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Editor

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Editor.

STUDY OF TESTS FOR INTEGRITY OF THE PITUITARY-ADRENAL AXIS

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The knowledge that the adrenal cortex plays an important role in the **pathogencsis** of a large variety of diseases has stimulated considerable interest in the development and use of tests for integrity of the pituitary-ad renal axis. The spate of reports appearing in the literature (Sayers and Sayers, 1948; Sayers, 1950; Bloom, 1957) testifies to the interest in this subject, and to its importance. However, inspite of the extensive work done on this subject, there are certain practical problems in the performance of these tests which still remain unsolved.

The tests of adrenal cortical function devised so far are based either upon direct measurement of the corticoid hormones in blood and urine or on the numerous haematologic and biochemical changes induced in the experimental subject by exogenous or endogenous AGTH.

The more important of.such adrenal function tests are classified below:—

I. Tests based upon direct measurement of adrenal corticoids or their metabolites in body fluids:

(i) Plasma cotticosU'roids.
(ii) Urinary corticostcroids*
(iii) Urinary 1 7-ketosteroids.

II. Tests based upon adrenal cortical response to exogenous or endogenous AGTH.

(i) Eosinophil response to exogenous ACTH.
(ii) Urinary uric acid response to exogenous ACTH.
(iii) Serum cholesterol respons ; to exogenous ACTH.
(iv) Urinary 17-hydroxycortieosteroid response to exogenous ACTH.
(v) Fluorescein-Hyaluronidasebkin wheal test.
(vi) Adrenal ascorbic acid depletion test.

III. Water-loading tests:

(i) Robinson-Power-Kepler test,
(ii) Sorter's test.

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IV. Miscellaneous tests:

(i) Serum and urinary sodium,

(ii) Urinary uropepsin.

(iii) Various tolerance tests (Selye, 1947).

Among these tests, there are several which have been more frequently employed in the studies reported so far. The criteria whidh have usually guided their more frequent use have been (i) their rapidity and convenience of performance and (ii) the specificity of the response obtained. For the same reasons the above mentioned water-loading and tolerance tests have been largely discarded.

The route of administration of ACTH in these tests has been a subject of considerable controversy. Thorn et al (1948) originally suggested a four-hour test in which the ACTH was injected intramuscularly. It was thought that the brief stimulus provided by the intramuscular ACTH injection constituted a test of adrenal cortical reserve. Renold et al (1952) subsequently reported encountering false negative eosinophil lesponses with the intramuscular test and therefore suggested use of intravenous infusion of 20-25 U. S. P. units of corticotropin over an 8-hour period for one or more days to stimulate the adienal cortex. Though this latter form of the test is commonly employed at the present time, its limitations are being increasingly realised (Jenkins et al 1955; Laidlaw, 1955). In this form the test is cumbersome both for the patient and the laboratory and nursing staff and is, therefore, not highly suitable for routine clinical use. Moreover, even with this test repeated stimulation with corticotropin for several dajs often becomes necessary to obtain adequate adrenal cortical response.

Several attempts are being made, therefore, to simplify the ACTH-iesponse tests. The intramuscular administration of high potency ACTH gel has been suggested (Jenkins et al, loc. cit., Wolfaon, 1958). Jenkins et al (loc. cit.) claimed to have obtained comparable, responses with the ACTH gel as with the intravenous procedure. However, Streeten et al (1953) have described a number of apparent failures among normal subjects to respond to adequate doses of high-potency ACTH gal. DeFilippis and Young (1957) have demonstrated that such apparent failures may be due to use of ACTH of substandard potency rather than due to unpredictability of release of ACTH from intramuscular depot or to failure of normal adrenal cortex to respond to single stimulating doses of ACTH.

Abrahamsen (1958) has suggested a 12 hour corticotropin test which involves one single I. M. injection of 20 I. U. corticotropin and has obtained responses comparable to the intravenous test. Engbring et al (1956) have claimed to have obtained greater response with intramuscular depot injection than with corticotropin administered intravenously over a 5-6 hour peri<xl.

It is evident from a review of all these studies that the problem of finding a simplified procedure for performiijg the ACTH response tests remains to be

solved. Moreover, it will be realised that there have been only limited systematic studies so far to evaluate the relative iniportance and practicability of these tests as indices of adrenal cortical function. The present study was undertaken in an attempt to tackle these problems and suggest suitable tests fqr convenient adoptionein experimental and clinical work.

The theoretical and practical aspects of the adrenal function tests carried out in the present study are described below together with our observations and results :—

°(i) *Urinary 17—hydroxycorticosteroids :* Reddy et al (1952, 1954) have developed a method for the quantitative determination of butanol-soluble 17, 21-dihydroxy-20-ketosteroids in urine, based upon the Porter-Silber reaction (Porter and Silber, 1950). Since there is evidence that 17-hydroxycorticosterone is the principal hormone secreted by the adrenal cortex (Nelson and Samuels, 1952), this method has largely replaced the earlier techniques based upon biological assay (Venning et al, 1946) or measurement of formaldehydogenic (Corcoran and Page, 1948) or reducing (Heard and Sobel, 1946) steroids. An alternative procedure that is being employed in some laboratories in U. K. „ involves measurement of 17-ketogenic steroids (Norymberski et al, 1953).

Using their method, Reddy et al (1952) have reported figures of 7. O-15.5 mgper24- hour for normal human subjects. Brown ct al (1954) have reported values of 2.1-12.3 mg; DeFilippis and Young (1957), 2.4-19.7 mg; Eik-Nes etal -(1953), 3.3-9. 3 mg for normal males and 2.1-5.8 mg for normal females; **tjill** et al (1956) have found values of 1-10 mg/24 hours in normal human subjects. Liddle et al (1954) have obtained figures of 9.5±4.0 mg for normal males and 6. 5 ±2.5 mg for normal females. The considerable variations in the normal excretion figures reported by different workers arise from the fact that the technique employing the Porter-Silber reaction is not fully standardised and modifications have been adopted by almost everyone of these workers.

In the present study using this technique, normal values for urinary 17-hydroxycorticosteroids excretion were 5.0-25. 7 mg per 24 hours for males and 3.7-20.2 mg for females. 50 subjects of portal cirrhosis had excretion values in the range 0.49-25.4 mg while in 43 cases of infectious hepatitis the values were 1.42-25.90 mg per 24 hours. There was, however, no consistent correlation between the diminution in urinary 17-hydroxycorticosteroid excretion values and responses to the other adrenal function tests (Wahi and Ramachandran, 1958). It would thus appear that results of urinary 17-hydroxycorticosteroids estimation have to be interpreted with caution, as they are apparently also affected by extra-adrenal factors such as liver function.

(ii) *Urinary 17-kelosteroids:* Urinary 17-ketosteroids arise to the extent of two$_5$thirds from hormones of adrenal cdrtex and the rest from the testis in normal human males. In females, adrenal conical activity accounts for all the urinary 17-ketosteroids (Mason and Engstrom, 1950). The rate of excretion of 17-ketosteroids is, however, influenced by factors such as malnutrition, anemia, infection, gastrointestinal disease, liver damage, etc. (Sayers, 1950). Venning and Browne (1949) have found a lack of parallelism between the urinary levels of biocorticoids and 17-ketostcroids under a variety of conditions. For these reasons results obtained with the urinary 17-ketosteroid test have to be interpreted with caution.

Several relatively simple and accurate methods have been devised for determination of urinary 17-ketosieroids (Mason and Engstrom, 1950) of which the technique of Callow et al (1938) is the one widely used. Using this method or a modification of it, several authors (Patterson et al, 1942; Barnett et al, 1946 ; Friedman, 1954 ; Ramachandran et al, 1956 ; Patwardhan et al, 1957) have reported varying values for urinary 17-ketosteroid excretion in normal human subjects. In the present study normal figures for urinary 17-ketosteroid excretion were 3.0-13.0 mg per 24 hours for males and 1.5-7 mg for females. These values for normal Indian subjects are much lower than those for their counterparts in western countries as observed by others also (Friedman, loc. cit.), the exact causes of which are unknown.

In 50 subjects with portal cirrhosis and 43 subjects with infectious hepatitis the values were much lower (0.15-5.6 mg and 0.24-9. 87 mg respectively). There was, however, no consistent correlation between diminished urinary 17-ketosteroids and impaired response to the other adrenal function tests in these cases. This observation emphasises the fallacy involved in using urinary 17-ketosteroids as an adrenal function test in liver disease. The diminution in urinary 17-ketosteroids in this disease appears to be both due to impaired conversion of cortical hormones to 17-keto steroids as well as diminished adrenal cortical function (Conn et al 1954 ; Wahi, 1957).

(iii) *Eosinophil Response to exogenous ACTH :* The decrease in circulating eosinophils in response to ACTH administration (Hills ct al, 1948 ; Sayers et al, 1949) has been shown to be mediated by the glucocorticoid hormones (cortisone, hydrocortisone) of the adrenal cortex (Spiers and Meyers, 1949). Thorn et al (1948) have developed this response into an adrenal function test in which the fall in eosinophils after an interval of 4 hours following I. M. injection of corticotropin is measured, a minimum of 50% fall being indicative of normal adrenal function. In the intravenous test introduced subsequently (Renold et al, 1952), a eosinophil fall of 85% or more was taken as indicative of adequate adrenal cortical stimulation.

Observations which diminish the significance of this test arc the considerable errors involved in manual counting of eosinophils and the effect of extra-adrenal cortical factors, such as epinephrine, on the eosinopenic respoase (Sandberg et al, 1953).

In the present study, an evaluation of the reliability and clinical significance of the 4-hour adrenal function test of Thorn et al (loc. cit.) was done in normal human subjects. It was observed that responses of 50-67% were consistently obtained with I. M. injection of 25 units of corticotropin (ORGANON) in healthy human subjects. The responses* were sub-normal in several of the patients of portal cirrhosis (4-61%) and infectious hepatitis (5-74%). There was, however, no consistent relationship between these responses ajid those for the other adrenal function tests (Wahi and Ramachandran, 1958). This observation emphasises the need for cautious interpretation of data obtained with the eosinophil test.

(iv) *Urinary uric> acid response to exogenous ACTH :* Thorn et al (1948) have used the phenomenon of increased urinary excretion of uric acid in response to ACTH, tp develop an adrenal function test in which the rise in uric acid excretion in 4 hours following a single I.M. injection of 25 units of corticotropin is measured. Though the test recommends itself due to its simplicity and ease of performance in clinical work, it has been subject to some criticism (Miller, 1955 ; Kothari and Rindani, 1956 ; Acland and Gould, 1956).

Several authors have emphasised the need for careful dietary control for obtaining reliable results with this test since variations in purine intake adversely affect this test (Miller, loc. cit., Taussky et al. 1950 ; Gordon et al, 1954).

In the present work the reliability of the 4-hour uric acid response test of Thorn et al (loc. cit.) was studied by performing the test in normal human subjects using high-potency corticotropin (ORGANON). It was observed that provided there was adequate dietary control, prior to performance of the test, as suggested by Thorn et al (loc. cit.) responses of 50-350% were consistently obtained in healthy human subjects. Under the same conditions of testing, several patients of portal cirrhosis and infectious hepatitis showed subnormal responses to this test, at a time when they also exhibited deficient responses to the other adrenal function tests.

(V) Serum cholesterol response to ACTH : Conn et al (1950) have demonstrated that a marked depression of serum cholesterol occurs during administration of ACTH to normal persons as opposed to lack of such response in patients with Addison's disease. Kyle et al (1952) studied serum cholesterol following a single injection of ACTH and have found that a drop in cholesterol level occurs and this was well correlated with greater physiologic stimulation by ACTH.

The reliability of the serum cholesterol response as an adrenal function test was examined in the present study. Following a single I. M. injection of 25 units high potency corticotropin (ORGANON), the fall in serum cholesterol in 4 hours was measured. It was observed that decreases in serum cholesterol of 15-25% could be consistently obtained in normal human subjects by this procedure. Our experience with this test has thus shown that under these conditions, serum cholesterol response to ACTH is a reliable index of adrenal function. Patients of portal cirrhosis showed response of 0-27% and those with infectious hepatitis 0-25% under the same conditions of testing,

and the diminished responses to this test were well correlated with impaired responses to the uric acid test (Wahi et al, 1957 ; Wahi and Ramachandran, 1958).

(ui) Urinary 17-hydroxycorticosleroid response to ACTH : **Jenkins et al (1955) have demonstrated that the determination of urinary 17-hydroxy-corticosteroids after AGTH stimulation is a sensitive index of adrenal cortical responsiveness and is more direct and specific than changes in peripheral blood eosinophil count. Thorn et al (1953) have found that a quantitative relationship exists between percentage fall in eosinophils and rise in uriniry 17-hydroxycorticosteroids in response to a 4-hour adrenal function test. This method, however, suffers from the defects that it involves accurate collection of urine and also that the increase in urinary 17 hydroxycorticosteroids in the four-hour period is too small for exact determination. De Filippis and Young (1957) have modified the test so that increase in urinary excretion of 17-hydroxycorticosteroid in the 24 hour period immediately following stimulation with intramuscular corticotropin gel is determined.**

This form of the test, was employed in our study, the rise in urinary 17-hydroxycorticosteroids in the 24 hour period following a single intramuscular injection of 25 units high potency corticotropin being measured. In the healthy human subjects tested, the urinary 17-hydroxycorticosteroid response varied from +5-2 to +10·5 mg. Under the same conditions of testing there was diminished response in a proportion of patients of portal cirrhosis (—9*2 to +11*7 mg) and in some subjects with infectious hepatitis (— 8'9 to +9*8 mg) and this was generally correlated with sub-normal responses to the urinary uric acid and serum cholesterol tests.

(vii) Fluorescein-skin-wheal test : **The 11-oxysteroids of the adrenal cortex (cortisone, hydrocortisone) possess the property of inhibiting the action of hyaluronidase, the enzyme which depolymerises hyaluronic acid present in connective tissue. Estradiol, testosterone, progesterone and pregnenolone are inactive in this respect (Selye, 1950). Finestone and Shuman (1952) have suggested an adrenal function test on the basis of this phenomenon in which the prolongation in time of disappearance of a fluorcsccin-skin-wheal following ACTH administration is measured. Patients with adrenal insufficiency apparently fail to show this "prolongation. In an attempt to assess its reliability the test was performed in normal human subjects. No consistent responses could be obtained, the main difficulty being in determining the end point of disappearance of the skin wheal in these subjects. Our experience thus suggests that the skin wheal test is not suitable for adoption as a practical test of adrenal function.**

[piii) Adrenal ascorbic acid depiction test : **Sayers et al (1946,1948) have demonstrated that depletion of adrenal ascorbic acid occurs under the influence of cold, histamine, epincphrine or ACTH and that there exists a quantitative relationship between this and the amount of cortical hormones secreted from the adrenal cortax. The measurement of alterations in adrenal ascorbic acid**

has, therefore, been made the basis of a technique for evaluation of adrenal cortical activity. Obviously, since it involves analysis of the adrenal, this test can only be performed in experimental animals.

