PLANTS OF KUWAIT, NORTH EAST ARABIA.

BY

MRS. V. DICKSON.

The following is a list of wild flowers of Kuwait State, (N.E. Arabia Dist. IV) including the islands of Failaka (pr. loc. Failicha) and Masjan, together with a few notes on the edible and medicinally used plants and shrubs.

I have collected specimens over a period of nine years, since 1929, and all these have been identified by the late Mr. Horwood, and determinations sent to me by Sir Arthur Hill of the Royal Botanic Gardens, Kew, London.

This list will be found much more complete than the one in *Records of the Botanical Survey of India*, vol. vi, no. 6; by Humphrey G. Carter, M.B., Ch.B. with notes by Sir Percy Cox, K.C.S.I., K.C.I.E. and Lt.-Col. S. G. Knox, C.I.E., which is as far as I know the only publication (excluding Blatter?) on flowers of Kuwait. Some plants mentioned by Carter such as Oleander do not grow wild in Kuwait, and were possibly found growing in gardens.

There is still one plant which has not yet been identified for me by Kew : a Cruciferae which appears to be a new species, and is probably referred to in the above publication as *Erucaria* Boiss.

My husband, Lt.-Col. H. R. P. Dickson, C.I.E., has been Political Agent in Kuwait from 1929-1936, and is now in the Kuwait Oil Company, so I have had great opportunities to collect flowers, as we have had a permanent camp each spring out with the Badawin in the desert some 50 to 100 miles in the interior. We were both of us also fortunate to visit His Majesty King Bin Saud last November in his capital Riyadh. The names of the flowers collected on this trip will be found at the end of this list.

The plants listed below were collected by me between the years 1933-1938.

PAPAVERACEÆ.

Hypecoum pendulum L.
Papaver Rhoeas L.
,, *Rhoeas* L. var. *subintegrum* Willk.
,, *somniferum* L.
,, *somniferum* L. var. *leplocanlolum* Fedde.
Roemaria hybrida DC.

CRUCIFERÆ.

Brassica Tournefortii Gouan.
Carrichtera annua Asch.
Diplotaxis Harra (Forsk.) Boiss.
,, *acris* (Boiss.)
Eruca sativa Lam. var. *eriocarpa*.

Erucaria aleppica Gaertn.
Farsetia aegyptia Turra
Fibigia longisiliqua Dcne.
Lepidium sativum L.
,, *ruderale* L.
,, *Aucheri* Boiss.
Leptaleum filiforme DC.
Malcolmia africana (L.) R. Br.
,, *assyriaca* Hausskn. et Bornm.
,, *pulchella* Boiss. var. *pygmaea* R. Br.
,, *torulosa* (Desf.) Boiss. var. *leiscarpa* Boiss.
Matthiola bicornis DC.
,, *troida* DC.
Notoceras bicorna Cav.
Savignya oblonga Boiss.
,, *parviflora* (Del.) DC.
Schimpera arabica Boiss.
,, *persica* Boiss.
Sinapis (*Brassica*) *arvensis* L.
Sisymbrium cf. *erucastroides* Stapf.
Torularia torulosa (Desf.). O. E. Schultz.

Resedaceæ.

Ochradenus baccatus Del.
Oligomeris subulata (Del.) Boiss.
Reseda arabica Boiss.
,, *decursiva* Forsk.
,, *muricata* Presl.

Cistaceæ.

Helianthemum ellipticum Pers.
,, *kahiricum* Del.
,, *ledifolium* Mill.
,, *Lippii* (L.) Pers.
,, *salicifolium* Mill.

Frankeniaceæ.

Frankenia pulverulenta L.

Caryophyllaceæ.

Ankyropetalum gypsophiloides Fenzl.
Gypsophila porrigens Boiss.
Loeflingia hispanica L.
Paronychia argentea L.
Polycarpaea repens (Forsk.) Asch. et Schwein.
Polycarpon tetraphyllum L.
Robbairea prostrata (Del.) Boiss.
Saponaria Vaccaria L.
Silene conoidea L.
,, *conica* L.
,, *leyseroides* Boiss. (calyx reticulate).
,, *villosa* Forsk.

Tamaricaceæ.

Tamarix articulata Vahl
,, *macrocarpa* Bge.

Malvaceæ.

Malva parviflora L.

Zygophyllaceæ.

Fagonia Bruguieri DC.
,, *glutinosa* Del.
Nitraria tridentata Desf.
Seetzenia orientalis Dcne.
Tribulus terrestris L.
Zygophyllum coccineum L.

