where R = Radius of the earth.

Δ = Epicentral distance in degrees of arc.

ρ = Density of the earth's crust.

α = Amplitude of the earth's horizontal motion.

T = Period of the long wave.

and V = Velocity of propagation of long waves.

Now taking

$$R = 6\cdot 4 \times 10^8 \text{ cms.};\ \rho = 3\cdot 0 \text{ gm./cm.}^3$$

and $V = 3\cdot 0 \times 10^5$ cm./sec.

we have

$$E = 4\cdot 3 \times 10^{17} \sin\Delta \times \int \frac{\alpha^2 H}{T^2} dt.$$

The average value of T at Colaba for the Baluchistan earthquake is about 12 s. and taking the average velocity of long waves as 3 km./sec. we find that $H = 4 \times 10^6$ cms. Also from the seismograms the value of $\int \frac{\alpha^2 dt}{T^2}$ is 0·02 cm.²/sec. The energy of the Baluchistan earthquake thus works out to be about 7×10^{21} ergs. The Colaba records of the North Bihar earthquake of January 15, 1934, were not satisfactory but a rough estimate for that shock gives the value of $\int \frac{\alpha^2 dt}{T^2}$ near about 0·2 cm²./sec., leading to the approximate value of 7×10^{22} ergs for its energy. Bihar earthquake was therefore about 10 times more energetic than the Baluchistan earthquake. This conclusion is also supported by the fact that the maximum amplitude of earth's motion at Colaba was greater than 1300 μ in the case of the Bihar earthquake while it is only about 400 μ for the Baluchistan shock. But the most unfortunate thing about the Baluchistan earthquake has been its occurrence during the early hours of the morning with consequent heavy death-roll.

The Progress of Work in India on the Embryology of Angiosperms.

By Dr. P. Maheshwari, D.Sc.,
Agra College, Agra.

INVESTIGATIONS on this subject started in this country only about fifteen years ago, but the number of annual contributions since then has been steadily increasing. The purpose of this article is to give a brief review of this work and to consider, if possible, some of the lines of research that may be most profitably undertaken in future by students of embryology in this country. Some judgment has been exercised in the selection of papers and a few investigations dealing with purely cytological studies have been left out, but otherwise the review is complete, and as far as the writer is aware, no important papers have been omitted.

The first observations of this kind were published from Allahabad by Kenoyer[1] (1919) who, while describing the dimorphic carpellate flowers in *Acalypha indica* L., noted the obturator, the beak-like tip of the nucellus and a few stages in the development of the embryo sac, which were, however, quite insufficient to permit definite conclusions.

Dastur[2] (1922) in an investigation of *Hydnora africana* Thumb., an interesting parasite, material of which had been collected from South Africa, writes that the ovules are orthotropous and have a single integument. The megaspore mother cell is hypodermal and directly gives rise to an 8-nucleate embryo sac of the Lilium-type. The most noteworthy fact is that the proembryo consists of a long chain of cells, of which the middle region gives rise to the embryo proper. These observations are of great interest, but it must be pointed out that the material was probably insufficient for a critical investigation and, as Schnarf[24] (1931) has pointed out, the statements need confirmation.

Tiwary[3] (1926), from Benares, made the *interesting discovery of polyembryony in Eugenia jambolana*, the extra embryos arising from the position of the egg apparatus or from the nucellus. It is also stated the original embryo sac sometimes becomes pressed out and obliterated, while some of the nucellar cells appear to be on their way to form embryo sacs. It may be mentioned here that recently Pijl[23] (1934) has published the results of a detailed study of polyembryony in several spp. of *Eugenia* and his observations differ in some respects from those of Tiwary.

Tiwary and Rao[4] (1934) have traced the development of the embryo sac in another member of the Myrtaceæ, ***Callistemon linearis***, which follows the normal course laid down for angiosperms.

From the same laboratory, Joshi[5] (1933) made a few observations on megaspore and embryo sac formation in *Argemone mexicana* L., and these were supplemented by Bose and Banerji.[4] The development is perfectly normal, but the antipodal cells attain a specially large size. Joshi's statement that endosperm formation may begin even before fertilisation needs more critical study.