In our experience, normal albino rats consistently show depletions in adrenal ascorbic acid of 72-79% with cold as the "stress" 49-54% with histamine, and 54-62% with AGTH. The test has also been employed by . us in our studies of role of adrenal cortex in evolution of carbon-tetrachloridc-induced cirrhosis (Wahi et al, 1956a, 1956b) and of dietary cirrhosis in albirio*rats, with consistent results. The adrenal ascorbic acid depletion test has the added significance that when cold or histamine is .used as the "stress" it is possible to assess both pituitary and adrenal cortical function (Sayers et al, 1948).

(ix) *Serum sodium :* The "salt-active" (mineralocorticoid) hormones of the adrenal cortex such as aldosterone and desoxycorticosterone are believed to stimulate renal tubular reabsorption of sodium and to regulate its concentration in urine and other body fluids (Selye, 1947; Prunty, 1958). The level of serum sodium has been shown to be remarkably constant under normal conditions and hence changes in its concentration constitute a sensitive index of adrenal secretion of mineralocorticoids, lower levels being suggestive of decreased mineralocorticoids and, higher levels, of increased circulating mineralocorticoids. However, it does not appear to be an infallible index of mineralocorticoid activity. Thus it has been observed in our studies (Wahi and Ramachandran, 1958) and in those of others (Holley and Mclester, 1951) that decreased sodium levels occur in a proportion of cases of portal cirrhosis, in which disease state an actually increased urinary aldosterone excretion occurs (Chart and Shipley, 1953; Pechet et al, 1954).

(x) *Urinary uropepsin:* Urinary uropepsin excretion has been shown to be directly influenced by adrenal cortical activity (Gray et al, 1951, 1954). It has been demonstrated further that among adrenal cortical hormones only the glucorticoids promote urinary uropepsin excretion. Estrogens, desoxycorticosterone, progesterone and adrenal androgens are inactive in this respect (Grayetal, 1954). Urinary uropepsin excretion is diminished in Addison's disease and is restored to normal by cortisone therapy (Gray et al, 1956). Uropepsin estimation in 24-hour urine specimens has, thei efore, been made an adrenal function test. The chemical method for uropepsin assay that is commonly employed is that of Anson and Mirsky (1932) cs modified by Gray etal(1954).

In our studies, uri-iary uropepsin excretion values in healthy human subjects were found to be from 6000 to 16000 units per 24 hours using this technique. The subjects of portal cirrhosis and infectious hepatitis had uropepsin 'excretion figures in the range 250-14540 units and 1740-64000 units respectively. This diminished excretion was usually paralleled by diminished responses to the other adrenal function tests> reported in this study. Urinary

uropepsin thus appears to be quite a reliable index of adrenal cortical activity when used in conjunction with other tests.

CONCLUSIONS

Thus our experience with adrenal function tests has shown *hat while some *of* these. offer simple and reliable methods of assessing the functional status of the adrenal cortex, there are others whose response have to be interpreted with caution. The choice of any group of tests would thus depend as much on the reliability and ease of performance of these as on the nature of the particular group of corticoid hormones (glucocorticoids, mineralocorticoids, or androgens) whose variations in disease are to be studied. The present study has also shown that the intramuscular ACTH tests yield reliable and consistent results, provided eertain precautions are taken while performing them.

REFERENCES

Abrahamssen, A.F., (1958) ... Acta Endocrin. 28:p.227.

Acland, J.D. and Gould, A.H., (1956) ... J. Physiol. 133:p.456.

Anson, M.L., and Mirsky. A.E., (1932) ... J. Gen. Physiol. 16:p.59.

Barnett,J., Henley. A.A., Morris, C.J.O.R., and Warren, F.L., (1946) ... Biochem. J.40:p.778.

Bloom, A., (1957) — Post-Gard. Med. J. 33:p:499.

Brown, H., Willardson, D. G., Samuels, L. T., and Tyler, F.H., (1951) ... J. Clin. Invest. 38 :p. 1524.

Callow, N.H., Callow, R.K., and Emmens, C.W., (1933) ... Biochem. J. 32:p.l312.

Chart, J.J., and Shipley, E.C., (1953) ... J. Clin. Invest. 32:p.56O.

Conn,J.W.,Vogel, W.C., Louis, L.H., and Fajans, S.S., (1950) ... J. Lab. Clin. Mcd., 35:p.5O4.

Conn, J.W., Fajans, S.S., Louis, L.H., and Seltzer, H.S., (1951) ... J. Lab. Clin. Med. 43:79.

Corcoran, A.C., and Page, I.H., (1948) ... J. Lab. Clin. Med. 33:p.l326.

DeFilippis, V., and Young, I. I, (1957) ... New Eng. J. Med. 257 : p. 1.

Eik-Ncs, K., Nelson, D. H., and Samuels, L. T., (1953) ... J. Clin. Endocrin. and Metab 13: p. 1280.

Engbring, H. E., Truitt, R. B., and Engstrom, W. W., (1956) ...Arch. Int. Med., 98 : p. 257.

Finestone, A. J., and Shuman, C. R., (J952) ... Am. J. Clin. Path., 22: p. 348.

Friedman, H. C, (1954 ... Lancet. CCLXV1I : p. 262.

Gordon, D., Horwitt, B. N., and Segaloff, A., (1954) ... J. CHn. Endocrin. and Mctab., 14 : p. 297.

G«-ay, S. J., Benson, J. A.. Rcifenstein, R, W., and Spiro, H. M., (1951) ... J. A. M. A., 107: p. 1*29.

Gray, S.J., Ramsey, C. G., and Rdfensfcin, R. W., (1951) ... New Eng. J. Med., 251 : p. 835.

Gray, S. J., Ramsey, C. G., and Then, G. W., (1956) ... Ann. Int. Med., 45 *i* p. 73.

H-ard, R.D.H., and Sobel, H., (1946) ... J. Biol. Chem., 165: p. 687.

Hills, A. G., Forsham, P. H., and Finch, C. A., (1948) ... Blood, 3: p. 755.

Hills, S. R., Goetz, F. C, Fox, H. M, Murawaki, B.J., Krakucr, L.J., Rcifenstein, R. W., Gray, S. J., Reddy, W. J., Hedberg, S.E., St. Marc, J. R., and Thorn, G. W., (1956) ... A.M.A. Arch. Int. Med., 97: p. 269.

Holley, H. L., and McLestcr, J. S., (1951) .. J. Amer. Med. Assn. 145 : p. 392.

Jenkins, D., Forsham, P. H., Laidlaw, J. C. Reddy, W. J. and Thorn, G. W., (1955) ... Am. J.Med., 18: p. 3.

Kothari, N.J., and Rindani, T.H., (1956) ... Arch. Internat. Pharmacodyn. et dc Therapy, **105** : p. 68.

Kyle, L.H., Hess, W. G. and Walsh, W.P., (1952) ... J. Lab. Glin. Med., 39*: p. 605.

Laidfaw,J. C., (1955) ... New Eng. J. Med., 253 : p. 747.

Liddle, G. W., Island, D., Cornfield, J., and .Forsham, P. H., (1954)... Endocrinology, 55 i p. 575.

Mason, H. L.,*and Engstrom, W. W.,(1950) ... Physiological Reviews **30** : p. 321.

Miller, A. T., (1955J\.. J. App. Physiol., 7: p. 660.

Nelson, D.H., and Samuels, L.T., (1952) ... J. Clin. Endocrin. 12: p. 519.

Noryml?crski,J. K., Stubbs R. D., and West, H. F., (1953) -...Lancet, 1: p. 1276.

Patterson, J. McPhee, I.M., and Grdcnwood, A. W., (1912) ... Brit. Med. J., 1: p. 35.

Patwardhan, V. V., Panse, T. B., and Khanolkar, V. R., (1957) ... Ind. J. Mrd. Sci., **11:** p. 4.

Pcchct, M. M., Duncan, L. E., Liddle, G. W., and Barttcr, F. C., (1954) ... J. Glin. Invest., 33: p. 957.

Porter, G. G., and Silber, R. H., (1950) ... J. Biol. Ghem , **185** : p. 201.

Prunty, P. T. G., (1953) ... "Modern Trends in Endocrinology", p.

• Ramachandran, M., Venkatachalam, P. S., and Gopalan, C-, (1956) ... Ind. J. Med. Res., 44: p. 227.

Reddy. W. J., Jenkins, D., and Thorn, G. W., (1952) ... Metabolism, 1: p. 511.

Reddy, W. J., (1954) ... Metabolism, 3: p. 439.

Renold, A. E., Jenkins, D., Forsham, P. H., and Thorn, G.W., (1952) ... J. Clin. Endocrin., 12 : p. 763.

Sandberg, A. A., Nelson, D. H., Palmer. J. G., Samuels, L. T., and Tyler, F. H., (1952) Clin. Endocrin. and Metab., 13: p. 629.

Sayers, G., Sayers, M. A., Liang, T.'Y., and Long, C. N. H., (1946) ... Endocrinology, ... J. 33 : p. I.

Sayers, G., and Sayers, M. A., (1948) ... Rec. Prog. Horm. Res., 2 p. 81.

Sayers, G., Burns, T. W., Tyler, F. H., Jagcr, B. V., Schwartz, T. B., Smith, E. L., Samuels, L. T., and Davenport, H. W., (1949) ...J. Clin. Endocin., 9: p. 593.

Sayers, G., (1950) ... Physiol. Reviews, 30: p. 241.

Selye, H., (1947) ... Text-Book of Endocrinology, Montreal, Acta Inc., p. 154.

Selye, H, (1930) ... Physiology and Pathology of Exposure to Stress, Montreal, Acta Inc., p. 250.

Spiers, R.S.,and Meyets, R. K., (1949) ... Endocrinology, 45: p. 403.

Streeten, D. H., Phil, D., Scllzer, H. S., Pont, H. E., and Conn, J. W., (1P53) ... Clin. Res. Proc, 3: p. 201.

Taussky, N., Swan, R., and Shorr,E., (1950) ... Proc. 2nd. Clinical ACTH Conference. Ed. Nole, J. R., Philadelphia, Blackison, Co., p. 273.

Thorn, G. W., Forsham, P. H., Prunty, F. T. G., and Hills, A.G., (1948) ... J. Amer. Med. Assn., **137** : p. 1003.

, Thorn, G. W.Jenkins, D., and Laidlaw, JoC, (1953) ... Rcc. Prog. Horm. Res., 8: p. 171.

Venning, E. H., and Browne, J. S. L., (1949) ... Ann. N. Y. Acad. Sci., 50 : p. 627.

Vennirg, E.H., Kazmin, V. E., and Bell, J. C?, (1946) ... Endocrinology, **38:** p. 79.

.Wahi, P. N., Tandon, H. D., and Bharadwaj, T. P., (1956a) ... A. M. A. Arch. Path., 62: p. 200.

Wahi, P. N. Tandon, H. D., and Bharadwaj, T. P., (1956b) ... A. M. A. Arch. Path., 62: p. 215.

Wahi, P.N., (1937) .,. J. Ind. Med. Assn., 29: p. 158.

Wahi, P. N., Ramachandran, S., and Navani, H., (1957) ...J. Ind. Med. Assn., 29: p. 133.

Wahi, P. N., and Ramachandran, S., (1958) ... A. M. A. Arch- Path., 66: p. 482.

Wolfson, W. Q., (1953) ... Arch. Int. Med., 92: p. 108.

ON A COLLECTION OF HIGH ALTITUDE SCORPIONS AND PSEUDO-SCORPIONS (ARACHNIDA) FROM THE NORTH-WEST HIMALAYA

By M. S. fy(ANi, M. A., D. Sc, F. L S.*, *Professor of Zoology and Entofoology St. JohrCs College, Agra.*

•> This report deals with the material collected from the nival zones by the Entomological Expenditions to the North-West Himalaya, organized by me from the School of Entomolegy, St. John's College, Agra, during the years 1951-1956. Two new and eight known species of scorpions and one new subspecies of pseudoscorpion are recorded here. Though small, the collection is extremely interesting on account of the high elevations, at which the specimens were found and from the point of view of the zoogeographical affinities of the terrestrial Arthropoda above the timber-line in the North-West Himalaya. The specimens, including the types, will in due course be deposited in the collections of the Zoological Survey of India Calcutta.

Order SCORPIONIDA

Family BUT HID AE

Buthus alticola Pocock

1895. *Buthus alticola,* Pocock, *J. Linn. Soc. London,* (Zool.), 25 : 302, pi. ix, fig. 3.
1900. *Buthus alticola,* Pocock, *Fauna British India.* Arachnid a, p. 21.

I have before me 1 male labelled: Above Kokhsar, near Rohtang Pass, North Aspect of the Pir Panjal Range (Lahaul), elevation 4000 metres above mean sea level, from under snow-covered boulders, 2nd week of June 1954, coll. M. S. Mani and Santokh Singh.

Body mostly dark brown,, with traces of black on carapace and first six tergites, otherwise as described by Pocock *(loc. cit.).*

This species was orignally described from the Hindu Kush (Chitral) at an elevation of about 1525 metres above mean sea level and a female specimen from the Punjab was provisionally described as a subspecies. This is the first definite record of the species from the Himalaya. Its occurrence above the timber-line in the North-West Himalaya on the north slopes of the Pir Panjal Range is of special interest.

Lychas nigristernis (Pocock)

1C99. *Archhomelrus nigristernU,* Pocock, J. *Bombay Nat. Hist. Soc,* 12 : 265.
1900. *Lychas nigwternis,* Pocok, *Fauna British India.* Arachnida, p. 38.

I have before me 1 female and 1 male, labelled: Chakrata Range, Upper Jamuna Valley, South Aspect, elevation 2500 metres above mean sea level,

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•Since this paper was written, the author is in, the Zoological Survey of India, Calcutta.

found under loose stones, September 1954, Coll. M. S. Mani and Santokh Singh.

Body mostly black, otherwise as described by Pocock *(loc. cit.)*. This species was previously described from near Dehra Dun in the sajtne part of the Himala) a at about the same elevation.

Family CHAERILIDAE

Chaerilus anthracinus Pocock

1900. ***Chae ilus anthracinus*** **Pocock,** ***Fauna British India,*** **p. 57.**

I have before me 1 female with the label : From under stones, about 1.5 kilometres from the Forest Rest House, Kalatop, Dhauldhar Range, near Dalhousie (Gurdaspur Dt. Punjab), elevation 2550 metres above mean sea level, late June 1953, coll. M. S. Mani and Santokh Singh.

Body wholly black; legs dark brown; otherwise as described by Pocock.

This species was previously described from Dalhousie on the same range of the Himalaya.

Chaerilus anthracinus rufescens Pocock

*** 1900.** ***Chaerilus anthracinus rvfescens,*** **Pocock,** ***Fauna British India,*** **p. 57.**

I have before me 2 males, McLeodgunj, elevation 1850 metres above mean sea level, near Upper Dharamsala, on Southern Aspect of Dhauladhar Range, on way to Dharamkot and Triund; 1 male from Triund, elevation 2700 metres above mean sea level, under stones near the upper edge of *Qjiercus incana* and *Rhododendron arbor turn* forest, middle of May 1953, coll. M. S. Mani and Santokh Singh.