Geraniaceæ.

Erodium ciconium Willd.
,, *cicutarium* L'Herit.
,, *glaucophyllum* Ait.
,, *laciniatum* Cav.
,, *triangulare* Musch.
,, *triangulare* Musch. var. *pulverulentum* Boiss.
Monsonia nivea J. Gay.

Rutaceæ.

Haplophyllum tuberculatum (Forsk.) A. Juss.
Peganum Harmala L.

Rhamnaceæ.

Zizyphus Spina-Christi Willd.
,, *Spina-Christi* Willd. var. *inermis* Boiss.

Leguminosæ.

Acacia Seyal Del.
Alhagi maurorum DC.
Astragalus annularis Forsk.
,, cf. *baeticus* L.
,, *bombycinus* Boiss.
,, *brachyceras* Led.
,, *corrugatus* Bent. ex DC.
,, *cruciatus* DC.
,, *dactylocarpus* Boiss.
,, *Forskahlei* Boiss.
,, *gyzensis* Del.
,, *peregrinus* Vahl
,, *Schimperi* Boiss.
,, *striatellus* Pall.
,, *tenuirugis* Boiss.
,, cf. *tribuloides* Del.
Hippocrephis cf. *bicontorta*.
,, *unisiliquosa* L.

Hymenocarpos nummularius Boiss.
Lotus pusillus Viv.
Medicago Aschersoniana Urb.
,, *laciniata* Willd.
Melilotus parviflora Desf. (*M. indica* L.)
Onobrychis ptolemaica DC.
Ononis serrata Forsk.
,, *reclinata* L.
Prosopis Stephaniana (Willd.) Spreng.
Scorpiurus muricatus L.
Trigonella anguina L.
,, *hamosa* L.
,, *stellata* Forsk.
,, cf. *maritima* Del.
Vicia peregrina L.

Rosaceæ.

Neurada procumbens L.

Cucurbitaceæ.

Citrullus Colocynthis (L.) Schrad.

Ficoideæ.

Aizoon canariense L.
,, *hispanicum* L.
Cryophyton (*Mesembryanthemum*) *nodiflorum* (L.) N.E. Br.

Umbelliferæ.

Ammi majus L.
Anisosciadium lanatum Boiss.
,, *orientale* DC.
Bupleurum semicompositum L.
Cuminum cyminum L.
Pimpinella puberula Boiss.
Tordylium persicum Boiss. in Haussk.

Rubiaceæ.

Crucianella membranacea Boiss. (*C. ciliata* Lam.)
Galium Decaisnei Boiss.
,, *sinaicum* Boiss.

Dipsacaceæ.

Cephalaria syriaca (L.) Schrad.
Scabiosa Olivieri Coult.
,, *palaestina* L.
,, *palaestina* L. var. *calocephala* Boiss.

Compositæ.

Aaronsohnia Factorovskyi Wart. et Eig.
Acantholepis orientalis Less.
Anthemis deserti Boiss.

Anvillea Garcini DC.
Artemisia monosperma Del.
Atractylis cancellata L.
,, *flava* Desf.
Calendula aegyptica Desf.
,, *persica* C.A.M.
Carduus pycmocephalus Jacq. and var. *arabicus* (Jacq.) Boiss.
Carthamus oxyacantha M. Bieb.
,, *tinctorius* L. (cultivated).
Centaurea mesopotamica Bornm.
,, *phyllocephala* Boiss.
,, *solstitialis* L.
Crepis parviflora Desf.
Filago spathulata Presl. var. *prostrata* (Parl.) Boiss.
Ifloga spicata (Forsk). Sch. Bip.
Koelpinia linearis Pall.
Launaea arabica (Boiss.) Cass.
,, *mucronata* (Forsk.) Musch.
,, *nudicaulis* (Less.) Hook. f.
Leontodon hispidulum Boiss. var. *tenuilobum* Boiss.
Matricaria (Chamomilla) aurea (L.) J. Gay.
Odontospermum pygmalum B. et H.
Picris saharae Batt.
Reichardia tingitana (Desf.) Roth.
Rhanterium epapposum Oliv.
Senecio coronopifolius Desf.
Urospermum picroides L.

Plumbaginaceæ.

Statice spicata (L.) Willd.
,, *thouini* Viv.
,, *suffruticosa* L.

Primulaceæ.

Anagallis arvensis L. var. *carnea* Koch.
,, *femina* Mill.
,, *latifolia* L.

Boraginaceæ.