Joshi and Raman Rao[7] (1934) made some very interesting observations on the embryology of *Tinospora cordifolia* Miers. The development of the embryo sac is quite normal, but there is no fertilisation and all the nuclei except the polars are said to degenerate. Endosperm formation continues, but no embryos could be seen even in mature seeds. These observations were immediately subjected to comments and criticisms (Sahni,[7] Tiwary[7]) and the presence of seeds with normal embryos has now been reported from Agra (Singh[7]), Bangalore (Seshagiriah[7]) and Ahmedabad (Ajrekar and Oza[7]). Cases of parthenocarpic fruits are on record and a condition as described by Joshi and Raman Rao is entirely possible, but as suggested by Singh it is more likely that in the present case the egg does not degenerate but develops parthenogenetically. Further observations on the embryogeny of this plant will be awaited with interest.

Joshi and Venkateswarlu[8] (1933) call attention to the peculiar behaviour of the synergids in *Ammania baccifera* L. The embryo sac develops in the usual way, but the synergids are persistent and begin to enlarge. Their nuclei divide amitotically, the lateral walls dissolve and the two cells fuse to form a "syn-synergid", which persists like a multi-nucleate collar round the suspensor of the growing embryo.

Naithani[9] (1933) from Allahabad, working on the life-history of *Digera arvensis* Forsk., found that the pollen grains are 3-nucleate at the time of shedding, and the megaspore mother cell gives rise to a row of 3 cells, of which the chalazal produces the embryo sac. A few months later Joshi and V. Rao[10] published a more detailed account of the same plant. The pollen grains are reported by them to be usually bi-nucleate and some variations have been recorded in megasporogenesis. It has been stated that 2, 3 or 4 megaspores may be formed and some other interpretations have also been offered, that are now shown to be incorrect by Puri and Singh.[11]

At Calcutta a large amount of work in this line is being done by Banerji and his students. Agharkar and Banerji[12] (1930) investigated the development of the embryo sac in *Carica papaya* and found that a normal linear tetrad is formed and as usual the chalazal megaspore gives rise to an octonucleate embryo sac with ephemeral antipodals. It must be pointed out that according to Heilborn* (1921, 1928) all the 4 megaspore nuclei (unseparated by walls) take part in the development and usually only one of them divides again, resulting in a 5-nucleate embryo sac. In view of the differences between these observations and those of previous authors like Kratzer* (1918) and Usteri* (1907), it seems profitable to reinvestigate the plant using material from as many different sources as possible. A feature which deserves further attention is the frequent formation of fruits even without male plants in the vicinity and the occasional presence of parthenocarpy.

Banerji's[13] work on the life-history of jute (*Corchorus olitorius* and *C. capsularis*) is a welcome addition to our knowledge of the *Tiliaceæ*. It is remarkable that even in an annual plant like this, growing in a tropical climate, the first division of the egg occurs 12–16 days after pollination. The same author has also studied the development of the female gametophyte of *Colocasia antiquorum* Schott.,[4] with a view to discover the causes of sterility in this plant. It was found that although degenerations start as early as the megaspore mother cell stage they are most common after the megaspores have been formed and sections of open flowers invariably show crumpled ovules without any embryo sacs.

Banerji and Bhaduri[14] (1933) have recorded the presence of false polyembryony in *Nicotiana plumbaginifolia* and also found some early stages of nucellar embryony in *Petunia* and *Withania*. Bhaduri[13] (1932) has given a detailed account of the life-history of *Solanum melongena* and another paper dealing with several other members of the family belonging to the genera *Solanum*, *Physalis*, *Withania*, *Datura*, *Cestrum*, *Nicotiana*, *Petunia*, *Salpiglossis* and *Brunfelsia*, is in the press. The same author has also observed an interesting peculiarity [first noticed by Miss Ferguson* (1927) in *Petunia*] in a tomato strain grown in the experimental grounds of the Calcutta University. It is stated that the fusion nucleus divides, before the opening of the flower, to form a small micropylar and a large chalazal chamber. After the discharge of the pollen tube, one of the male nuclei fuses with the egg and the other with the endosperm nucleus in the micropylar chamber. This results in the formation of two types of endosperm cells, some with the triploid number (derived from the micropylar cell) and others with the diploid number (derived from the unfertilised chalazal cell).

