species, no Indian species has so far been investigated.

The foot of the sporophyte is especially well developed. The main point of interest is the structure of the capsule wall which, so far as the author knows, has been described as two layered in the whole genus, with thickenings usually in the inner layer. Humphrey, however, describes thickenings in the outer wall of *F. longiseta*. In the present species the wall is generally two layered as described by Kashyap; but sometimes it is three-layered with thickenings in the inner two layers.

In *Treubia insignis*, the largest of the dorsi-ventral Acrogynae, the wall of the sporogonium is three or four-layered, with thickenings on the inner layers.

The sporophyte of *F. himalayensis* (Kash.) thus occupies an intermediate position between *T. insignis* on the one hand and the other species of *Fossombronia* on the other.

Presumably *Fossombronia* might have been derived from forms like *Treubia insignis* by a process of reduction; this view appears to be borne out by the structure of the capsule wall.

(3) *On the morphology of Riccia robusta (Kash.)*: (Proc. Indian Science Congress, Lahore, pp. 214-15, 1927).

The observations recorded in this paper are based on specimens of this species from Lucknow and several other places in the United Provinces where it is common in winter. The species has so far been recorded only from Lahore and Banda.

The facts now added extend the diagnosis of the species and portray some interesting new features.

There is nothing very special in the vegetative characters except for the presence of ventral scales which have been stated by Professor Kashyap to be absent. They are hyaline and fall off soon after they have been formed. Some doubt was also expressed on the presence of the male reproductive organs but my specimens clearly show them in most of the stages of development. Their structure and development is of the usual type.

A rather peculiar feature of *R. robusta* is the occasional presence of two archegonia in one chamber.

(4) *On the morphology and development of the sporophyte of Notothylas indica (Kash.)*: (Proc. Indian Science Congress, Lahore, p. 215, 1927).

Although much work has been done on the Anthocerotales in other countries, the Indian species have received very little attention.

Kashyap and Datta studied two Indian species of *Notothylas* but their observations were confined to the description of the mature sporophyte and the structure of the thallus

The author has, therefore, tried to follow in detail the life history of *Notothylas indica*, a liverwort which grows abundantly at Lucknow and several other places in the United Provinces in shady habitats during the rainy season.

The male and female sex organs do not occur on separate plants, as has been described before by Kashyap and Dutta, but are found on the same plant, and the former appear earlier.

The structure of the archegonium is of the type described for other species.

The development of the sporophyte of *Notothylas* has been a subject of repeated investigations. The most puzzling question has been the columella and the origin of the characteristic archesporium at its top. Leitgeb reports that a columella is present in some capsules of a certain species while it is absent in other capsules of the same species. A detailed study of the embryology of *Notothylas indica* was therefore carried out as it might elucidate some of these points.

Most of the stages in the development of the sporophyte are quite distinct. After the establishment of the three tiers, periclinal walls arise in the cells of the uppermost tier, separating the amphithecium from the endothecium. The lower two tiers produce the foot, while the rest of the sporophyte develops from the uppermost tier alone. The columella is derived from the endothecium and the inner layers of the amphithecium produce the archesporium.

As reported before (Kashyap and Datta) a characteristic feature of *Notothylas indica* is a longitudinal row of brown cells on each side of the incipient valve, so that in an intact capsule there are two longitudinal brown lines running from the apex of the capsule down to a little more than

half its length. In a number of cases a third such line was also seen, suggesting that there are three valves. Occasionally four such lines may be found at the apex, two of which fuse after a short distance. The last fact suggests the existence of four valves.

(5) *The structure and development of sex organs in Notothylas indica:* (Proc. Botany Section, Indian Science Congress, Calcutta, 1928).

Our present knowledge of *Notothylas indica* is confined to the structure of the thallus and mature sporophyte (Kashyap and Dutta. Proc. Lahore Phil. Soc. IV) and to the embryology (Pande, Proc. Indian Science Congress, Lahore, 1927).

The author now describes the structure and development of the sex organs.

The ripe antheridia are orange red in colour and arise endogenously as in other Anthocerotales. Generally 3 or 4 of these are found in a chamber; but as many as 6 may occasionally be met with.

The structure and development of the archegonium so far worked out agrees with the account given for the other species of *Notothylas* except that the number of neck-canal cells in the mature archegonium of *N. indica* is 6.

S. K. Pande and S. R. Kashyap.

(6) *A contribution to the life-history of Aneura indica St.:* (Journal of the Indian Botanical Society 3: 79-89, pls. 1-7, December, 1922).