The specimen from Triund is somewhat darker than those from McLeodgunj. The colour variation is correlated with the differences in the elevations between the two localities. The specimen from Tiiund was collected at night on an alpine meadow, on which is situated a shepherds camping site.

Chaerilus granosus Pocock

1900. ***Chanilu* granosus,*** **Pocock,** ***Fauna British India,*** **Arachnida. p. 56.**

I have before me 1 female taken along with the specimen of *Lychas nigris-ternis* (Poc.) recorded above. The sprcicc was originally known from Mussurie on the Western Himalaya.

Chaerilus insignis Pocock

1894. ***Chaerilus inignit,*** **Pocock,** ***Ann. Mag. nat. Hist.,*** **(6) 13: 82.**
1900. ***Chaerilus insignis,*** **Pocock,** ***Fauna British India*** **Arachnida, P. 53.**

I have before me 1 male taken from under stones, covered by snow, below Rohtang Pass, above Kokhsar, North Aspect of 1 ir Panjal Range (Lahaul), elevation 3970 metres above mean sea level ; 1 male from under a stone at the edge of glacier (Sissu Glacier) 4000 m, between Kokhsar and Sissu

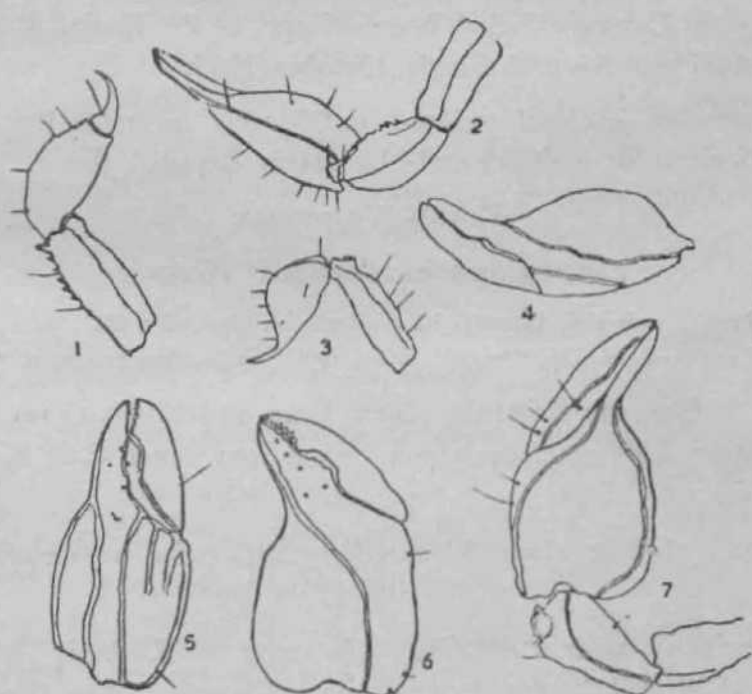
(Lahual), South slope of the Great Himalaya, elevation 3600 metres above mean sea level, June 1954, Coll. Santokh Sfrigh.

Body dark brown, about 60 mm long, otherwise as described by Pocock *{loc.cit.).*

This species was originally described from Ladakh and this is the first record of the species south of the main crest-line of the Great Himalaya. **The** specimens were sflll hibernating at the time of collection. Under the same stones were also found severil specimens of Dermaptera and Garabidae, which'we re however active daring thn niglit.

Chaerilus pirpanjalus. sp. nov. .

Male.—Body very dark reddi?h-brown or almost black. Carapace equal to the first and second caudal segments combined, but shorter than the third and fourth caudal segments combined, also shorter than the fifth caudal segment. Lateral crests on tergites conspicuous, but the crest on the third tergite somewhat longer and not composed of a single pear-like granule. Tail more than three times the length of carapace. Humerus and brachium shorter than carapace. The surface of carapace mostly granular, with the granules larger near the lateral eyes and in front; with a well defined lateral submarginal carina. Tergites granular; lateral Crests fine, short and consisting of minute granules; median crests composed of several large granules. Sterna large, with the sides parallel; the last sternite of abdomen granular, with four well developed long crests, each containing several fine granules. First segment of tail with a width nearly equal to the length of the fourth segment; the second



Figs. I, 5, 6 & 7. *Chaeritus phpunjalui*, sp. **nov.**
Figs. 2, 3 & **4.** *Scmpiops%ohtangen$is,* sp. **nov.**

s*egment* as wide **as long; first** and second segmenls with the dorsal surface granular; keels well developed and denticulate; dorsum of the fifth segment smooth, the last two granules of the inferior lateral keel conspicuously larger than others; vesicle granular, with a semi-circular groove at base of the aculeus. Humerus about twice as long as wide, conspicuously granular above, finely granular elsewhere. Brachium equal to humerus, granular above and behind; keels smooth and shiny; with 9 pored setae along the hind margin above and 3 near apex. Hand rugose, dark reddish-brown, 5 keels, each shiny and continuous and not composed of separate granules; one pored seta at base of the fixed finger above, another at about one-fourth the length of hand behind, a third near the basal one-third above near the posterior keel; other pored setae as in fig. 6 and 7; outer side of the upper hand with a row of hemispherical granules below; near the marginal keel underhand sparsely granular. Pectinal teeth 6:6 or 5.6. Both movable and fixed fingers black.

Length: total body length 40 mm. Hand 6 mm. Movable finger 6 mm. Humerus 5 mm. Brachium 5 mm.

Female—Like the male, but on the whole somewhat darker. Hand also darker. Humerus aboat three-fourths the cephalothorax. Brachium equal to humerus. Peetinal teeth 5.

Holotype one male, *allotype* one female, in spirit. From under stones, Transitional zone between the taiga and the timber-line, Upper Beas Valley, South Aspect of the Pir Panjal Range, elevation 2650 metres above mean sea level, Coll. No. 883/56, cardex No. 213, Sta. No. 6, R. L. Kotpal, 20-vi-1956; Coll. No. 211, Rahla, H. N. Baijal, 25-V-1955 one immature specimen, Coll. No. 1140; also several adults and juveniles of both sexes from under stones, Chandanwadi in Lidder Valley, North Slope of Pir Panjal Range, Kashmir, Coll. M. S. Mani and Santokh Singh, October 1953.

This species is closely related to *Chaerilus tricostatus* Poc* but is easily distinguished from it by well defined characters detailed above.

Family VEJOVIDAE

Scorpiops hardwickii (Gerv.)

1344. *Scorpio hardwickii,* Gcrvais in *Walker's Ins. Apt.,* 3 : 66.
1900. *Scorpiops hardwickii,* Pocock, *Fauna British India,* Arachnida, p. 66.

I have before me 1 female taken from under stones on the Chakrata Range, elevation 2500 metres above mean sea level, Coll. Koshy Mathew, September 1953.

Body mostly b!ack; about 30 mm long; otherwise as described by Pocock *{loc. cit.).*

This species is widely distribute*d in parts of Kashmir, Jaunsar between elevations of 1828 and 2750 metres and on hills near Dehra Dun, Kasauli and in Nepal Himalaya.

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*Pocock, R. I. 1899, J. Bombay nat. Hist. Soc., **12:266; *Fauna*** *British India,* Arachnida, **p. 59 (1900),**

Scorpiops montatus Karsch

1879. ***Scorpiops montanus, K&rsch, Mitt. Munch, ent. Ver.,*** **3 : 107.**
1900. ***Scorpiops montanus,*** **Pocock,** ***Fauna British India,*** **Arachnida, p. 70.**

I have before me 1 female taken from under stones on an alpine meadow at the edge of *Quercus semicarpifolia* forest, Triund, South Aspect of Dhauladhar Range, elevation 2700 metres above mean sea level, abeve Upper Dharamsala, Coll. M. S. Mani and Santokh Singh, May 1953.

Body wholly black, legs reddish-brown, about 65 mm long; otherwise as described by Pocock *(loc. cit.).*

This species is recorded previously from Dehra Dun, Jaunsar (elevations between 1800 and 2743 metres) and Dharamsala in the western and north-western Himalaya.

Scorpiops rohtangensis, sp. nov.

Male.—Dark reddish or reddish-brown; legs yellowish-brown; pedipalp reddish-brown. Tibia of pedipalp with paired tuberculate spines in front. Tail more than four times the length of carapace; the superior keels of the caudal segments 2 to 4 spiniform and elevated behind. Brachial pores only 7 on the under side in a row along the hind margin. Aculeus defined basally by a semi-circular groove. Underhand with only 3 setal pores in addition to the front two rows of 2 setal pores. Lateral eyes 3. Pectinal teeth 6-7. Total length 50 mm, tail length 35 mm. Otherwise closely resembling the male of *Scorpiops petersii* Poc*

Holotype one male taken from under snow covered boulder near Rohtang Pass, North Aspect of Pir Panjal Range, (Lahaul), elevation 4300 metres above mean sea level, June 1954. Coll. M. S. Mani and Santokh Singh.

Order GHELONETHIDA (=Pseudoscorpionida)

Suborder NEOBISIIDAE

Family *Neobisiidae*

Microcreagris kaznakovi lahaulensis, subsp. nov.

This new subspecies differs from the typical form *Microcreagris kaznakovi* (Redik.)† from Tibet and Central Asia, in having only nearly contiguous 4 eye spots and not true eyes; in the femur and tibia of the pedipalp being wholly smooth and not medially granulated and in the deep black-brown tergites.

*** Pocock, R. I. 1893.** ***Ann. Mag. nal. Hist.,*** **(6) 12 : 323, pi. xiv, fig. 10;** ***Fauna British India,*** **Arachnida, p. 70 (1900).** ***Scorpiops petersii*** **Pqp. is known from Dehra Dun and Jaunsar, Mussurie and Simla Hills, at elevations of about 1830-2750 metres above mean sea level.**

†Redikorzav, 1922. ***Mem. Acad.St. Petersb.,*** **22:96** ***[Deleobisium {Microcreagris) kaznakovi];*** **MaxBeier, 1932.** ***Das Tierreich, 51*** **: 145.**

The general body colour reddish to dark reddish-brown; juvenile specimens often yellowish-brown. Cephalothorax with 6 sensory setae on anterior margin; palp hand with 4 sensory setae.

Holotype **one example in spirit : Coll. No. 48/55 from under snow-covered stones, Rohtang Pass, Pir Panjal Range, elevation 4300 metres above mean sea level, coll. Santokh Singh, 5-vi-1955; also 6 examples (2 adults and 4 juveniles) from the same lot; 2 examples Coll. No. 92/55 taken from under boulders on cliff east of Chhatru, Lahaul, elevation 3800 metres above mean sea level, South Aspect of the Great Himalaya, Coll. Santokh Singh, 15-vi-1955.**

The genus ***Microcreagris*** **is essentially a Holarctic form; this is the first record of the genus from India and also from the Himalaya.**

ECOLOGICAL STUDIES ON AQUATIC AND SWAMPY VEGETATION OF GORAKHPUR

A Survey*

By **D. N. SEN, M.SC**, *Department of Botany, St. Andrew's College, Gorakhpur.*

INTRODUCTION

The present survey of aquatic and swampy vegetation was done on the advise of the Principal of this college, who himself being a botanist has an experience of thirty-two years of this locality, and the growth of innumerable hydrophytes has drawn the attention of the author. This type of study has a great scope in this particular field due to presence of many 'tals' and 'jheels' all around Gorakhpur; moreover this part is almost unsurveyed, and so the author became more interested in the rich hydrophytic vegetation.

As far as the literature is concerned, we hardly find a complete note on this type of Indian vegetation. Though monumental works of Arber (1920) and Fassett (1940) are there, but most of the plants dealt by them are foreign to our country. So it has been attempted here to give a fairly complete account of the plants met with in this field, and a more detail work is intended later on.

As far as the author is aware no work has been done particularly on the ecology of aquatic and swampy.vegetation of the eastern parts of Uttar Pradesh, except by Misra (1946), though we get incomplete accounts of the plants is different floars. A fresh start has recently been made by Mirashi (1954), Pattnaik & Patnaik (1956), and Puri and Mahajan (1957 & 1958).

Though every attempt has been made in surveying this area, yet it is not claimed to be a complete and perfect work on the subject so far as the plants is concerned. The reason is that the occasional floods in this part of the state almost completely change the picture of the vegetation in different localities. Regular excursions were made in different localities after the recent (1955) floods in this area.

LOCALITY AND CLIMATE

District Gorakhpur occupies the extreme north-east corner of Uttar Pradesh and comprises a huge stretch of the country lying to the north of the river Ghagra. The geographical limits are determined by the parallels of 26.5' and 27.29' north latitude and of 83.4' and 84.26' east longitude. The area vary from year to year owing to the erratic action of river Ghagra in general and river Rapt in Gorakhpur particular.

There is a wide area of lowland, the average height above sea level is 316 feet, which is apt to be inundated due Jo heavy rains and floods, a factor of high importance in the ecology of hydrophytic vegetation. It is almost a natural Tarai area with a large water table. The soil is extremely retentative of moisture, and so many of the swampy plants are seen for a long time even though there is no water superficially.

In south west of Gorakhpfur where swollen volume of river Rapti holds up the waters of the river Rohin and Ami at the respective points of junction there are two huge sheets of water in the Domingarh and Amiar Tal. Water in the low land near these rivers comparatively dries up, but they flow on as thin streams.

The climatic data is given in Table I for the year 1955-56, the period during which most of the collections were made after the floods. This year there were heavy rains and the said rivers were in floods.