From the same laboratory, Roy[15] (on *Pachyrhizus*, *Cajanus*, *Dolichos*, *Pisum* and *Lathyrus*), Datta[10] (on *Cassia tora*) and Pal† (on *Tamarindus indica*) have made valuable additions to our knowledge of the Leguminosæ. The statement that in all the plants mentioned above (except *Lathyrus*), no parietal cell is cut off and the archesporial cell differentiates in the third layer of the nucellus, needs more critical observation. It seems more likely that it is actually hypodermal as in the other members of the family, but becomes clearly distinguishable only after having cut off a wall cell and attained an appreciable increase in size (see remarks by Singh and Shivapuri[11], p. 429). S. Datta[5] has made some interesting observations on the embryogeny of two spp. of *Nolana*.

At Bangalore, Dr. M. A. Sampathkumaran has given a great impetus to such work. Rao[14] (1932) in a preliminary note on *Balanophora indica* states that the development of the embryo sac in this plant resembles *B. globosa* described by Lotsy* (1899). It must be mentioned here that very recently Ekambaram and Panje[11] from Madras have published their observations on a sp. of *Balanophora* collected from the Coorg-Malabar forests. Unlike other spp. of this genus, investigated by Treub* (1898) and Ernst* (1914), this one seems to have a normal sexual cycle with an embryo sac arising from the micropylar megaspore of a tetrad and with strong evidence of fertilisation. The female gametophyte is U-shaped with 4 nuclei in each end, but those destined to form the antipodals and the lower polar nucleus fuse among themselves to form a large irregular nucleus. The endosperm arises from the upper polar nucleus and the fertilised egg divides longitudinally.

Seshagiriah (1932[14], 1934[7]) has made some very interesting observations on the life-history of *Zeuxine sulcata* Lindley, a marsh orchid. Degenerations are found to be of frequent occurrence in the anthers and the second reduction division is entirely suppressed, resulting in the formation of "dyads of microspores". The nucleus in these cells divides to form the tube and generative nuclei, but the pollen grains soon degenerate. In some pollinia the heterotypic division was found to show certain abnormalities in the presence of several spindles which result in the formation of supernumerary nuclei, but none of these is functional. The megaspore mother cell undergoes the usual reduction divisions and forms a linear tetrad of megaspores. A peculiar feature is that all four cells of the tetrad directly function to form an embryo and additional embryos arise from divisions of some nucellar cells. In a friendly letter to the writer, the author states that an actual reduction of chromosomes is accomplished during the formation of megaspores and both nucellar and megasporic embryos persist in mature seeds.

From the same laboratory Narasimha Murthy[17] (1933), working on *Limnophyton obtusifolium* Miq., finds 3-nucleate pollen grains with two male cells, an 8-nucleate embryo sac developing according to the "Scilla-type" and a delayed triple fusion. The same author has also studied the life-history of *Ottelia alismoides*,[7] which is similar to other members of the Hydrocharitaceæ, except in having 2-nucleate pollen grains and a hypodermal archesporial cell which is said to function directly as the megaspore mother cell. Another feature of interest is that sometimes the microspores form linear tetrads in addition to the usual isobilateral type.

Rangasamy[10] (1934) has worked out the life-history of *Vallisneria spiralis*, but this investigation seems to have been carried out in ignorance of the previous studies of Burr* (1903) and Wylie* (1923) on this species.

Laksminarasimha Murthy[7] (1934) has studied the life-history of four members of the Commelinaceæ: *Cyanotis cristata*, *Cyanotis axillaris*, *Aneilema spiratum* and *Zebrina pendula*. The presence of needle-like crystals and mitotic divisions in the tapetal periplasmodium is of interest. After fertilisation, the narrow antipodal end of the embryo sac pierces deep down into the nucellus like a haustorium. The young embryo is merely a spherical mass of cells corresponding to the "Pistia-type" among monocotyledons.