Anchusa aggregata Lehm.
Arnebia decumbens Coss. et Kral. (*A. cornuta* Led.) F. et M.
,, *tinctoria* Forsk.
,, *hispidissima* DC.
Gastrocotyle hispidia (Forsk.) Bge. and var. *songarica.*
Heliotropium undulatum Vahl
Lappula spinocarpos Aschers.
Lithospermum callosum Vahl and var. *asperrimum* Bornm.
,, *incrassatum* Guss.

Convolvulaceæ.

Convolvulus aff. *lineatus* L.
,, *oxyphyllus* Boiss.

Convolvulus pilosellaefolius Desf.
,, *sp.* cf. *sericeus* Burm.
Cressa cretica L.
Cuscuta planiflora Ten.

Solanaceæ.

Hyoscyamus pusillus L.
Lycium arabicum Schweinf.
,, *barbarum* L.

Scrophulariaceæ.

Antirrhinum Orontium L.
Linaria chalepensis (L.) Mill.
,, *micrantha* Cav.
,, *simplex* DC. var. *flaviflora* Boiss.
Scrophularia deserti Del.

Orobanchaceæ.

Cistanche tubulosa Schenk.
Orobanche aegyptiaca Pers.
,, *cernua* Loefl. var. *desertorum* Beck.

Labiatæ.

Salvia aegyptiaca L.
,, *spinosa* L.
Teucrium Polium L. var. *lanuginosum* Celak.
,, *Oliverianum* Ging.

Plantaginaceæ.

Plantago albicans L.
,, *amplexicaulis* Cav.
,, *ciliata* Desf.
,, *coronopus* L.
,, *cylindrica* Forsk.
,, *Lagopus* L.
,, *ovata* Forsk.
,, *Psyllium* L.

Illecebraceæ.

Herinaria cinerea DC.
,, *hemistemon* J. Gay.
Paronychia arabica DC.
Pteranthus dichotomus Forsk.

Chenopodiaceæ.

Anabasis articulata Forsk.
,, *setifera* Moq.
Arthrocnemum glaucum Ung.
Atriplex dimorphastegia Kar. et Ker.
,, *sp.* aff. *A. parviflora* Lowe.
,, *leucocladum* Boiss.

Bassia eriopora Schrad.
Beta maritima L.
Chenopodium album L.
,, *murale* L.
Cornulaca monacantha Del.
Echinopsilon muricatum (Schrad.) Moq.
Haloxylon salicornicum Bge.
Polycnemon sp.
Salsola hispidula Bge.
,, *Kali* L.
,, *longifolia* Forsk.
,, *verrucosa* MB.
Suaeda baccata Forsk.
,, *vermiculata* Forsk.

Polygonaceæ.

Calligonum comosum L'Hérit.
Emex spinosus Camped.
Polygonum Bellardi All.
Rumex pictus Forsk. var. *bipinnatus* (Lil.) Maire.
,, *vesicarius* L.

Thymelaeaceæ.

Lygia Passerina L.
,, *pubescens* (Guss.) Boiss.

Balanophoraceæ.

Cynomorum coccineum L.

Euphorbiaceæ.

Andrachne telephioides L.
Crozophora oblongifolia A. Juss. (*C. obliqua* Vahl) A. Juss.
Euphorbia cornuta Pers.
,, *sp.* cf. *E. hieroglyphica* DR.

Asclepiadaceæ.

Calotropis procera R. Br.

Valerianaceæ.

Valerianella leiocarpa Koch. (*V. Dufresnei* Bge.).

Fumariaceæ.

Fumaria parviflora Lam.

Characeæ.

Chara vulgaris L.

Gentianaceæ.

Centaurium (*Erythraea*) *ramosissimum* (Pers.) (sensu Fl. Orient.)

Linaceæ.

Linum usitatissimum L.

Juncaceæ.

Juncus acutus L.

MONOCOTYLEDONS.

Iridaceæ.

Iris Sisyrinchium L.
Gladiolus segetum Ker.—Gawl.

Liliaceæ.

Allium desertorum Forsk.
,, *laceratum* Boiss. et Noe
,, *sphaerocephalum* L. and var. *arvense* Parl.
Asphodelus tennifolius Cav.
Bellevalia flexuosa Boiss.
,, cf. *longipes* Post.
Dipcadi erythraeum Webb et Benth.
Gagea reticulata (Pall.) Schult. and var. *rigida* (Boiss. et Sprun.) Pasch.
Muscari comosum (L.) Mill.

Amaryllidaceæ.