Table I

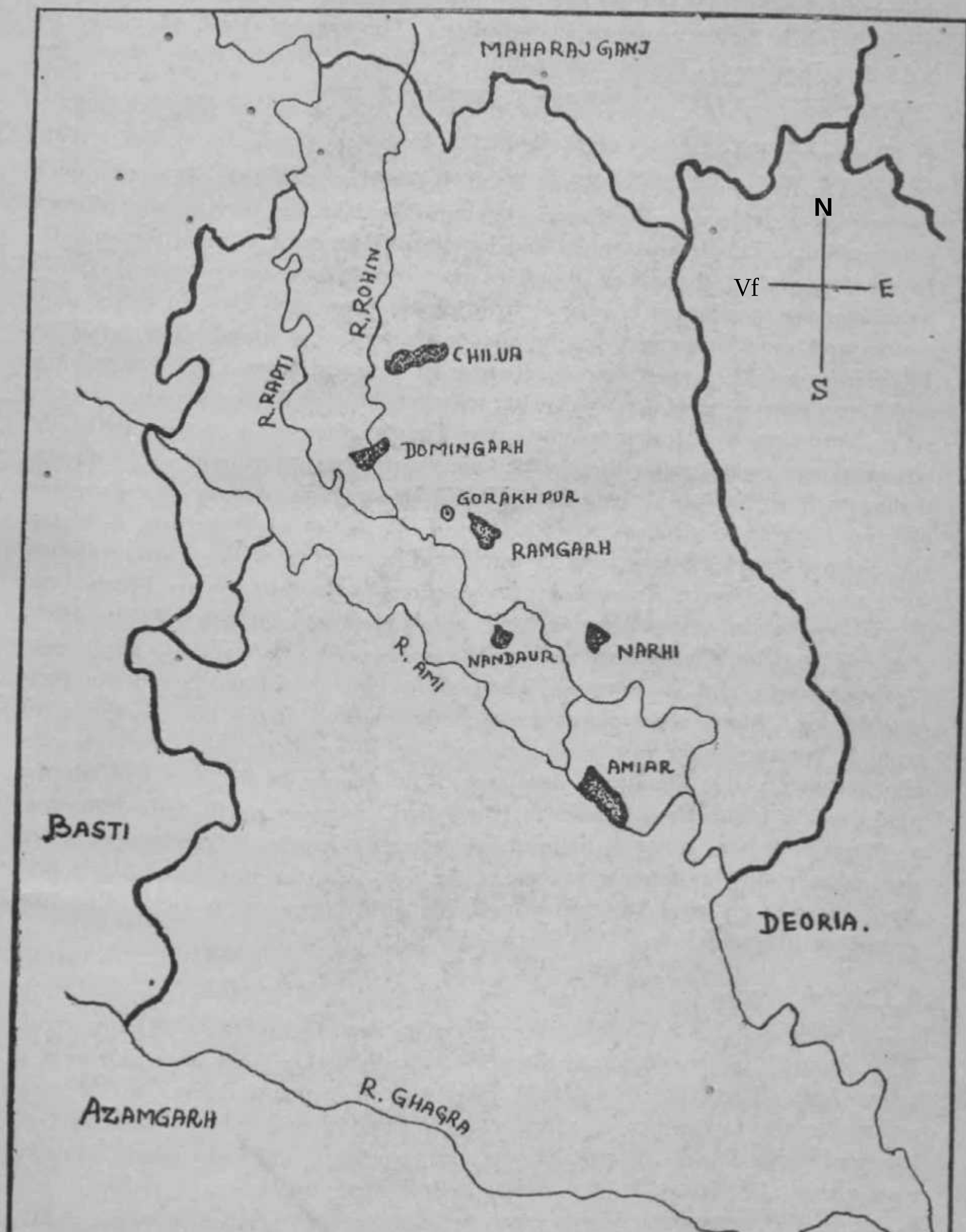
Climatic data of Gorakhpur

(Kunraghat-Gorakhpur Meteorological station: Height above sea-level 316 feet)

Month & Year	Temperature in O°. F. Mean Maximum	Mean Minimum	Relative Humidity % At 0830 Hr. I.S.T.	At 1730 Hr. I.S.T.	Rainfall in inches	Mean Temp. in O°F
1955						
July	87.1	78.5	89	78	16.13	82.8
August	87.1	79.0	79	82	14.94	83.0
September	88 0	78.6	78	78	21.66	83.3
October	86.0	72.1	79	64	3.34	79.1
November	81.3	60.8	66	55	00.00	71.1
December	71.9	51.7	88	60	00.00	61.8
1956						
January	69.8	51.5	84	56	00.63	60.7
February	76.5	53.8	63	40	00.31	65.1
March	90.0	64.9	57	27	00.36	77.5
April	101.1	74.4	44	21	00.00	87.7
May	99.7	80.7	69	46	5.35	90.2
June	91.2	79.0	85	71	**11.84**	85.1

HABITAT AND VEGETATION

Gorakhpur is remarkable for the number of its large perennial lakrs, formed in most cases by the abandoned channels of rivers, which have been blocked by the accumulation of silt or else merely consist of deep natural depressions in which the surface drainage collects without finding an adequatr out.ct. Besrfes it possesses a vast numbers of temporary sw.-mps and 'jheeis' varying in appearance from broad sheets of-water during the rains to a shallow marsh or even arable land in dry seasons. The accompanying map gives an



Map Showing THE LOW/** Of Habitats.

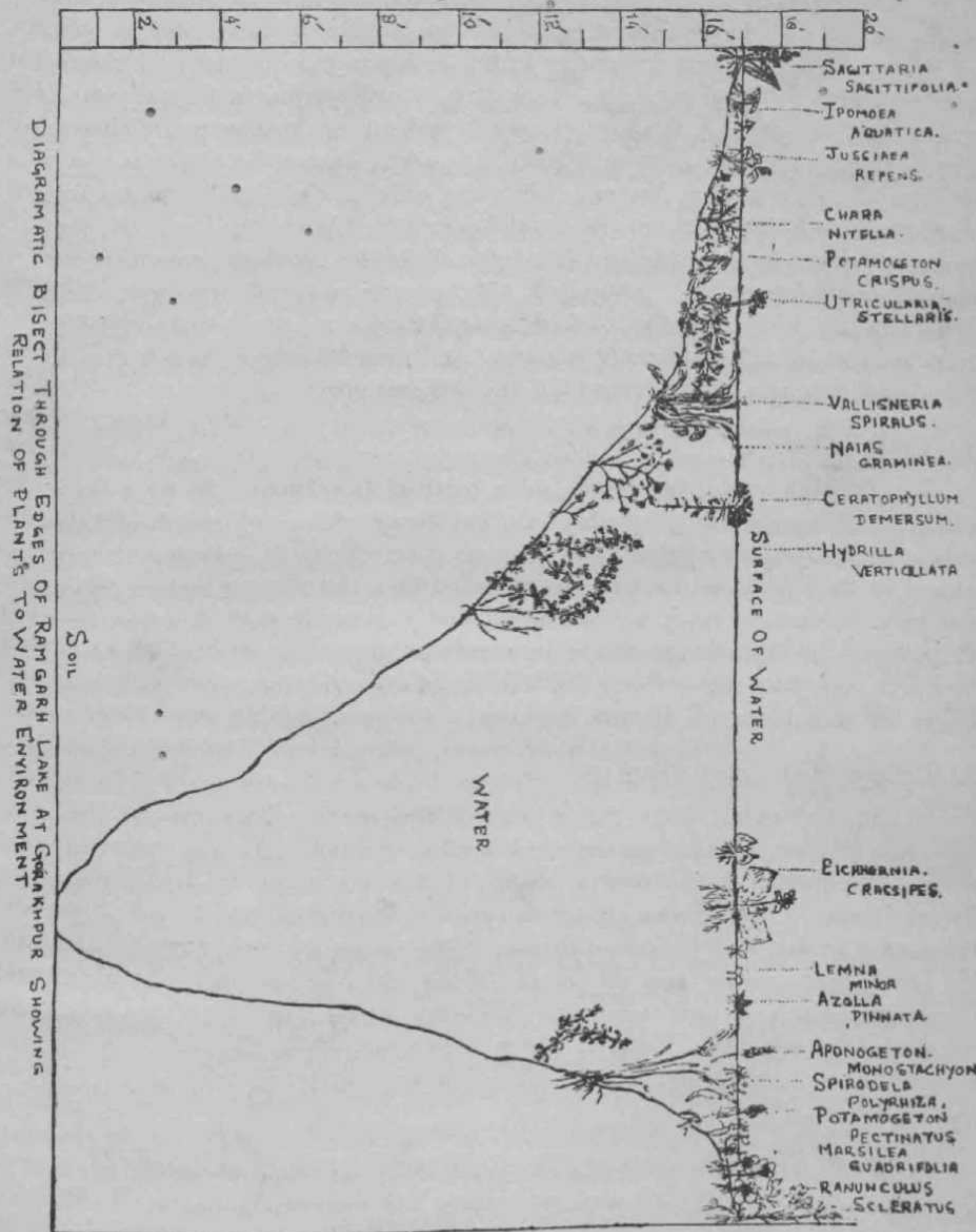
idea of the important habitats of hydrophytes recorded in the present survey. **The** main localities of this study were a few prominent and impoitant lakes round about Gorakhpur, though there are a large number of ponds and ditches inside the city, which were also visited from time to time. The prominent among those which do not get dry even in hotest part of the year is Ramgarh Tal whose depth is 20 feet or more at one place. The average depth of Narhi Tal is 15 feet, Domingarh 18 feet and Chilua is 16 feet. Besides these there are many other tributaries of the above mentioned rivers.

1. Ramgarh Tal:—

On the south side of Kasia Road, is the Ramgarh Tal. It was formerly covered by a dense growth of reeds, but now the lake has been cleared off such a vegetation. This is a perennial and important lake quite deep in the middle. In the deep waters, there is an abundant growth of *Polamogzlon crupus* and *Hydrilla verticillata,* but a mixture of several hydrophytes grow well even in the shallow waters and moist margins. In the shallow waters were found, *Naias graminea, Zannichellia palustris,* and *Chara sp.* growing in a mixed mass. *Spirod la polyrhiza* and *Lemna minor* were also seen growing together, but not in abundance. *Jussiaca repens,* growing with rice plants, may reach the open water with the aid of spongy roots. After these were the plants growing in mud with sufficient water, such as *Sagittaria sagittifolia, Monochoria vaginalis, Scirpus sp., Polygonum glabrum, Polygonum serrulatum, A*phod'lus tennifoliut, 0 nanthe stoloniformis, Eichhornia crassipes* was found growing both in water and on mud as well. Plants collected from moist land were *Ranunculus scleratus, Veronica anagalis, Rum*x dentatus* and *Bergia ammanoides.* Also growing well but less prominent were *Eclipta crccta, Ammania baccifera, Chenopodium mm ale, Alternanthcra sessilis, HygrophUa polyr.perama, Cladium ?nariodes,* and *Saccharum* sp., Those plants have been listed in order of their prominence. Many other plants grow on the margins of this hike on the moist ground, but they have not been included here because they arc seen growing also at other places almost on dry land. The margin of the lake towards the road side (in front of south gate of Howii Park) is under much biotic influence, so the growth here is not so luxirant, as seen a few yards ahead where there are rice fields or on the opposite margin of the lake. In the months of March and April there is an abundant growth of Blue-green alga.? near rice fields. No record of the algal flora has been made.

2. NARHI TAL:—

Narhi Tal is a big lake about six miles from Gorakhpur on Dcoria road. It is situated in the interior in the north east direction, so the approach to it is rather bad. There are two smaller lakes Jhunjhunwa and Baliva, but they all make one sheet of water in rainy season. Leaving aside those plants met at Ramgarh lake *Slavinia oblongifolia* was seen growing wild only here. *MarsiUa erosa* grows abundantly in rice fields, and *Potamogeton indie its. Jussiaea repens* is one of the commonest plants growing in water and when the water is dry, spreading on the sand without spongy roots, *Jussiaea sufltuticosa* was collected only from the roadside ponds on Deoria road leading to Narhi Tal. *Ipomoea aquatica* attains a huge length here. *Limnanlhmum crbtatum, Commelina benghalensis, Azolla sp.,* and *Equiseium sp.,* arc other common plants found here.



UlAGRAMATIC **BISECT** OF THE RAMGARH LAKE

3, DoMfNOARH TALI

The **Domingarh** and Karmaini lakes on the west of Gorakhpur **are** formed by **the** overflow of the river Rohin. The two 'Tals' arc separated by a portion of elevated ground, but as these^sheets of water arc joined together **during high** floods, they may for all practical purposes be considered as one.

The lakes shrink to comparatively small dimensions in summers, but they show a characteristic hydrophytic vegetation of most of those plants found in water at Ramgarh Tal. A very interesting feature is a complete absence of *Eichhornia crassipes,* though this plant is the commonest of hydrophytes in Gorakhpur. It grows in abundance on the roadside ponds and ditches leading to Domingarh. Prominent aquatic plants recorded from here were, *Potamogeton peclinatus, Vallisneria spiralis, Csratophyllum demersum, Utricularia stellaris, Utriculatia flexuosa, Naias graminea, Trapa bispinosa.* On the moist banks *Ipomoea aquatica (I. reptans), Poly' gonum plebejum, Ammania baccifera, Medicago denticulata, Xanlhium strumarium* and *Commelina benghalensis* were collected. *Aponogeton mGiwstachyon* was seen exclusively in this lake. On the roadside many temporary ponds and brick-kilns were seen to be full of *Spirodela polyrhiza, Azolla pinnata* and *Eichhornia crassipes. Lippia nodfflora* was seen growing on the wet margins.

4. CIHLUA TAL:—

This is situated some seven miles north of Gorakhpur. As far as vegetation is concerned this is not very rich, but shows a luxuriant growth of *Vallisnsria spiralis, Hydrilla verticillata,* and *Naias graminea. Typha sp.,* growing scattered almost in the middle of the lake was recorded from this place, *Eleocharis congesta* not very common at other habitats was found growing in shallow waters here. Plants growing in moist ground were mostly the same as recorded elsewhere. *Sagittaria sagittifolia* was growing on comparatively dry land, and *Salvia plebia* grows in abundance on almost dry land.

5. College and other Tanks:—

St. Andrew's College Botanic Garden's water tank also presents a fine collection of water plants, growing nicely well in natural conditions. The water tanks in the garden have a natural growth of *Nymphaea Lotus, Naymphaea stellata, Euryale ferox, Limnanthemum cristatum, Hydrilla verticillata, Vallisneria spiralis, Potamogeton crispus,* and *Utricularia flexuosa.* The interesting Pteridophytes growing nicely here are the two species of *Salvinia; Salvinia rotundifolia* and *Salvinia oblongifolia,* which are not commonly met with, except the latter which was recorded from one more locality. There is so much vegetative growth in the former that the tank in full is a few days, and some plants have to be removed out of it.

Therf are innumerable smaller ponds and pools round about the city of Gorakhpur, some of them are used for bathing and washing clothes, but, a good number of them remain unused by human beings. They also present a good number of hydrophytes, at least for sometime during the year, but all of them have not been enumerated here, as the plants growing there are common to those which have already been described. *Ottelia alismoides,* was recorded only from Asuran Ka Pokhara, together with a dense growth of *Nelumbium speciosum* and *Jussiaea repens.* Plants listed above in different habitats are in the order of their prominence at a particular locality and no phylogenetic system of classification has been followed.

ECOLOGICALLY INTERESTING PLANTS

The most widely distributed and commonest of the water plants in this area is *Eichhornia crassipes*, locally known as 'Jal-kumbhi,' *Eichhornia sp.*, introduced %as ornamental plant, has become a serious pest, (Lawrence 1951). In India, this also seems to be a recently^ introduced genus, as we find a very little account in the order floras of India. Waters which aie slow moving, ponds xn the city and jlieels in the outskirts, hardly look to be such and resemble more to green terrestrial fields. This is due to r*pid vegetative growth, that no place in the water is left. The plant reproduces vegetatively so much that the whole pond is covered in no time, and hence it has become a terrc* and the state government is searching measures to get rid of the pest. The plant when floating freely has large bladder like swollen petioles, but much ecological variations in the form of petiolate floats have been observed in the same pond. Because of much vegetative growth the plants lie so close to each other, that the leaves start overlapping and those remaining outside water produced smaller floats, at the same time some other leaves may come out and spread in different directions (the probable reason for which can be physiological) and the petiolate > floats of these leaves take the shape of spindles from 6-10 inches in length, which is quite remarkable.