Srinath[7] (1934) reports the usual type of embryo sac in *Herpestris monniera*, characterised by an absence of wall cells and the formation of an integumentary tapetum, as is general among the Sympetalæ. The first division of the primary endosperm nucleus is followed by a transverse wall, separating the embryo sac into two chambers. The nucleus of the chalazal chamber divides only once and this part develops directly into a 2-nucleate chalazal haustorium. The micropylar chamber gives rise to all of the endosperm and a micropylar haustorium composed of four uni-nucleate lobes.

Kausik[7] (1935) has investigated the life-history of *Utricularia coerulea* L. The development is essentially similar to that described by Wylie and Yocom* (1923) in *U. vulgaris*. In both spp. the fertilised egg sends in a tubular prolongation, and the endosperm gives rise to both micropylar and chalazal haustoria, which take an active part in the absorption of food material.

The Rutaceæ is perhaps the first family in which polyembryony was discovered and Chakravarthy[7] (1935) has added *Murraya koenigi* to the list. The supernumerary embryos, which are derived from the adjoining nucellar cells, are usually distinguishable from the egg-embryo by the absence of a suspensor in the former. Most of them get arrested in their development and only 2 or 3 form cotyledons.

From Agra, a number of papers have been published by Maheshwari and his students. Johri[18] has investigated the life-history of *Limnophyton obtusifolium* and the chief difference between his results and those of Narasimha Murthy is that according to the former most of the embryo sacs are only 6-nucleate (the latter author found them to be 8-nucleate), as the two chalazal nuclei usually do not divide after the 4-nucleate stage. He has also reported a similar behaviour in *Sagittaria sagittifolia*,[11] *S. guayanensis*[11] and *S. latifolia*.[11] That the embryo sac of the Alismaceæ develops according to the Scilla-type and is as a rule only 6-nucleate, is also supported by the observations of Dahlgren (1928*, 1934[21]) on various other plants of the family. Johri[11] (1934) traced the development of the male and female gametophytes of *Cuscuta reflexa* Roxb. Peters'* (1908) statement on the absence of a middle layer in the anthers of *Cuscuta* is contradicted. The pollen grains were originally reported as 2-nucleate, but sections of older flowers recently cut for further study, reveal that the generative cell divides to form two male cells before the opening of the anther. The same author[11] has also studied the development of the gametophytes of *Berberis nepalensis* Spreng., and has called attention to the similarities between this family and the Ranunculaceæ. In another note, which is to be published shortly, he reports the presence of a 16-nucleate embryo sac in *Acalypha indica*, developing in essentially the same manner as was described by Miss Stephens* (1909) for the Peneaceæ, but several variations have been found with regard to the number of polar nuclei entering into the composition of the fusion nucleus.

Bhargava[13] (1932) published an account of the life-history of *Boerhaavia repanda*, which is essentially similar to *B. diffusa*, described earlier by Maheshwari.[16] The same author[11] has also studied the life-histories of *Mollugo nudicaulis* and *Trianthema monogyna*.† In both cases the development is normal, but in *Mollugo* the pollen grains were occasionally seen germinating *in situ*, and a third integument (hitherto unreported in the family) has been seen in the ovules of *Trianthema*. The same author has found that in *E. erecta*,[11] the tapetal cells form a periplasmodium and the pollen grains are 3-nucleate. The embryo sac develops normally, but there are sometimes only two antipodal cells, one of which is 2-nucleate. Later, the number of nuclei in the antipodal cells may increase, so that each is many-nucleate.

Puri[11] (1934) has reinvestigated the development of the embryo sac and embryo of *Moringa oleifera* and he finds that the previous observations of Rutgers,* recording the presence of a 5-nucleate embryo sac and free nuclear embryo in this plant, are unfounded. As a matter of fact, the embryo sac is of the usual 8-nucleate type and the first division of the egg is followed by wall formation as in other angiosperms. Occasionally the number of free nuclei in an embryo sac is more than eight, and some abnormal ovules with paired nucelli have also been seen. A feature of special interest is the presence of integumentary vascular bundles in the ovules.