Ixiolirion montanum Herb.

Cyperaceæ.

Cyperus conglomeratus Rottb. var. *arenarius* Coss.
,, *rotundus* L. (probably).
,, *arenarius* Retz. (cf. Auch no. 5483).

Gramineæ.

Ammochloa palaestina Boiss.
Argilops triunciatis L.
Aristida ciliata Desf.
,, *obtusa* Del.
,, *plumosa* L.
Avena barbata L.
Bromus tectorum L.
Cenchrus ciliaris L.
Cutandia memphitica Batt. et Trab.
Cynodon Dactylon Pers.
Koeleria phleoides Pers.
Lolium rigidum Gaud.
Panicum turgidum Forsk.
Phragmites communis Trin.
Sphenopus divaricatus Reichb.
Stipa tortilis Desf.

Filices.

Ophioglossum vulgatum L. var.

PLANTS OF RIYADH, SAUDI ARABIA.

(*Collected in October* 1938.)

Acacia sp. (probably A. Seyal Del).
Aerua javanica (Burm.) Lam.
Amaranthus Blitum L.
Anvillea Garcine (Burm.) DC.
Artemisia monosperma Del.
Blepharis edulis (Forsk.) Pers.
Capparis galeata Fres.
,, *spinosa* L.
Cassia obovata Coll.
Corchorus trilocularis L.
Daemia cordata R. Br.
Digera arvensis Forsk.
Haloxylon Schweinfurthii Asch.
Lycium Barbarum L.
Morcandia arvensis DC.
Oxalis corniculata L.
Peganum Harmala L.
Picridium tingitanum Desf. var. *subintegrum* Boiss.
Pulicaria crispa (Forsk) Benth. and Hook.
Punica Granatum L.
Rhazya stricta Dcne.
Solanum nigrum L.
Trisetum pumilum Kunth. (grown from seed collected in Dahana).
Zizyphus nummularia Walk et Arn.

Some notes on the edible plants of Kuwait and those used medicinally.

Asphodelus tenuifolius Cav. 'Burwug'.

This plant is used by the Badawin of Kuwait in making ' 'Igt', which is a form of dried milk; it is made especially for use during the summer and is mixed with water and eaten with dates.

Citrullus Colocynthis (L.) Schrad.

This plant known to the Arabs as 'Esherri' is their main purgative. The seeds are collected when the fruit is ripe and seven seeds are taken at once as a strong purgative. Sheep sometimes eat the fruit when it is green.

Dipcadi erythraeum Webb et Benth. 'Busal Mow'.

The bulb of this plant is very juicy though rather tasteless; it is dug up and eaten by all Badawin children.

Heliotropium undulatum Vahl 'Rum-Rām'.

This plant is used by Badawin as a cure for snake bite. The plant is dried and pounded up, and made like tea with hot water. This is then strained, and the patient is given the liquid to drink, and the 'leaves' are bound on to the bite. Other methods, such as branding and keeping the patient awake are also used, as the 'Rum-Rām' will not effect a cure by itself. The Badawins tell you

that the Monitor lizard ('Wurral') when bitten by a snake, has been seen to go to this plant and roll in it.

Lygia Passerina L. 'Kharāit'.

This is also used among the Badawin as a purgative, mainly in spring when it is picked and eaten green. It may be dried also and pounded up.

Malva parviflora L. 'Khubāiz'.

Among the Persian community in Kuwait this plant is eaten a great deal when it is young and green. It is cooked like spinach.

Neurada procumbens L. 'Sa'adān'.

Badawin children are very fond of the young circular seeds of this plant to eat.

Haplophyllum tuberculatum Juss. 'Al Masāicha'.

This plant is used among the Badawin of N.-E. Arabia as a cure for a scorpion sting. The plant is picked and quickly put into a pocket and then in a dark bag to dry. Some of the leaves are pounded up and mixed with a few drops of hot water and bound on to the place where the person was stung. It is said to be a quick cure and to relieve pain at once.

Rumex pictus Forsk. 'Hambusis' and *Rumex vesicarius* L. (Hamēth) are both eaten by townspeople and Badawin alike.

Emex spinosus Camped. 'Al Hambizān'.

The white root of this plant is eaten by Badawin children.

Scorzonera papposa DC. 'Rubāhla'.

The brown carrot-like root of this plant when peeled is eaten by Badawin and is very tasty.

Teucrium Polium L. 'Al Jādah'.