In another locality very close to river Rapti, a few scattered plants were found growing on perfect sand after the floods. After digging a few inches in the sand, water came up, but there was no change in the shape and size of the floats depending upon the plant, as can be expected, because there is no necessity of such an structure in dry land. At another place close to Bichia stream, which in the month of March and April becomes very thin and shallow, the plants had absolutely no swollen petioles and their form was entirely different from what we find in it. This may be suggestive to represent stage of succession from water to land vegetation.

The large distribution of *Eichhornia crassipes* in this area is due to occasional floods. The plant is taken away by water current to distant places. This plant has been observed in bloom at two times during the year, one in the month of March and April and second near about September and October. Reproductive capacity of plant by seeds has not been estimated, but as has been said propagation by vegetative means is very significant. It is strange to note that this pest in the east has not reached the area investigated by Misra (1946).

***Ipomoea aquatica (I. reptans)* grows at many places in muddy soil, but may also occasionally reach some distance in the open water, with the aid of aerenchymatous stem (Misra 1946). When the water recedes the margins of the pond dry first and because of this, plant can not get the amount of water it requires, so it runs towards water, giving roots at each node, except at younger Parts and tip, which reaches the water and remains there as a whole. So the habit of the plant can hardly be said to be floating as stated by Pattnaik and Patnaik (1956).**

Ceratophyllum dcmcrsum is also quite common but does not occur in such great abundance anywhere in this area, so as to drive out nearly all other competitors (Arber 1920). Ecologically there is hardly any difference in 'leafy-shoots' and 'rhizoid-branches' in the specimens collected over here, as is ordinarily the case in the plant.

Ranunculus sclcratus is most common at Ramgarh lake, whereas it is completely absent in some other places, or rarely found. It is capable of both land and water life, and may easily be included as one of the typical marsh plants. This species here was never seen growing in deep waters, but can live "nicely well when flooded, and hence the phenomenon of heterophylly shown by it. In real sense no necessity was observed for different types of leaves in the plant, yet it produce them from the very beginning, the compound and lobed below and simple and entire above, respectively. There is hardly any difference in number of stomata in the different types of leaves (Arber 1920), as the leaves hardly remain submerged or floating in water for a longer period.

Polygonum serrulatum grows well in marshy places to perfect water together with *Eichhornia crassipes* at some places, giving out roots from one or two lowermost nodes. The stem increases in thickness from below, but no aerenchyma was observed, which may be expected in the swollen stem. There is much increase in the size of the pith, which becomes quite extraordinary, and even in the oldest stem which was sufficiently thick, no secondary growth was observed, the detail account of which would be superflous over here.

Jussiaea repens grows abundantly at Narhi Tal only, though recorded from Asuran Ka Pokhra and Ramgarh Tal also. It grows in shallow waters when it developes spongy roots and the plant hardly shows any trichomal growth over it. When the water dries the plants are left in moist soil only, but they grow equally good in that condition, when there are no more spongy roots and it developes trichomes also.

ECOLOGICAL CLASSIFICATION OF THE RECORDED PLANTS

The plants listed below are in order of their prominence and true nature to the category, and no system of classification has been followed here. The author has made a very free use of Arber's (1920) and Dudgeon's (1920) schemes and has elaborated it depending only on those plants which have been collected from .this area. This scheme is open to criticism and a number of other plants can be accommadated here. The difficult situation arises at places when a plant shows different behaviour in different environments; like *Jussiaea repens, Eichhornia crassipls,* and *Ipomoea aquatica* etc., and then this scheme fails.

A. Free-floating Aquatic Stage:—

Many of the algae come under this category of which there is a great variety and form, but no consideration to the algal flora has been made here. The recorded vascular plants in this stage are:—

I. Rootless:—

- (i) *Salvinia rotundifolia.*
- (ii) *Salvinia oblongifolia.*

II Rooted—

- (i) *Spirodela polyrhiza.*
- (ii) *Lemna •minor,*
- (iii) *Eichhornia crassipes.*
- (iv) *Azolla pinnata.*

B. Attached Floating Aquatic Stage:—

Here in this category the leaves of the plants completely come up on surface of water and float, but in the species of *Potamogeton,* some of the leaves float while others remain submerged, and all the plants here are rooted.

- (i) *Nymphaea Lotus.*
- (ii) *Nelumbium speciosum.*
- (iii) *Euryale ferox.*
- (iv) *Trapa bispinosa.*
- (v) *Jussiaea repens.*
- (vi) *Jussia?a sujfruticosa.*

C. Submerged Aquatic Stage:—

This stage is prominent from the succession view point. A few plants are rootless throughout, but others become attached and give out roots when water recedes, for example *Hydrilla verticillata* remain submerged and free but when growing in shallow waters may give out roots at many places.

I. Rootless and Free—

- (i) *Potamogeton crispns.*
- (ii) *Utricularia flexuosa.*
- (iii) *Utricularia stellar is.*

II. Rooted and Attached:—

- (i) *Vallisneria spiralis.*
- (ii) *Hydrilla verticillata.*
- (iii) *Ottelia alismoides.*
- (iv) *Naias graminea.*
- (v) *Zanichellia paluslris.*

D. Attached Emersed Aquatic Stage:—

Plants recorded in this stage are confined to shallow waters, which may be called marchy places, and they are left stranded when the water recedes.

They can be called amphibious because they grow successfully for quite a long time even when exposed. Primarily they are aquatic plants, but in many cases occur as land forms.

(i) *Marsilea quadrifolia.*
(ii) *Marsilea erosa.*
(iii) *Eleocharis congesta.*
(iv) *Scirpus sp.*
(v) *Ranunculus scleratus.*
(vi) *Ipomoea aquatica.*
(vii) *Monochoria vaginalis.*
(viii) *Sagittaria sagittifolia.*
(ix) *Typha sp.*
(x) *Oenanthe stoloniformis.*

E. Wet Medow Stage:—

The plants in this category consist of vegetation on the margins of moist ground near the lakes and pools. They are primarily land plants, but grow mostly near water and moist soil and show hydrophytic characters due to climatic and adaphic factors especially. There are a numLer of plants that can be included here but only those plants are listed below which are very true to this category and are most prominent and the rest are only inumcrated in the recorded list.

(i) *Rumex dentatus.*
(ii) *Veronica anagalis.*
(iii) *Bergia ammanoides.*
(iv) *Polygonum plebejum.*
(v) *Ammania baccifera.*
(vi) *Chenopodium murale.*
(vii) *Eclipta erecta.*
(viii) *Alternanthera sessilis.*
(ix) *Fimbristylis sp.*
(x) *Polygonum glabrum.*
(xi) *Polygonum serrulalum.*
(xii) *Caesulia axillaris.*
(xiii) *Cyanotis axillaris.*
(xiv)» *Xanthium strumarium.*
(xv) *Salviaplebia.*, and many others.

SPECIFIC ENUMERATION OF PLANTS RECORDED

On the basis of collection made by the author throughout this survey round about Gorakhpur, the following data can be given at the present stage:—

PTERIDOPHYTA

1. Equisetales (i) *Equiselum sp.*

2. Hydroptcridineae—

(i)	**Marsileaceae**	(i)	*Marsilea quadrifolia L.*
		(ii)	*Marsilea erosa.*
(ii)	***Salviniaccae**	(i)	*A zolla pinnata.*
		(ii)	*Salvinia oblongifolia.*
		(iii)	*Salvinia rolundifolia.*

ANGIOSPERMS

Dicotyledons

I	**Kanunculaceae**	(i)	*Ranunculus sclerakts* Linn.
II	**Nymphaeaceae**	(ii)	*Nymphaca Lotus* Linn.
		(ii)	*Nymphaea stellata* Willd.
		(iii)	*Euryale forox* Salib.
		(iv)	*Nelumbium speciosum* Willd.
III	**Elatineae**	(i)	*Bergia ammanoides* Roxb.
IV	**Papilionaceae**	(i)	*Medicago denticulata* Willd.
V	**Lythraceae**	(|)	*Ammania baccifera* Linn.
VI	**Onagraceae**	(i)	*Jussiaea repens* Linn.
		(i|)	*Jussiaea suffruticota* Linn.
		(iii)	*Trapa bispinosa* Roxb.
VII	**Umbelliferae**	(i)	*Oenanthe stoloniformis* Wall.
VIII	**jCompositae**	(i)	*Eclipta erecta* Linn.
		(ii)	*Xanthium strumarium* Linn.
		(iii)	*Gaesulia axillaris* Roxb.
IX	**Gentianaceae**	(i)	*Limnanthemum cristatum* Griseb.
X	**Convolvulaceae**	(i)	*Ipomoea aquatica* Forsk.
XI	**Scrophulariaceae**	(i)	*Veronica aangallis* Linn.
XII	**Lentibulariaceae**	(*.)	*Utricularia flexuosa* Vahl. Enum
		(ii)	*Utricularia stellaris* Linn.
XIII	**Acanthaceae**	(i)	*Hygrophila polysperma* T. Anders
XIV	**Verbenaceae**	(i)	*Lippia nodiflora* Rich.
XV	**Labiatae**	(i)	*Salvia plebia* **R.Br.**
XVI	**Amarantaceae**	(i)	*Alternanthera sessilis* **R.Br.**
XVII	**Chenopodiaceae**	(i)	*Chenopodium murale* Linn.
XVIII	**Polygonaccae**	(i)	*Polygonum Plebejum* R. Br.
		('')	*Polygonum glabrum* Willd.
		(iii)	*Polygonum serrulatum* Lagasc.
•		H\r\ (IV)	*Rumex dentalus* Linn.
XIX	**Ceratophyllaceae**	(i)	*Ceratophylhtm demersum* **Linn.**

Monocotyledons

XX	**Hydrocharitaceae**	m	**Hydrilla verticillata* Royle.
		(ii)	*Vallisneria spiralis* Linn.
		(iii)	*Ottelia alismoides* Pers.
XXI	**Wiaceae**	(i)	*Asphodelus tennifolius* Linn.

XXII	rontedenaceae	(i)	*Eichhornia crassipes* Solms.
		(ii)	*Monochoria vaginalis* Presl.
XXIII	Commelinaceae	(iii)	*Commelina benghalensis* Linn.
		(ii)	*Cyanotis axillaris Sch.*
XXIV	Typhaceae	(i)	*Typha sp.*
XXV	Lemnaceae	(i)	*Lemna minor* Linn.
		(ii)	*Spirodela polyrhizc* Schleid.
XXVI	Aponogetonaceae	(i)	*Aponogeton monostckyon* Lirn.
XXVII	Alismaceae	(i)	*Sagittaria sagittifolia* Linn.
XXVIII	Potamogetonaceae	(i)	*Potamogeton indicus* Rqxb.
		(ii)	*Potamogeton crispus* Linn.
		(iii)	*Potamogeton pectinatus* Linn.
XXIX	Naiadaceae	(i)	*Naias graminea* Del.
		(ii)	*Zannichellia palustris* Linn.
XXX	Cyperaceae	(i)	*Fimbrislylis sp.*
		(ii)	*Eleocharis congesta* Don. Prodr.
		(iii)	*Scirpus sp.*
		(w)	*Cladium maroides* P. Brown.
XXXI	Gramineae	(i)	*Andropogon intermedius* Br. Prodr.
		(ii)	*Eleusine aegyptica* Desf.
		(iii)	*Saccharum sp.*

SUMMARY AND CONCLUSION

A brief account of the survey of aquatic and swampy plants of Gorakhpur has been given. The study was done throughout the year, after the 1955 floods round about the city of Gorakhpur. A list of those plants met with in different habitat and localities have been made. A few ecologically interesting plants have also been described. The ecological classification of the plants has also been given.

According to Fassett (1940), 'on aquatic is defined as a plant that may, under normal conditions, germinate and grow with at least its base in the water and is large enough to be seen with naked eye. Under some conditions almost any plant may be found in the water.' On this basis mentioned in the later sentence, the author has not included many other Angiosperms collected near lakes and pools and from the moist grounds. Only those plants have been given much stress which were found growing in water, in soil covered with water or in swamps. No due consideration to algal flora has been given in this paper.

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LITERATURE CITED

1. ARBER, A. 1920, Water Plants, Cambridge.

2. BISWAS, K. & CALDER, C. 1954. Hand-book of Common Water and Marsh Plants of India and Burma. Delhi.

3. DUDGEON, W. l£20. A contribution to the Ecology of the Upper Gangetic Plain *Jour. Indian Bot. Soc.* 1.

4. DUTHIE. J.F. 1918. Flora of Upper Gangetic Plain, Calcutta.

5. FASSETT, N. C. 1940. A Manual of Aquatic Plants. New York & London.

6. HOOKER, J. D. 1879. Flora of British India, London.

7. KENOYER, L. A. 1924. Weed Manual of Gwalior State and Adjacent Parts of India. Calcutta.

8. LAWERENCE, G.H.M. 1951. Taxonomy of Vascular Plants. The Macmillan Co. New York.

9. MIRASHT, M.V. 1954. Studies in the Hydrophytes of Nagpur. *Jour. Indian Bot. Soc.* 33 : 294-308.

10. MISRA, R. D. 1946. The Ecology *of* Low Lying Lands. *Indian Ecol.* 1 : 11.

11. PATTNAIK, N. & PATNAIK, N. K. C. 1956. The Hydrophytes of Cuttack. *Jour. Indian Bot. Soc.* 35 : 157-170.

12. PURI G. S. & MAHAJAN, S. D. 1957. Studies on the Vegetation of Mahabaleshwar. *Proc. Ind. Sci. Cong.* Part. Ill *Abs.* p. 288.

13. PURI, G. S. & MAHAJAN, S. D. 1958. The Vegetation of Marshes & Swamps in PoonaDistt. *Proc. NJ.S.* (In Press)

14. WEAVER, J. C. & CLEMENTS, F. E. 1938. Plant Ecology. New York.

15. WILLIES, J. C. 1951. A Dictionary of the Flowering plants and Ferns. Cambridge.

ANTIPODALS DURING THE DEVELOPMENT OF CARyOPSIS IN EUGHLAENA MEXICANA SGHRAD

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A tendency towards the multiplication of antipodal tissue is a feature noticeable in the family Gramineae (Hector, 1936). Embryological investigations on plants belonging to the tribes Chlorideae, Hordeae, Paniceae, Andropogoneae, and Maydeae (of the sub-families Poideae and Panicoideae) reveal the presence of a large number of antipodal cells. An increase in number as well as size of antipodal cells is reported in *Pennisetum typhoideum* (Narayanaswami, 1953), *Panicum miliare* (Narayanaswami, 1955 a), and *Echinochloa frurmntacea* (Narayanaswami, 1955 b). In *Triticum* (Kõrnicke, 1893) the primary antipodal cells have been observed increasing vigorously in number and size to produce finally a convex mass of 6-10 or at times 36 cells. Such investigations in the tribe Maydeae are, however, restricted to *Zea* anc* *Euchlaena.* Embryo sacs of *Zea mays* (Hector, 1936) bearing 24-36 antipodal cells are on record. Antipodal complex in *Euchlazna m°xicana* consists of 30 or more cells (Cooper, 1938). The present author came across an increase in size of antipodal cells ot*Euchlasna mwicana,* a hitherto unreported feature, and he thus takes the opportunity to put it on record.