Gupta[10] (1934) has described the development of the male and female gametophytes in *Potamogeton crispus*, and in another note, to be published shortly, he has reported some interesting variations in the life-history of *Wolffia arrhiza*.† Here the anther consists of only 2 loculi, parietal tissue is reduced to the endothecium and tapetum, and the pollen grains are 3-nucleate. The tapetal cells become amœboid and wander into the anther loculus, while the epidermis disappears completely at maturity. The development of the embryo sac is of the Scilla-type and the antipodals and synergids are very ephemeral. The nucellus is absorbed at an early stage, except for a cap of cells which persists at the top.

Singh and Shivapuri[11] (1935) have studied the development of the gametophytes of *Neptunia oleracea* and Capoor[19] has done the same for *Ulmus integrifolia*. The latter has shown beyond any doubt that the embryo sac in *Ulmus* is of the normal type, arising from the chalazal megaspore of the tetrad. This necessitates a reinvestigation of *U. americana*, which is the only plant in the order Urticales, that has been reported to have a Lilium-type of embryo sac (Shattuck,* 1905).

Maheshwari[16] (1929) gave an account of the life-history of *Boerhaavia diffusa*. The pollen grains were originally reported to be 2-nucleate, but recently some 3-nucleate ones have also been seen. The ovule has a beak-shaped nucellus provided with a single integument, and the pollen tube travels down to the base of the funiculus and then turns into the tip of the nucellus. The number of antipodal cells increases to 6 or 7 after fertilisation (more recently, Bhargava has seen that in *B. repanda* this can happen even before fertilisation). The endosperm is free nuclear and the embryo is provided with a short but massive suspensor.

Maheshwari and Singh[6] (1930) found that in *Asphodelus tenuifolius* the embryo sac arises in the normal way, but a third integument begins to develop at an early stage, almost entirely enclosing the ovule after fertilisation. In a later communication, the first author reports that the endosperm is not free nuclear, but of the Helobiales-type. In another paper, the same author has described stages in the life-history of *Ophiopogon wallichianus*,[11] Hook. f., a member of the family Hæmoderaceæ. The life-history follows the normal course, but a primary wall cell may or may not be cut off in the ovules.

Maheshwari tried to find out the cause of the abortiveness of such a large number of flowers in *Albizzia lebbek*[20] and *Mangifera indica*[7] and found that in both cases it was due to widespread degenerations occurring at almost all stages in the anthers and ovules. The study of the life-history of the latter confirms the observations of Juliano and Cuevas[22] (1932), but the pollen grains are 3-nucleate at the time of shedding. The fertilised egg remains undivided for a long time—till about a thousand free nuclei have been formed in the endosperm.

Maheshwari and Gupta[7] (1934) have studied the development of the female gametophyte of *Ludwigia parviflora* and *Jussieua repens*. In both cases a linear tetrad of four megaspores is produced, but usually the micropylar functions. Sometimes the chalazal may also enlarge and occasionally some tetrads resembling an inverted "T" were seen in *Ludwigia*. The mature embryo sac is only 4-nucleate with an egg apparatus and a single polar nucleus. Sterility of the ovules was common and in *Ludwigia* several cases were encountered, where both nucellus and embryo sac had degenerated leaving only the integuments.

In a short note Maheshwari[4] has reported that in *Hydrilla verticillata* the anther-tapetum becomes amœboid, the pollen grains are 3-nucleate, the embryo sac is of the normal type, the endosperm of the Helobiales-type, and the embryo more or less resembling that of *Alisma*. Occasionally two paired nucelli were seen, each with its own inner integument, but enclosed within a common outer integument.