This plant is used as a cure for Basrah fever and is sold dried in the bazaars of Kuwait. The leaves are pounded up and brewed with boiling water into a kind of tea. Some of this is drunk and some of it poured over the person. Sheikh Mubarak of Kuwait always used this cure when he had fever. A specimen was sent by Dr. C. S. G. Mylrea of the American Mission Hospital in Kuwait to the School of Tropical Medicine, who sent it on to Messrs. Parke Davis & Co.

Following is a report from them by Mr. E. M. Holmes dated 30-11-20.

Report on a woolly leaved herb.

'The specimen received from Messrs. Parke Davis & Co. has been carefully examined by me, with the following result :—

"The minute flowers are evidently those of a Labiate plant possessing the character of the genus *Teucrium* of the species *Teucrium Polium*. The plant was formerly used as a herb in

Europe, and in Spain still retains the vernacular name of *Poleo montano*. The plant is supposed to be the Polion of the Greeks and is said by Arabian writers to be deobstruent, diuretic, and anthelmintic and tonic. It is mentioned by Dioscorides, 111, 115, Pliny, 21, 7, 120. In Bombay it is one of the drugs sold under the name of 'Jadah' and comes from Bandar Abbas. It is described by Dr. M. Dymock in *Mat. Med. West India*, 2nd ed. p. 616, and accords exactly with the specimen received''.'

The United States Dispensatory further says:—

'Plant said to have been used advantageously in cholera in the Levant, a specimen of which was sent to Paris proved to be *Teucrium Polium*—which we have no doubt was identical with the drug you sent to us.'

Trigonella stellata Forsk. 'Nifl'.

The Badawin women of the great Shammar tribe of Northern Arabia use this plant when dried to put on their hair after it has been washed.

Arnebia decumbens Coss. et Kral. 'Chahil'.

The root of this plant, which is crimson, is used by some Badawin women and girls as a 'rouge'. The freshly pulled up root is rubbed lightly on the cheeks and it gives a perfect colour to them.

Atriplex sp. aff. *A. pariflora* Lowe. 'Hartabeel'.

This plant when young is eaten by the Persian population of Kuwait as a kind of spinach.

Some Trees and Bushes of Kuwait and their uses.

Calotropis procera R. Br. 'Ashurr'.

This tree is used for making gunpowder. The bark is first made into charcoal, and then pounded up very fine and used with saltpetre. The tree has no doubt been brought up from Hassa where it is very common, and grows here only in one village (Fantas) some 20 miles south of Kuwait town.

Zizyphus Spina-Christi Willd. 'Sidr'.

The dried and pounded leaves of this tree are used by the town women of Kuwait as a hair wash. It is also used for washing the dead.

The Badawin makes his camel stick 'Misha'ab' from the branches of these trees which grow in great quantities in the Summan region of Saudi Arabia. The fruit is sold in the bazaars and is much liked by the town people and Badawin alike.

Haloxylon salicornicum Bge. 'Hamdh' or 'Rimdh'.

There are many bushes of the Chenopodiaceae which are classed under the Arabic names given above. These are all valuable as firewood in the desert and also for grazing for camels, owing to their salt properties.

A NOTE ON THE EMBRYOLOGY OF THE GROUND NUT (*ARACHIS HYPOGAEA* L.)

BY

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(*With two text-figures*).

Arachis hypogaea is a crop plant of great economic importance. In India, it is cultivated extensively in Bombay, Madras and the Central Provinces. In Bengal, Mysore and in other parts of India attempts are now being made to grow ground-nut on an extensive scale. The plant is grown as a *rabi* crop.

The literature on the embryology of Leguminosae is extensive. It has recently been reviewed by Schnarf (**9**), Roy (**6**) and others. Excepting a few cases which, however, require reinvestigation, the development of the female gametophyte in the family was found to be of the normal type. Guignard (**1**), Souèges (**11**), Samal (**8**) and others have studied the development of the embryo. Considerable variation has been noted in the development of the pro-embryo and the suspensor.

Reed (**4**) appears to be the only investigator who has worked on the embryology of *Arachis hypogaea*. He has only described the fully developed gametophyte and certain stages in the development of the embryo in connection with his studies on the anatomy, ecology and embryology of the plant.