MATERIAL AND METHODS

Most of the observations recorded here are from microdissections of ovules after Paliwal's technique (Paliwal, 1953). The excised embryo sacs are stained with propino-carmine or Feulgen's solution and mounted in glycerine jeliey. To confirm microdissections, observations have also been made form serial sections.

OBSERVATIONS

The organized embryo sac of *Euchlaena mexicatoa* is an eight nucleate and seven celled structure (Fig. 1), bearing an egg apparatus, two polar nuclei and ^ree antipodal cells. The present author, besides recording an increase in number of antipodal cells, has also observed a considerable increase in their size as well even before fertilization (Fig., 2 & 3). At eight nucleate stage the biggest of the three antipodal cells is 46.15/1 long and 19.31/i broad, but with the growth in size of an embryo sac the antipodals increase in number as well as size,and the biggest cell among them becomes 115.37/x long and 92.31f* broad. *n ovules showing post-fertilization stage of zygote and primary endosperm nucleus (fig; 4) antipodal cells 100/*X64/I are observed. Measurements at the cellular, endosperm stage (Fig. 5) re\«al them to be *69.23fi* X 46.15M.

.The increase in size of antipodal cells appears to be inversely proportional to their number in an embryo sac, so that when the number is more they are less prominent in size and when the number is less they have a bigger size. Thus biggest cell among a group of thirty antipodals averages 63.08/1 X 61'54/*, while in an embryo sac with only twelve antipodal cells the size is 115.37/* X 92.37M.

The antipodal cells either at first become elongated and then become broader to finally have a more or less spherical shape, or the cells assume a spherical shape from the very start. The enlarged cells, which soon become vacuolated and multinucleate, take a dark stain. Vacuoles occur nearer the periphery of cells while their centres are occupied by the nuclei and cytoplasm (Fig. 3). Antipodal cells are traceable in embryo sacs with quite well developed endosperm (Fig. 5). Cooper (1938) reports that they are present even in mature grains.

This extremely enlarged antipodal complex is not very much like that of *Eleusine coracana* (Narayanaswami, 1955c), to which haustorial function has been assigned. They are, however, observed to be most active and inflated at the advanced embryo sac stage and during the formation of endosperm their size gradually decreases and finally they disappear or persist as greatly pressed cells in the mature grain. From a study of both sections and dissections the author concludes that sections do not always present a complete picture of such organs. Paliwal (1953) and Singh (1957) have expressed a similar difficulty while working on Santalaceae and Cucurbitaceae respectively. This may probably be the reason why previous workers, who studied through sections alone, completely ignored this significant enormous increase in size of antipodal cells.

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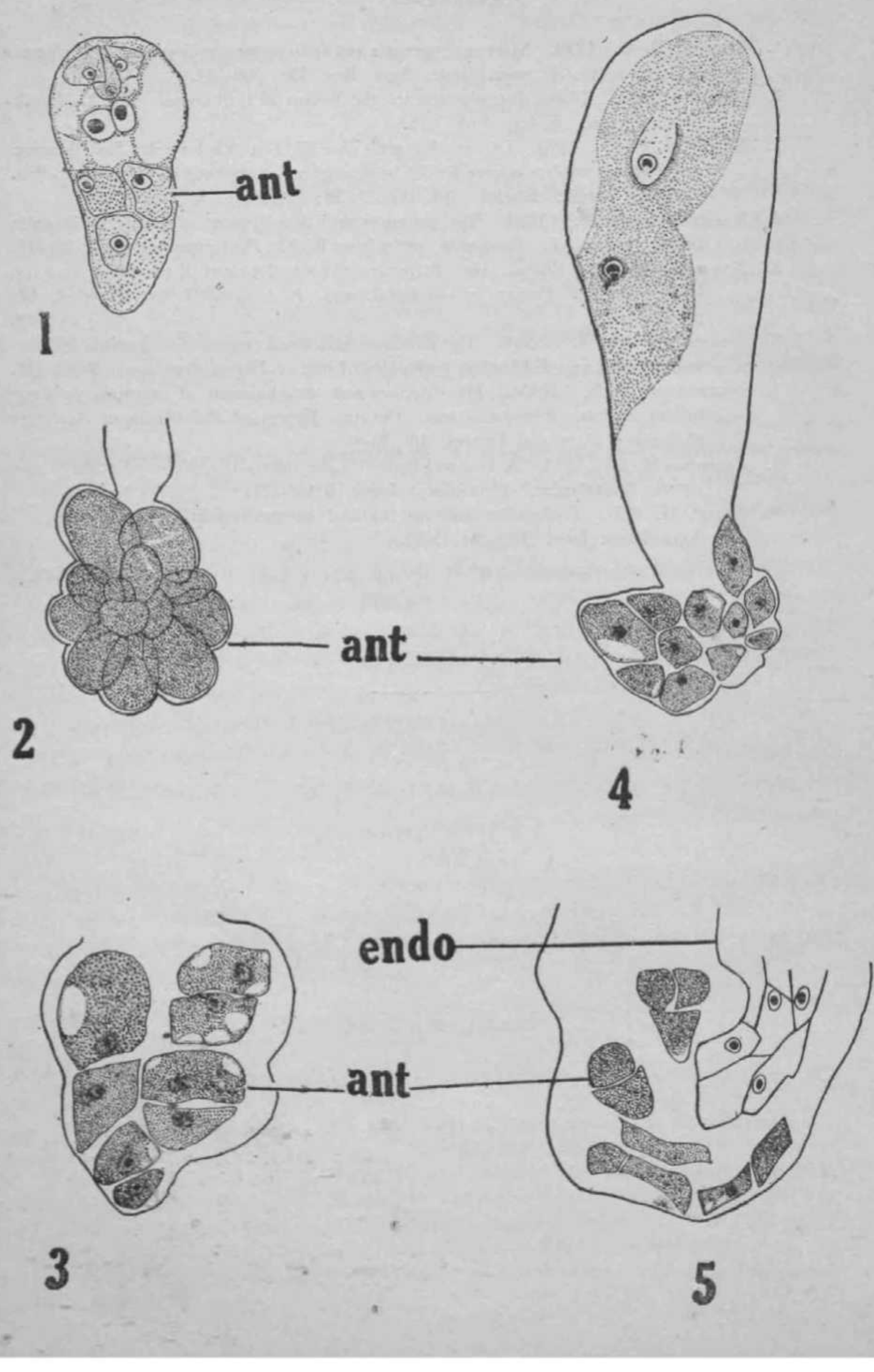
EXPLANATION OF FIGURES

Abbreviations: *·ant,* antipodal cells; *endo,* endosperm.

Fig. 1, Organized embryo sac. X30. Fig. 2, Antipodal region of an embryo sac, showing antipodals after their increase in number and size prior to fertilization. xl60 Fig. 3, Antipodal region of an embryo sac, showing multinucleate and vacuolate condition of antipodal cells after their increase in number and size prior to fertilization. x80. Fig. 4, Fertilized embryo sac showing the zygote and primary ndosperm nucleus. x!60. (Figures 2, 3 & 4 are from microdissections, overlapping antipodals in Fig. 3 & 4 have been separated out by tapping the slide.) Fig. 5, Embryo sac at cellular endosperm stage, capping the endosperm are the antipodal cells. xl60

REFERENCES

1. COOPER, D. C. 1938. Macrosporogenesis and embryo sac development in *Euchlaena mexicana* and *Zea mays*. Jour. Agri. Res. 55: 539-551.
2. HECTOR, J. M. 1936. Introduction to the Botany of field crops. Vol. 1. South African Agri. Series, Vol. 16.
3. KÖRNIGKE, F. A. 1896. Untersuchungen über die Entwickelung der Sexualorgane von *Triticum* mit besonderer Berücksichtigung der Kerntheilungen. Verh naturhist. Ver. d. Preuss. Rheinl. und. Westf. 53: 149.
4. NARAYANASWAMI, S. 1953. The structure and development of Caryopsis in some Indian millets. I. *Pennisetum typhoideum* Rich. Phytomorphology, 3: 98-111.
5. NARAYANASWAMI, S. 1955a. The Structure and development of caryopsis in some Indian Millets. *Panicum miliare* Lamk. and *P. miliaceum* Linn. Lloydia, 18: 61-73.
6. NARAYANASWAMI, S. 1955b. The structure and development of caryopsis in some Indian Millets. *Echinochloa frumentacea* Link. Phytomorphology, 5:161-171.
7. NARAYANSWAMI, S. 1955C. The structure and development of caryopsis in some Indian millets. *Eleusine coracana* Gaertn. Papers of the Michigan Academy of Science, Arts and Letters, 40: 32-46.
8. PALIWAL, R. L. 1953. A new techinque for the micro-dissections of embryo sacs of the Santalaceae. Phytomorphology, 3:118-121.
9. SINGH, D. 1957. Endosperm and its chalazal haustorium in Cucurbitaceae. Agra Univ. Jour. Res, 6; 75-89.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RETARDATION IN THE RATE OF GERMINATION OF CAJANUS CAJANJXINN) MILLSP. SEEDS TREATED WITH COLCKICINE

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Colchicine is generally utilized to induce polyploidy. Seeds soaked in colchicine, however, shoW a retarded rate of germination and subsequent unhealthy growth of seedlings. This effect in most cases is found to increase with the increase in time of application and concentration of the chemical (Bates, 1939; Tomar and Khanna, 19551. Richaria (1940) has, however, stated, that in seedlings there is a saturation point in the absorption of colchicine which in higher concentrations is toxic and leads to reduced percentage of germination as well as stunted growth. The present author, in an attempt to induce polyploidy in *Cajanus cajan* (Linn.) Millsp., observed undoubted retardation in percentage of germination in different treatments which depended on concentration as well as duration of treatment.

MATERIAL AND MRTHOD

Seeds *of Cajanus cajan* were soaked in water for 21 hours when the radicle just appeared. They were then treated with colchicine. Each treatment consisted of immersing ten seeds, in five replications, in aqueous solution of colphicine of tbe following concentrations: .05%, .1%, .2%, .4%, .6% and .8% for 1, 2, 4, 8, 12, 18, 24 and 48 hours. At the end of each treatment the seeds were thoroughly washed with water to remove all traces of colchicine. They were then sown in different pots with proper labels. The seedlings which appeared above the ground after three to four days of sowing were counted.

OBSERVATIONS

Table I

Showing germination percentage under different treatments.

Cone./	Duration of Treatments lhr.	2hrs.	4hrs.	8hrs.	12hrs.	18hrs.	24hrs.	48hrs.
.05%	76	62	72	40	36	46	36	8
.10/0	80	70	76	50	54	10	26	4
.2%	70	74	60	34	44	20	6	0
.4%	64	60	50	18	48	12	6	6
.6%	74	36	28	20	20	8	8	2
.8%	64	54	40	22	16	14	6	2

It is clear in table I that the percentage of germination decreases with the increase either in the concentration of colchicine or of duration of treatment. Thus seeds treated with .05% colchicine for one hour show 76% germination while those treated for 48 hours show only 8% germination. This is true of all the concentrations of colchicine, barring a few exceptions probably due to experimental error, underlined in the table. This gradual reduction in the percentage of germination of seeds of *Cajdaus cajan* is due to the deleterious and toxic effect of the chemical with Us increased concentration and duration of soaking

Table II

The table for Analysis of Variance (On the basis of germination, counts per pot)

	d. f.	S* a.	Mean ss variance ss/d. f.	F value	Remarks
Cone.	**5**	195.1	39 2	**14.05**	Significant difference
Time.	**7**	1117.8	159.6	22.8	Significant difference
Interaction	35	137.0	3.9	1.3	Non-significant interaction.
Error	192	546.4	**2.79**		

The analysis of variance (Table II) clearly shows that there is no interaction between concentration and time and that they are undoubtedly significant. The effect of increased concentration of colchicine on the percentage of germination is shown in table III while that of duration of treatment in table IV.

Table^IH shows that wider variation in the concentration produces significant reduction in the percentage of germination. At .6% and .8% concentrations of colchicine germination counts are significantly low' as compared with those obtained with .05% to .4% solutions of colchicine. Table III also shows that there is no difference in the percentage of germination between .05% and .1%, .2% and .4%, and .6% and .8%.

Table III

Germination percentage under different cone, of colchicine.

Cone, of chemical	Germination percentage in a particular cone.		Critical difference at 5% level,	at 1% level
·05%	**47.0**		7.3	9.6
		No difference		
·1%	**50.0**			
·2%	**38.5**			
		No difference		
·4%	**43.0**			
·6%	**24.5**			
		No difference		
·8%	**24.7**			

Table IV

Germination percentage for different duration of treatment

Duration of treatments	Germination percentage		Critical difference at 5% level,	at I % level.
1	7L3		*8A*	11.1
2	**59.0**			
		No difference		
4	**54.3**			
8	**30.6**			
		No difference		
12	**36.6**			
18	23.3			
24	14.6			
48	3.6			

It is quite clear from Table IV that the percentage of germination is adversely affected with increase in the duration of treatment. The maximum germination 71.3% is obtained when the seeds are soaked for one hour. In those soaked for two hours the percentage of germination is found to be significantly reduced to 59.0. The same is true for the duration of treatment for !2, 18, 24, and 48 hours. There is, however, non-significant difference observed in 2 to 4 and 8 to 12 hours treatments.

CONCLUSIONS

The foregoing investigation clearly shows that the percentage of germination of the seeds of *Cajanus cajan* treated with colchicine is inversely proportional to concentration and duration of treatment as revealed by Table I. This reduction in germination percentage ^ with increased concentration and duration of soaking is probably due to the toxic action of the chemical and deleterious physiological response of the organism to the chemical. This view is also expressed by Schwanitz (1950) and Tondon (1950). An increase in time also brings about the same effect for the same concentration as has been shown by the present study. It has also been reported by Tomar and Khanna (1955).

ACKNOWLEDGMENTS

My heartfelt thanks are due to Prof. Bahadur Singh lor guidance and eontinued interest in the work as well as for helpful suggestions and valuable criticism. I am grateful to Dr. R. L. Paliwal for suggesting this problem.