Maheshwari and Singh[7] (1934) have investigated the life-history of *Commelina benghalensis*, a common annual weed with white cleistogamous flowers developing underground and blue aerial flowers enclosed in a spathe. Of the three aerial flowers usually occurring in a spathe, one is male and two are hermaphrodite; of the latter, only one opens while the other is cleistogamous like the underground flowers. A true periplasmodium is present in the anthers and the presence of crystals of calcium oxalate in this is noteworthy. The nucellus forms a beak-shaped outgrowth, which comes up to the level of the micropyle. An important point is the presence of a normal tetrad of four megaspores, although it was previously considered that the development is of the Scilla-type (Guignard,* 1882, on *C. stricta*).

At Ajmer, Mathur[7] has been working, at the writer's suggestion, on the life-history of *Convolvulus arvensis*. The cutting off of a primary wall cell in the nucellus is a fact of interest, as there are very few cases in the Sympetalæ where the hypodermal archesporial cell does not directly function as the megaspore mother cell.

At Nagpur, Richaria[4] (1934) has been working on the development of the stamens in several Asclepiads and it is reported that in spp. of *Hemidesmus*, *Cryptostegia* and *Cryptolepis* there are four sporangia in each stamen, while *Calotropis*, *Dæmia*, *Holostemma* and *Pergularia* have only two. In all cases except *Cryptostegia* and *Cryptolepis*, the microspores are arranged in the form of linear tetrads. In the last two genera, where the arrangement is tetrahedral, the pollinia are not well organised and form only a loose mass.

At Coimbatore, Dutt and Subba Rao[15] (1933) have investigated the development of the embryo sac and embryo of sugarcane. An abnormal case of an embryo sac with reversed polarity, pollen tubes with four male nuclei, and one case of polyembryony are recorded. In two cases it was seen that a few divisions had taken place in the egg, although the primary endosperm nucleus had not divided.

INVESTIGATIONS IN PROGRESS.

The above is a summary of what has been done, but several papers are in the press and many investigations are in progress.

At Benares, Tiwary is continuing his studies on the Myrtaceæ and has started additional work on the embryogeny of several Convolvulaceæ. Tiwary and Misra are studying the causes of sterility in *Hibiscus rosa-sinensis*, and Rao has almost completed his work on the embryo sacs of *Mœrua* and *Antigonon*. Joshi and Venkateswarlu have completed their work on *Ammania baccifera*, and the first author is continuing further work on several plants of the Lythraceæ, *Amaranthaceæ* and *Phytolaccaceæ*.

At Calcutta, Banerji has completed his investigations on the embryology of *Arachis hypogea* and *Typhonium trilobatum*, and Samal has done the same for *Crotalaria juncea*. Das is working on *Trichosanthes dioica*; E. A. R. Banerjee on *Capsicum annuum*; Hedayetullah on some members of the Capparidaceæ; Datta on the Nymphæaceæ; Roy on *Aloe vera* and some Leguminosæ; and Bhaduri on several plants of the Solanaceæ.

At Agra, Capoor is working on the embryology of *Carica papaya*, *Urginea indica* and some members of the Urticales; Puri on *Anona squamosa* and *Moringa*; Bhargava on the Loranthaceæ and Capparidaceæ; Johri on the Euphorbiaceæ and Butomaceæ; Gupta on the Lemnaceæ; Singh on the Onagraceæ and Amaranthaceæ; and Maheshwari on *Hydrilla* and *Tamarix*.

At Nagpur, Nirula and Gadkari are working on the embryology of some Asclepiads; and at Ajmer, Mathur has started some work on the life-history of *Vogelia indica*. In the South, Ekambaram and Panje are working on *Balanophora*, Raghavan on *Cleome*, Seshagiriah on the Orchidaceæ, Chakravarthy on the Rutaceæ, and Laksminarasimha Murthy on some of the Commelinaceæ.

FUTURE OUTLOOK.

So far, the floral characters of angiosperms have been regarded as the most reliable taxonomic guides. While this may be true, it is no longer possible to ignore other factors. It is now being increasingly realised that an approach to a natural system of classification can be gained only by a study of the plants in their entirety. It is dangerous for specialists to go on classifying and rearranging plants merely on the basis of one set of characters with which they are most familiar. The crying need of the day is a classification, which also takes into consideration, embryology, wood anatomy, and the vascular supply to the floral organs. In future, any attempt, which does not take these factors into account, will be looked upon with half-heartedness.