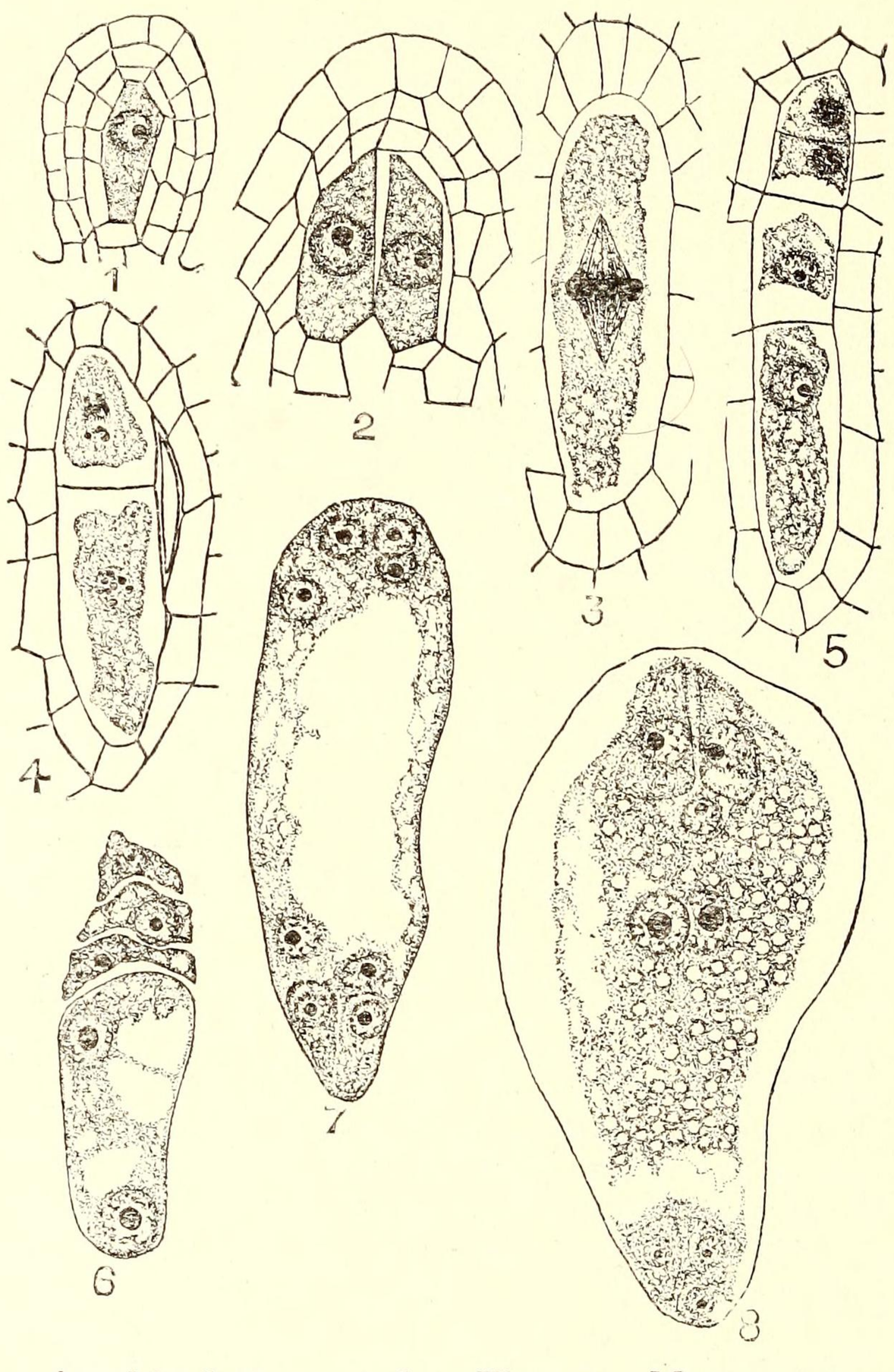
The material used in this investigation was obtained from plants grown in the University College experimental ground and was studied according to the customary methods.

As is characteristic of the family Leguminosae, the monocarpellary ovary bears the ovules on the ventral suture. Generally the ovules are two in number, but sometimes three or only one have been noted. The ovule initials are at first noted as small papillate processes on the placenta. Due to more active cell division on one side of the ovule they gradually curve and take up an anatropous position. At this time the outer wall of the ovule generally comes in contact with the wall of the ovary, but the curvature of the ovule does not appear to be due to the contact with the ovarian wall as has been suggested by Reeves (**5**) working on *Medicago*. Both the ovules curve in the same direction and the curvature is always towards the stylar end of the ovary. It is interesting to note in this connection that Reeves (**5**) working on *Alfalfa* found the curvature of the ovule towards the base of the ovary. In *Albizzia Lebbeck* and *Phaseolus vulgaris*, Maheshwari (**2**) and Weinstein (**12**) found the ovules curving towards the stylar end of the ovary.