REFERENCES

1. Bates, G. H. (1939) Polyploidy induced by colchicine and its economic possibilities. Nature 144 : 315-316.
2. Richaria, R.H. (1940) Tetraploid Til *(Sesamum orientate)*. Curr. Sci. 9; 542.
3. Schwanitz, F. (1950) Untersuchungen and Polyploiden pflanzen. VII. Zur Atmung diploider und tetraploider *Pflanzen.* Ziichter, 20: 76-81.
4. Tondon, S. L. (1950) Golchicine induced polyploidy in spinach, Gurr. Sci. 19: 66.
5. Tomar, M. S. and Khanna, A. N. (1955) Colchicine induced polyploidy in radish. Ind. Jour. Hort, 12: 1-9.

A NOTE ON AIR-LAYERING IN *MORUS ALBA*^

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Mulberry is an*ideal tree for yielding quick financial returns through its fnfits, leaves and timber. It primarily belongs to the temperate zone and thrives exceedingly well in a "tea climate"; still various species of *Moras* are being grown all over India. It has a good dietetic value and is an indispensable plant for rearing silkworms. Mulberry commands a very good market for its timber from which hockey sticks and badminton rackets are manufactured.

Until recently mulberry has been much neglected by the fruit growers of Uttar Pradesh. The State Government has established a well-equipped fruit processing factory in the midst of the orchard area at Ramgarh, where fruit pulp and juices are produced and the market for the fruits is assured. This progress created interest in the growers and thus the mulberry plantations have become a craze among the cultivators.

Since long, propagation of *Morus* by cuttings has been common practice. Budding and inarching can also be successfully done, but no attempt has been made, so far, on marcottage in *Morus.* Marcottage in *Morus* was, therefore, taken up to obtain mulberry plants of dwarf and bushy nature and having plenty of roots, in a shorter period.

About 2 years old shoots, which had developed light brown colour and had an approximate diameter of one to two centimetres on fully grown trees at botanical garden, Government Agricultural College, Kanpur, were taken. A ring of bark about half an inch wide, i" below a plump and dormant bud, was removed, on 10th September, 1957. The following hormone concentrations mixed in lanolin were applied on the lower bud and around it :—

Name of the hormones.	Concentrations in parts per million.				
0) Naphthalene acetic acid.	5;	10;	20;	and	30 thousand.
(2) Indole acetic acid.	5;	10;	20;	and	30 thousand.
(3) Indole butyric acid.	5;	10;	20;	and	30 thousand.

There were 10 marcottees under each treatment and they were covered with a mixture of compost and sand in the proportion of one part compost and 3 Parts sand, and were wrapped with gunny piece and tied. Marcottees were watered daily.

The marcottees were severed from the parent plant, two months after from the time of initial treatment, untied, unwrapped and washed carefully. The results obtained are given below :—

Table showing effect of different fcormones on rooting in Macrottage of Morus alba.

Treatment.	Concentration in parts per million.	% of Rooting	Average No. of roots per gootee.	Average length of roots in cms.	No. of Fig.
I. Naphthalene Acetic Acid.	(a) 5,000	8C	43	3.35	1
	(b) 10,000	100	68	4.20	2
	(c) 20,000	50	30	3.00	.
	(d) 30,000	20	5	0.84	.
II. Indole Acetic Acid	(a) 5,000	£0	50	3.90	3
	(b) 10,000	80	above 100	2.90	4
	(c) 20,000	60	60	3.83	.
	(d) 30,000	60	30	2.20	•
III. Indole Butyric Acid	(a) 5,000	80	above 100	7.00	5
	(b) 10/100	100	40	4.10	6
	(c) 20,000	60	5	2.30	•
	(d) 30,000	60	9	1.50	*
Control	...	Nil	.	.	7

From the table, it is apparent that rooting in marcottage in mulberry responds well to all the hormone treatments tried, yet the lower concentrations, i.e., 5,000, and 10,000 parts per million naphthalene acetic acid (Figs. 1 & 2,) indole acetic acid (Figs. 3 & 4) and indole butyric acid (Figs. 5 & 6) have given better results. The control (Fig. 7) treatment did not show any apparent rooting except callus formation.

Fig. 1.

Fig. 2.

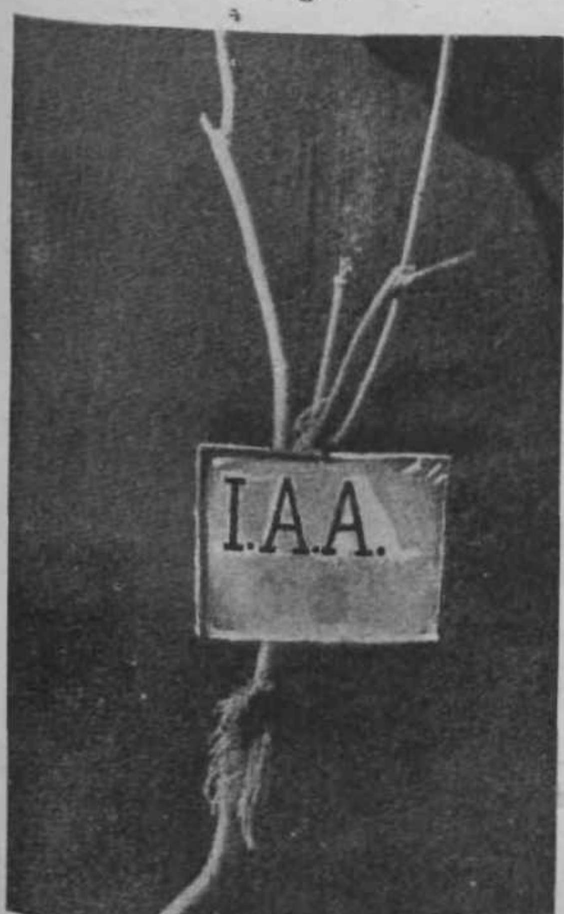

Fig. 3.

Fig. 4.

Fig. 5.

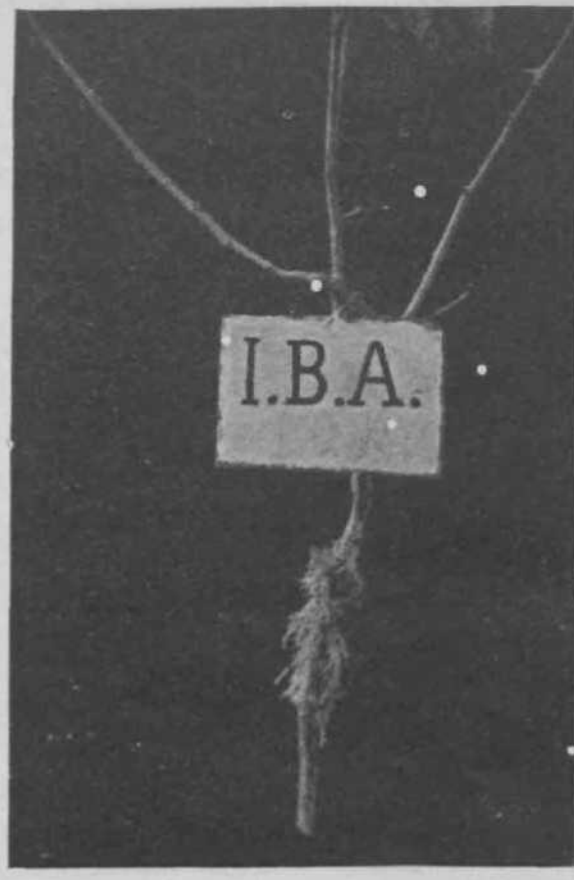

Fig. 6.

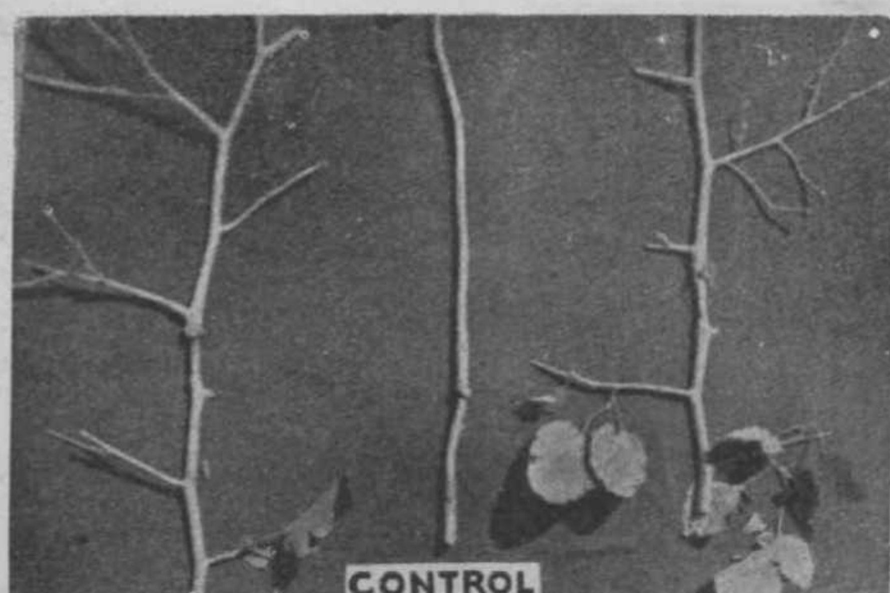

Fig. 7.

PAPYROpRAPHIG CHARACTERIZATION OF NON-VOLATILE ORGANIC ACIDS IN SOME EDIBLE WILD FRUITS OF NAINITAL

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INRODUGTION

Kumaon region in the Himalayas is very rich in vegetation but on account of poor irrigation system and limited cultivable land, the yield of cereals and vegetables in this area is not sufficient for the population. As most of the cultivators and local people are economically poor, they cannot afford to purchase the imported grains and vegetables. Under the circumstances most of the inhabitants, in time of need when there is scarecity of the cultivated products, utilise fruits, young shoots, tubers or other parts of the wild plants.

A detailed list of unusual and supplementary food plants of this region has been given by Bhargava (1958). The authors in earlier communications (1958a,b,c,d) have chromatographically analysed sugars and non-volatile organic acids in some of the wild fruits of this region. In the present brief article the non-volatile organic acids present in some wild edible fruits are being communicated.

EXPERIMENTAL

Juices of fresh rips fruits were prepared by crushing them in a glass mortar and centrifuging the extract for 10 minutes at 4,000 r.p.m. The concentration of the fruit juices was increased to double their strength by first spotting 0.004 ml. on Whatman No. 1 filter "paper, drying and then again putting the same volume at the same spot (when more quanitity of the fruit juices was spotted, it resulted in streaking of the spots). A number of known organic acids (0.002 ml. of 1% solution) were also spotted on the same chromatogram on which the fruit juices were chromatographed.

The upper layer of n-butanol - formic acid - water (10 : 2 : 5, v/v; Kalyanankar *et al*, 1952) was used as solvent phase. The chromatograms, after developing by the descending technique for 24 hours, were first air dried over right at room temperature (20° -24° C.) and then agiin dried at 75°-80° C. for about one hour. Tne acids were located as lemon yellow spots on the chromatograms by spraying the paper with bromo-phenol-blue (0.08 gm. in 100 ml- of 95% ethanol). The Rf values ofigluconic*, oxalic, tartaric, ascorbic,

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•Gluconic acid forms an equilibrium mixture with its lactone in aquous solution, and since bromo-phenol-blue is specific only for carboxylic acids so the Rf value given here is of gluconic acid and Yiot of its lartonr.

citric, malic, malonic and succinic acids were also determined and were found (o be 0.12, 0.2, 0.25, 0.33, 0.36, 0.43, 0.66 and 0.76 respectively.

The following non-volatile organic acids have been found to J)e present in different fruits: citric and malic acids in the fruits of *Myrica nagi* Thumb. (Kaiphal) and *Rubus lasiocarpus* Smith (Kala hisalu); and malic acid only in the fruits of *Berberis lycium* Royle (Kilmora) and *Crataegus crenulata* Roxb. (Ghingaru).

LITERATURE CITED

1. BHARGAVA, K. S. *Bombay Natural Hist. Soc*, 1959 (under publication).
2. GUPTA, D. R. & GUPTA, S. C. Proc. 45th Ind. Sci. Cong., part III, 146, 1958 a.
3. GUPTA, J. C Proc. 45th Ind. Sci. Cong., part III, 172, 1958 b.
4. GUPTA, J. C, GUPTA, D. R. & GUPTA, S. C. *Sci. and* CM/., 23. 480, 1958 c.
5. GUPTA, S. C. & GUPTA, D.R. *Proc. 45th Ind. Sci. Cong.*, part III, 146, 1958 d.
6. KALYANANKAR, G. D., KRISHNASWAMI, P. R. & SREENIVASAYA, M. *Cwr.Sci.* 21, 220, 1952.

INVESTIGATION OF THE KINETICS OF THE DECOMPOSITION OF POTASSIUM PERSULPHATE

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ABSTRACT

Potassium Persulphate in aqueous solution decomposes slowly at 60«C. The decomposition shows auto-inhibition in the beginning and then follows First Order kinetically. This decomposition is slightly catalysed by glass beads without disturbing its nature. Sulphuric acid exerts a strong catalysing influence on the decomposition of persulphate when the reaction follows first order without any auto-inhibition. Oxalic acid is also found to cataylse this reaction when it becomes auto-catalytic to start with and then suffers auto-inhibition, and hence shows no definite order. By increasing the concentration of oxalic acid the period of auto-catalysis increases and the reaction tends to attain Zero-Order. These observations have been explained by a homogeneous cum heterogeneous mechanism based on the formation of free radicals.

INTRODUCTION

Early WORKERS[1-6] studying the thermal decomposition of perdisulphuric acid and persulphates, observed that their decompositions in aqueous solutions were accelerated by rise of temperature and were dependent on the concentrations of the solutions. M.G. LEVI and E. MIGLIORINI' observed that the thermal decomposition of potassium persulphate was unimolecular ana was catalysed by acids. A. KURTENACKER and H. KUBINA" observed that the decomposition of persulphates was very slow and was much catalysed by silver nitrate. T.L.ALLEN[9] studying the oxidation of oxalic acid by potassium persulphate catalysed by copper and sUver ions, has suggested a ™chaiusm for the catalysed as well as the non-catalysed oxidation. J.L.R. MUKb^AN and R. H. CRIST[1]"; O. RISSE"; and A. K. BHATTACHARYA and N. R. DHAR" studied the photochemical decomposition and found that it P ™ * * ^ similar to the thermal decomposition. At higher concentration of solution and limited light intensity the decomposition followed a *ero or linear order, the velocity being proportional to the intensity of light.

It is observed from the above references that the estimation of persulphate was done, in a number of cases, by assuming the formation of sulphuric acid and titrating it with standard alkali. We, have found that this method does not give accurate estimation of persulphate, hence we adopted a slight modification of the method of BARTLETT and COTMANN" in which $NaHCO_3$ ^{H}» SO_4 buffer was used. This method bos been found to be satisfactory for the estimation of persulphate, with or without oxalic acid, sulphuric acid, potassium chloride etc.