A study of the existing literature reveals that among the families found in India, there is a great dearth of information with regard to the Menispermaceæ, Dilleniaceæ, Bixaceæ, Flacourtiaceæ, Sapindaceæ, Dipterocarpaceæ, Combretaceæ, Rhizophoraceæ, Sonneratiaceæ, Alangiaceæ, Punicaceæ, Bombacaceæ, Simarubaceæ, Sapotaceæ, Salvadoraceæ, and others; while the Piperaceæ, Santalaceæ, Loranthaceæ, Balanophoraceæ, Fumariaceæ, Resedaceæ, Podostomaceæ, Malpighiaceæ, Thymelaeaceæ, Elatineæ, Plumbaginaceæ and Pandanaceæ have yielded such exceptional results in the past, that further investigations on these would be welcome. Among special genera, which deserve a fresh study, the following may be mentioned particularly: *Lemna*, *Costus*, *Pandanus*, *Najas*, *Cypripedium*, *Typha*, *Casuarina*, *Salix*, *Opuntia*, *Codiæum*, *Euphorbia*, *Garcinia* and *Zizyphus*.

There also remain a number of our fruit trees and crop plants, which must be investigated both morphologically and cytologically before the principles of scientific plant breeding can be applied to them with confidence. It is true that most of these plants will not yield results of such academic importance as those suggested above, but they might lead on to discoveries from which the country may reap a benefit running into large sums of money.

Some real difficulties have for a long time formed a bar to rapid progress in this work. One of these is the difficulty of obtaining properly fixed material. At present a person who wants to do such work, has to limit himself to such plants which grow in his neighbourhood, although actually he is often interested in investigating as many representatives as possible of a special family or order, with which he has gained most familiarity. A second and more serious difficulty is the paucity of literature in this country. Much time is spent in searching for the necessary references and some authors actually engage themselves in such work without knowing what has already been done on the particular family or genus in which they are interested. Those, who know the literature and maintain some sort of a card index to keep in touch with current papers, find it difficult to procure the original references for study. The only way to avoid this difficulty is to encourage the exchange of reprints and journals among responsible workers. It is a pity that those persons, who are themselves favourably placed with regard to this matter, are often very conservative in lending literature and do not realise the difficulties of others, who have to fall back to a great extent on their private resources for purchasing reprints and journals.

In spite of these difficulties a good beginning has been made. Fortunately there are several enthusiastic workers in the country, several problems awaiting investigation are lying at our very doors, and in some cases even funds are available. Given the necessary facilities and encouragement, and a true recognition of their labours, the future is bound to be bright. Individually these investigations may seem trivial, but they all swell the fountain of knowledge and it is this accumulated information, which will help future workers to solve questions on which we can at present only indulge in guess-work.

In the end, I wish to express my sincere thanks to all those who co-operated with me in supplying the necessary information, and particularly to my pupil, Mr. H. R. Bhargava, who helped me in the preparation of the bibliography.

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† In the press.

Chronica Botanica.

We have pleasure to announce the publication of the first Volume of *Chronica Botanica*, a new international year-book, devoted to all branches of Plant Science, edited by Dr. Fr. Verdroon in collaboration with an Advisory Board and numerous Assistant and corresponding Editors. Plant Science has a new annual such as never before existed in any branch of Science. Prof. E. D. Merrill, Director, New York Botanical Garden, writes, "The *Chronica Botanica* as conceived covers a new field not hitherto pre-empted, conflicts with no established periodical, supplements those already in existence and should, by its very nature, encourage the spirit of international co-operation, a spirit characteristic of this, our science of which we as botanists representing all nations, are individually and collectively proud." This new publication will help all research workers interested in botany to keep in touch with the activities of the numerous *Institutions*, devoted to pure and applied botany. We have no doubt that the publication, so comprehensive and so useful, will be welcomed by everyone interested in Plant Science.