Aneura indica is one of the few Indian species of *Aneura.* It is very variable in the shape and structure of the thallus, especially in the form of the upper epidermal cells. The male and female sex organs are borne on separate plants. The development of the sex-organs agrees with the account

of the other species as described by Campbell (Mosses and Ferns 1918) and Clapp (Life-history of *A. pinguis*. Bot. Gaz. 14: No. 3, 1912). The sporophyte remains enclosed by the calyptra till a late stage. The elaterophore is very highly developed, extending to about the middle of the capsule and the elaters are attached in a spreading manner. The wall of the capsule is two layered and the cells of both the layers possess broad, brown, annular bands. The gametophyte has 6 chromosomes and the sporophyte 12.

T. C. N. Singh.

(1) *A note on the fasciation of flowers in Quisqualis indica:* (Journal of the Indian Botanical Society, Vol. V, p. 16, figs. 1, 2, 1926).

Records the occurrence in *Quisqualis indica* of unusually large flowers with the floral formulas K-9, C-9, A-18 and K-10, C-10, A-20. The ovary in each case was bilocular instead of unilocular. So far as the author is aware, fasciation of flowers has not previously been recorded in the Combretaceae.

(2) *A study of the Mussoorie ferns:* (Proc., Botany Section, Indian Science Congress, Calcutta, 1928).

An investigation of the fern flora of Mussoorie from the taxonomic, biological, and anatomical point of view. Nine genera and 18 species were studied.

(3) *A note on the presence of a sporangium on the indusium of Cheilanthes:* (Proc., Botany Section, Indian Science Congress, Calcutta, 1928).

The author records the occurrence of an apparently normal sporangium on the margin of the indusium of a species of *Cheilanthes* from Mussoorie.

(4) *A note on vegetative reproduction in two mosses from Mussoorie:* (Proc., Botany Section, Indian Science Congress, Calcutta, 1928).

The two mosses studied are: (1) *Bryum hemisphaericarpum* C. Mull., in which case a large number of short club-shaped gemmae are produced in an acropetal succession on a cushion of tissue situated in the axils of leaves. Most of the leaves on the plant bear gemmiferous cushions of the types described above such that when examined superficially, the plant looks like a mature strobilus of *Selaginella.* The gemmae have hook-like outgrowth at their apices; (2) *Philonotis Turneriana.* Mitt. In this case, small leafy bulbils are produced in the axils of leaves at the stem apices.

N. Singh and B. N. Sinha.

(5) *A note on the teratology of certain angiosperms:* (Proc., Botany Section, Indian Science Congress, Calcutta, 1928).

The authors record abnormalities in the following five types: (1) *Datura Metel L.* : In this case, the flowers sometimes show, besides the normal five stamens, an extra sixth stamen which is exactly like a normal one, both in its internal and external morphology. (2) *Cosmos sp.* : Fasciation of capitulum. (3) *Phlox sp.* : Nearly half a dozen abnormal flowers have been examined. They show variation in floral parts, specially in the calyx (K3-6), corolla (C5-6) and androecium (A5-6). (4) *Trichosanthes dioica :* Fasciation of fruits (a homologue of two) is described. It is interesting to note that each of them is tricarpellary. (5) *Helianthus annuus L. :* An abnormal capitulum shows seven leaf-like structures looking like involucral bracts (in the centre), each borne in the axil of a chaffy bract. It is concluded that they are homologous to the habitually (nearly) abortive sepals which have become leafy and the corresponding flowers bearing them have aborted.

B. N. Sinha.

The origin and evolution of the Archegonium : (Woodhouse Memorial Prize Essay for the year 1927). (Journal of the Indian Botanical Society, Vol. VIII).

Research work in progress :

B. Sahni is continuing his work on Indian fossil plants and hopes shortly to send to the press two monographs, one on Indian Petrified Conifers and the other on Indian Petrified Palms. Several smaller pieces of research are also in hand.

S. K. Mukerji is preparing his paper entitled : *The Forests of Kashmir and their useful products* for publication in the 'Empire Forestry Journal.' He has undertaken a new line of investigation with regard to finding means for combating malaria by tackling the question of effecting chemical changes in the breeding grounds of mosquitoes. It has been suggested in certain quarters that the irrigation water from canals is making the arable land more and more alkaline and hence unsuitable for cultivation. Dr. Mukerji proposes to investigate this question as soon as the necessary apparatus arrives from England. He is further continuing his work in connection with the ecology of the vegetation of Kashmir as well as that of Lucknow. The problem of the 'Usar land' is also receiving attention.

H. P. Chowdhury is continuing work on various aspects of the respiration of fruits with a view to elucidate the problem of their physiological decay. He also intends, as soon as the necessary apparatus arrives, to investigate the possibility of preserving the important local fruits in cold storage. The collection of data with regard to the total yield and the amount of wastage of some of the well-known fruits of Lucknow has been taken in hand.

S. K. Pande is continuing his studies of Indian liverworts.

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