The origin of the integuments becomes apparent along with the curvature of the ovule. Both the integuments arise from the outer layer of cells of the ovule and in the early stages of their development are composed of two layers of cells. The inner integument is first noted, but very soon the outer integument makes its appearance. At the time of differentiation of the integuments the megaspore mother cell is generally in the early stages of heterotypic prophase. The growth of the outer integument is more rapid than the inner and by the time the megaspore mother cell is in synopsis, the outer integument reaches the same level as the inner. From this stage onwards, the growth of the outer integument is more rapid on the side of the ovule opposite to that of the placenta, and as a result it very soon completely encases the ovule. Both the integuments take part in the formation of the micropyle, at which region they are comparatively thick.

A single archesporial cell usually differentiates in the third layer of the nucellus and directly functions as the megaspore mother cell. The origin of the archesporial cell or cells, in the third layer of the nucellus appears to be a common feature in the Papilionatæ and has been noted previously by

Roy (**6**), Paul (**3**) and others. Two megaspore mother cells lying side by side have been noted in some preparations (text-fig. 2). Reeves (**5**) records the occurrence of two or more sporogenous cells side by side in *Alfalfa,* Singh and Shivapuri (**10**) in *Neptunia oleacea* and Paul (**3**) in *Tamarindus indicus.* The cell covering the megaspore mother cell usually divides before the reduction division and as a result the megaspore mother cell is pushed inside the nucellus (text-fig. 1 and 2). The megaspore mother cell passes through the usual stages of meiosis. During the heterotypic metaphase a bipolar spindle is oriented (text-fig. 3) and the movement of the chromosomes is regular. There is a

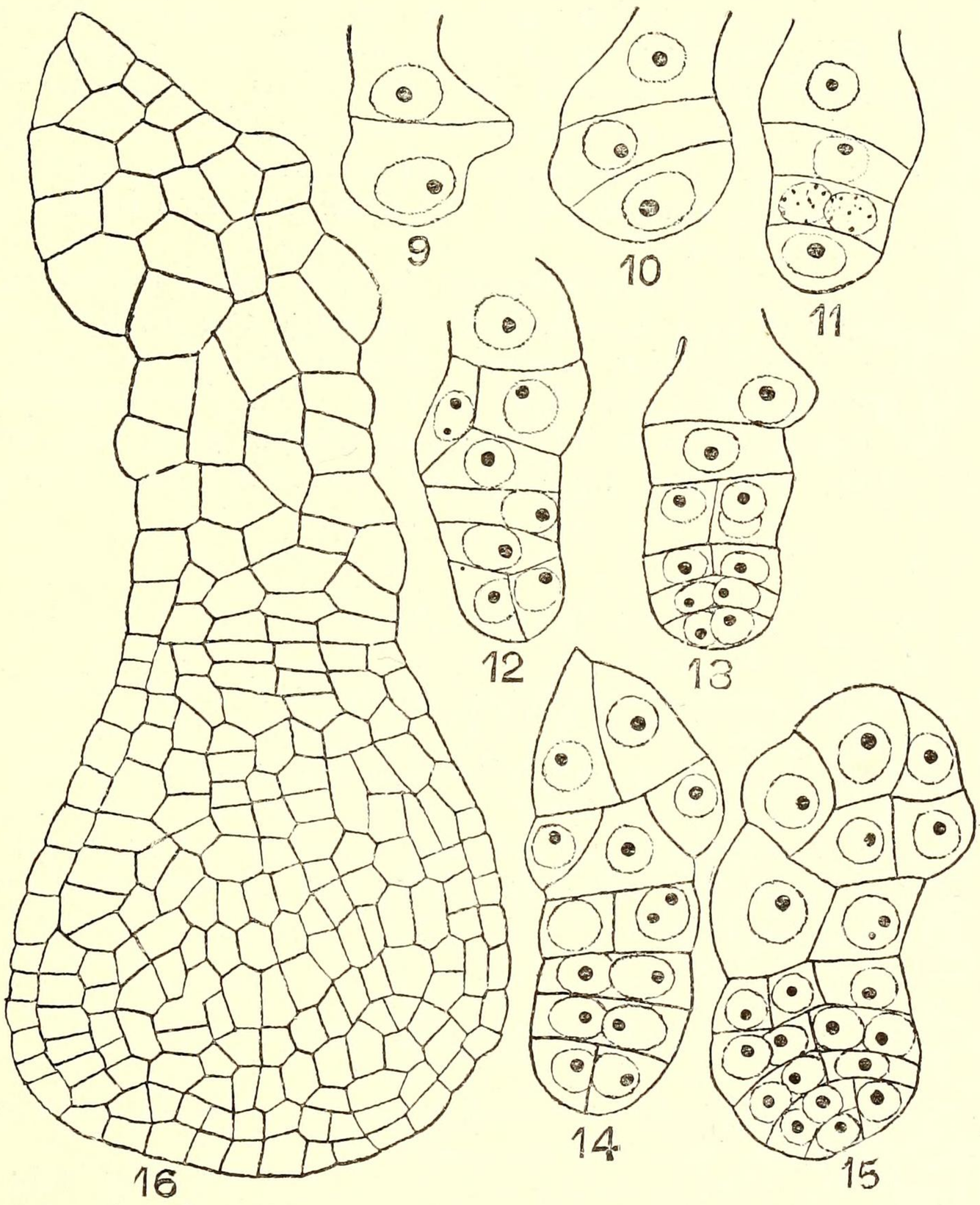


Text-figures 1-8. *Arachis hypogaea* L. Fig. 1. Megaspore mother cell ×500. Fig. 2. Two megaspore mother cells lying side by side ×900. Fig. 3. Heterotypic metaphase ×900. Fig. 4. Homotypic division ×900. Fig. 5. Linear tetrad of megaspores ×900. Fig. 6. Binucleate stage of the embryo-sac; note that the upper three megaspores have not degenerated ×900. Fig. 7. Eight-nucleate embryo-sac ×900. Fig. 8. Mature female gametophyte; note presence of starch grains in the embryo-sac ×900.

well defined interphase and the daughter nuclei become well organised and separated by a cell wall. During the homotypic division both the cells usually divide at about the same time (text-fig. 4). As previously noted by Maheshwari (**2**) and Roy (**6**) the lower cell of the dyad is comparatively longer than the upper. This inequality in the size of the dyads appears to be a characteristic feature of the Papilionatæ. As a result of the homotypic division four macrospores are produced which are arranged in a linear row and separated by cell walls (text-fig. 5). In no case was a *T*-shaped arrangement of tetrads observed. The lower or the chalazal macrospore alone functions while the rest degenerate. It appears from the results obtained by previous investigators that in most Papilionaceous plants the chalazal megaspore is functional. Saxton (**7**), however, found the third megaspore from the micropylar end to be functional in *Cassia tomentosa.*

The functioning megaspore is usually capped by dark staining masses—the remnants of the other degenerated macrospores. It is usually deeply embedded in the nucellus due to the repeated division of the cover cells. The nucleus of the functioning megaspore next divides and gives rise to the primary micropylar and primary chalazal nuclei. It is interesting to note that sometimes the binucleate stage is reached before the degeneration of the three upper megaspores. Text-fig. 6 illustrates such a condition. By two-nuclear divisions an eight-nucleate embryo-sac is produced and a big vacuole is noted in the centre of the sac. From the two-nucleate stage onwards the parietal cells surrounding the embryo-sac show signs of disintegration. At the eight-nucleate stage the embryo-sac increases considerably in size and the chalazal end becomes very narrow.

The mature embryo-sac is somewhat oval with the antipodal end tapering. The three antipodals become separated from the main body of the embryo-sac and appear to be surrounded by cytoplasmic membranes. They degenerate very soon, as appears to be common in the sub-family Papilionatæ. The synergids are pear-shaped in appearance with the nuclei disposed at the micropylar end and the vacuole below. No filiform apparatus could be detected. The egg cell is placed between the synergids and extends beyond them into the embryo-sac. There is a large vacuole at the apical region of the egg and the nucleus is placed in the denser cytoplasm at the base. The two polar nuclei lie close together, near the central region of the sac, they fuse later. The mature embryo-sac as previously noted by Reed (4), is full of starch grains (text-fig. 8). The occurrence of starch grains in the embryo-sac of higher plants seems to be of frequent occurrence.



Text-figures 9-16. *Arachis hypogaea* L. Stages in the development of the embryo. Figs. 9-15 ×400: Fig. 16 ×180.

As stated previously, Reed (4) has only described the mature gametophyte of *Arachis hypogaea,* and has not worked out its development. His account of the female gametophyte agrees with our observation, but his figures illustrating the structure of the synergids, the egg and the polar fusion nucleus appear to give an entirely wrong impression of the organisation of the mature embryo-sac.