From the above literature it is evident that the mechanism of the decomposition of potassium persulphate suggested so far is not conclusive and still leaves sufficient scope for further investigations. We, therefore felt interested in it with a view to arrive at its probable mechanism which may also throw some light on the mechanism of the reaction between potassium persulphate and oxalic acid, detailed investigations on which are in progress and will form part of the next publication of the authors.

EXPERIMENTAL

The experimental procedure was the same as followed before.[14] All salts used were of A.R.B.D.H., quality and solutions were prepared in conductivity water. Decomposition of potassium persulphate was studied alone as well as in the presence of glass beads, sulphuric acid and varying concentrations of oxalic acid. For these experiments 200 cc of freshly prepared potassium persulphate solution was taken in a 250 cc flask and kept in a thermostat maintained at the temperature of the experiment. The amount of potassium persulphate was estimated at different intervals of time, by a slight modification of the Barlett and Cotmann's method. The values of velocity constants for Zero-Order (K_o) and First Order (Kj) have been calculated by the usual formulae.

OBSERVATIONS

DECOMPOSITION OF POTASSIUM PERSUIPHATE IN SOLUTION

Table I

$K_2S_2O_8$^0.02M

(a) Temperature=60° C.

t	(a-x)	K_1	
0 nuns.	19.1 cc.		
30	18.7	0.0007063	
60	18.4	0.0006218	
120	17.9	0.0005393	
300	16.3	0.0005282	
420	15.3	0.0005281	
600	14.1	0.0005047	mean=0.00052006
840	12.6	0.0004951	
1020	11.2	0.0005234	
1260	9.9	0.0005216	

(b) Temperature = 70° C.

t	(a-x)	K_1	
0 mins	18.9 c.c		
30	17.7	0.002188	
60	16.6	0.002165	
120	15.0	0.001927	
240	12.2	0.001824	
300	10.8	0.001866	mean=0.0018472
360	9.8	0.001825	
420	8.9	0.001794	

From Table I it is observed that the velocity of decomposition of potassium persulphate in solution increases with rise of temperature. The value of first order velocity constant (K_x) is highest in the beginning which gradually decreases upto 120 mins., both at 60° C and 70° C, and then becomes constant. From the values of First Order velocity constants at 60°C and 70°C the temperature coefficient and activation energy come out to be 3.55 and 28,370 cals., respectively.

INFLUENCE OF GLASS SURFACE

Table II

K,S_aO_8=0.02 M; Temp.=:60°C. Glass beads : 2340 (diam.=0.4 cm.)

t	(a-x)	K_1	
0 mins	19.2 ex.	-	
30	18.6	0.0010590	
60	18.3	0.0007868	
120	17.7	0.0006775	
300	15.9	0.0006288	
420	14.9	0.0006039	
600	13.4	0.0005995	mean=0.00062008
840	11.6	0.0005999	
1020	10.3	0.0006108	
1260	8.9	0.0006102	

On comparing Table II with Tabk I (a), it is observed that the increase of glass surface by glass beads accelerates the decomposition of potassium persulphate, but the nature of K_t remains the same as that without the addition of glass beads.

INFLUENCE OF SULPHURIC ACID

Table m

K,S,0_8=0.02 M; H_aSO_4=0.04 M; Temp.«=60oC.

t	(a-x)	K,
0 mins.	20.1 c.c.	-
60	18.8	0.001113
120	17.7	0.001059
180	16.5	0.001096
240	15.5	0.001083
300	14.5	0.001088
360	13.6	0.001086
420	12.7	0.001093
480	11.9	0.001092
540	11.2	0.001083

mean=0.0010881

From Table III it is observed that sulphuric acid accelerates the decomposition of potassium persulphate much more, and the value of K_x remains almost constant throughout.

INFLUENCE OF VARYING CONCENTRATIONS OF OXALIC ACID

Table IV

$K_2S_2O_8$=0.02M; Temp.=60°C.
(a) Oxalic Acid=0.00125 M.

t	(a-x)	K_0	K,
0 mins.	19.3 c.c.	-	-
30	18.8	0.01666	0.0008752
60	18.0	0.02166	0.0011620
120	17.3	0.01666	0.0009135
180	16.7	.0.01444	0.0008048
240	16.3	0.01250	0.0007044
300	15.9	0.01133	0.0006465
480	14.5	0-01000	0.0005960
(b) Oxalic Acid=0.0025 M			
0 mins.	19.3 c.c.	-	-
60	18.6	0.01166	0.0006179
120	17.9	0.01166	0.0006275
180	16.6	0.01500	0.0008379
240	16.1	0.01333	0.0007561
300	15.6	0.01233	0.0007101
480	14.3	0.01042	0.0006252

(c) Oxalic Acid=0.005 M.

t	(a-x)	Ko	K_1
0 mins.	19.3 ex.	•	-
60	18.6	0.01166	0.0006179
120	17.9	0.01166	0.0006275
180	16.5	0-01555	0.0008712
240	15.1	0.01750	0.0010230
300	13.3	0.02000	0.0012420
480	12.6	0.01400	0.0008886

(d) Oxalic Acid=0.01 M .

0 mins.	19.2 ex.	-	m
30	18.9	0.01000	0.0005220
.60	18.6	0.01000	0.0005297
120	17.7	0.01250	0.0006775
180	17.0	0.01220	0.0006769
240	16.5	0.01125	0.0006314
300	15.7	0.01166	0.0006710
480	12.5	0.01392	0.0008943

On comparing Table IV and I (a) it is observed that oxalic acid exerts a catalysing influence on the decomposition of persulphate and the reaction becomes auto-catalytic for some time in the initial stage. It is further seen that the period of auto-catalysis increases with increasing concentrations of the acid and when the concentration of the acid is 0.01 M, the reaction follows a more or less zero-order.

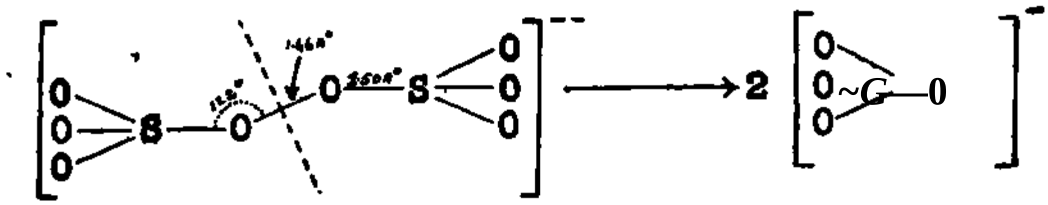
DISCUSSION

The decomposition of potassium persulphate in aqueous solution may be represented by the stoichiometric equation:

$$K_aS_aO_8+H_2O \quad -> \quad 2KHSO*+1/2O_2$$

and it is accordingly expected to follow first order as has been reported in literature.

Authors have studied this decomposition at 60° and 70° C and have noted a period of auto-inhibition of about two hours in the beginning after which the reaction follows first order. From the value of temperature coefficient (3'55) °f the reaction it may be suggested that the S_2O_8—ion, consisting of two SO_4 groups joined by an oblique covalent bond, (ZACHARIASEN & MOONEY[16]) at Wgh temperature breaks into SO_4- Radicals which bring about the decomposition of the persulphate by the following mechanism, similar to that suggested by T.L. Allen.



(Initial Step)

slow

(1) $SO_4^{-} + H_2O \longrightarrow HSO_4^{-} + OH$ (Becomes appreciable at higher concs. of SO_4^{-} and is also catalysed by glass surface.)

fast

(2) $2\ OH \longrightarrow H_2O + 1/2\ O_2$

In view of the above mechanism the rate determining process for the reaction is step (1). Hence,

$$-\frac{d[S_2O_8^{--}]}{dt} = k' \ [SO_4^{-}] \ [H_2O]$$

$$= k'' \ [SO_4^{-}]$$

i.e. $$-\frac{d[S_2O_8^{--}]}{dt} = K_1 \ [S_2O_8^{--}]$$ (Since $[H_2O]$ is very high and $[SO_4^{-}] \propto [S_2O_8^{--}]$)

This equation is supported by our observations after an interval of two hours in Table 1. The higher values of K_1 in the beginning may be due to the catalytic influence of the glass surface of the reaction vessel on the reaction between SO_4^{-} radical and H_2O in step (1) to form OH radicals, similar to that observed by ALYEA & HABER[16] in the reaction between hydrogen and oxygen. The catalytic influence of *glass* surface is further supported by our observations on the decomposition of potassium persulphate in the presence of glass beads. (Table II)

The auto-inhibition in the initial stage of the progress of the reaction is likely due to the inhibitive influence of the reaction product oxygen, which may gradually get adsorbed on the surface of the glass. Since the solubility of oxygen at 60°C will not be very appreciable, its inhibitive influence would be limited and would become constant after some time, which in our experiments reaches upto two hours. After two hours the catalysing influence of glass surface becomes constant and hence the decomposition follows a normal velocity exhibiting first order as stated above.

Sulphuric acid provides H^+ ions, which catalyse step (1) by reacting with SO_4^{-} according to the following process:

(3) $SO_4^{-} + H^+ \rightarrow HSO_4$

(4) $HSO_4 + H_2O \rightarrow HSO_4^{-} + OH + H^+$

This is supported by our observations in Table III in which the yalues of K_x are higher compared to those in Table I (a). The catalysing influence of H+ ions is so great that in their presence auto-inhibition due to the reaction product referred before is inappreciable.

Oxalic acid is found to accelerate, the velocity of reduction of potassium persulphate when it becomes auto-catalytic for a certain period in the beginning. The period of auto-catalysis increases with increasing concentration of oxalic acid (Table IV). The' total reduction in 480 mins., gradually increases by increasing the concentration of oxalic acid, but it is not proportional to the concentration of* the acid. This suggests that only a certain fraction of oxalic acid is effective in inducing this reaction and its mechanism may be governed by chain process. The catalytic influence of oxalic acid may be due to H^+ ions and C_2O_4— ions. The influence of H+ ions has already been shown above and that of C_2O_4—ions may be explained by assuming steps 5, 6, 7 and 8.

(5) $SO_4^- + G,O_4^{-} \xrightarrow[\text{fast}]{\text{comparitively}} bO_4 + CO_2^- + CO_2$

(6) $CCy^- + S_aO_8^- \xrightarrow{\text{slow}} SO_4 — + SO_4^- + CO_2$

(7) $CO_8 - 4 - SO_4^- \xrightarrow{\wedge H} SO_4$— $+ CO_2$ (chain breaking)

(8) $GO_a - H - O_2 \longrightarrow O_2^- + CO_a$ (leading to the formation of H_2O_2)[17]

(9) $OH + CO_2^- \longrightarrow CO_2 + OH^-$ (chain breaking)

GO_2-ion produced in (5) reacts with S_2O_8—regenerating SO_4~. This causes an additional decomposition of persulphate by step (6) with the result that the overall reaction becomes auto-catalytic for a certain period till the chain breakmg processes (7), (8) and (9) become prominent and auto-inhibition starts. This period should increase with increasing concentration of C_2O_4—ion which results in the production of higher concentration of CO_2~. This also accounts for the disturbance of first order decomposition of persulphate as observed in Table IV. With increasing concentration of C_2O_4—, the concentration of CO_2- will also increase and will remain almost constant when excess of oxalic acid is used, so that the rate of reduction should show Zero Order in step (6), as the velocity of reaction in (6) will depend upon the concentration of CO_2- irrespective of the concentration of S_2O_8—. This explains the tendency of the change of order from one to zero with increasing concentrations of oxalic acid. The authors have been able to confirm this observation in their previous Publication[14], by taking oxalic acid in excess.

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The authors are greatly indebted ,to Dr. A. K. Bhattacharya, D.Sc, *;R-1. C, Head of the Chemistry Department, Agra College, Agra for his kmd guidance in carrying out these investigations, without the help of which lt could not ljave been possible to bring out this publication.

REFERENCES

1. K.Elbs. & O. SCHNONHERR (Zeit Elektrochem. 1. 417. 468. 1895.)
2. K.ELBS & P. NEHER. (Chem. Ztg. 45. 1113. 1921.)
3. C. MARIE & L. J. BUNEL. (Bull. Soc. Chem. 3.30.930. 1903.)
4. A KAILAN & L. OLBRICH. (MONATSH. 47. 449. 1927.)
5. C.A.PETERS & S. E. Moody. (Amer. Journ. Sci. 4. 12. 267. 1901.)
6. L. GREEN & O. MASSON. (Journ. Chem. Soc. 97. 2083. 1908.)
7. M. G. LEVI. & E. MIGLIORINI. (Gazz. Chim. Ital. 36 (ii). 5f9. 1906.)
8. A. KURTENACKER & H. KUBINA. (Z. Anal. Chem. P3. 14-36. 1931.)
9. T. L. ALLEN (J. A. C. S. 73. 3589. 1951.)
10. J.LR. MORGAN & R. H. CRIST. (J.A.C.S. 49. 16. 338. 961. 1927.)
11. O. RISSE. (Zeit. Phys. Chem. 140. 133. 1929.)
12. A. K. BHATTACHARYA & N. R. DHAR. (Zeit. Anorg. Chem. 175. 357* 1928.)
13. BARTLETT & COTMANN. (J. A. C. S. 71. 1419. 1949.)
14. L. K. SAXENA & C. P. SINGHAL. (Agra Univ. J. Res. (Sci) Vol. 6. part 2. 1957.)
15. ZACHARIASAN & MOONEY (Z. Krist. 88. 63. 1934.)
16. ALYEA & HABER. (ref: Text book Phys. Chem. S. Glasstone. p. 1082.)
17. WEISS. (Trans. Faraday Soc. 1947.)

STUDIES ON THE CRANIAL OSTEOLOGY OF INDIAN CLUPEOID FISHES

1. The Skull of *Hilsa ilisha* (Ham.)

By JAGDISH CHANDRA MOONA, *Lecturer in Zoology^ Ramjas College, Delhi.*

INTRODUCTION

On the advice of Dr. B. M. Sinha, Head of Zoology Department Meerut College, Meerut studies on the cranial osteology of Indian Clupeoid fishes have been taken up. On going through the literature available at Zoological Survey of India library, Calcutta and elsewhere, it was found that with the exception of a few papers, very little work has been done on the osteology of the group. The only exhaustive contribution ft that of Ridewood (1904), 'On the cranial osteology of the Clupeoid fishes'. In the present paper the skull *of Hilsa ilisha* has been described which will serve as a type and the study will be extended to other Indian genera of Clupeoid fishes in due course. It is hoped that such a study, besides adding to the knowledge on the psteology of Clupeoids, will help in checking the existing schemes of classification of Clupeoid fishes.

The fishes were obtained fresh from the local fish market. Their heads were dissected out and skulls prepared by removing muscles, occasionally dipping m boiling water. For the proper study of the articulation between different bones, the entire skull was disarticulated into the cranium and a number of series—the maxillary, orbital, opercular, hyopalatine, mandibular and hyobranchial. The cranium and the series were then disarticulated into individual bones, which were studied under a hand lens or dissection microscope. The observations were confirmed with alizarin preparations of the skull.

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THE SKULL

The *skull* (plate I) of the fish is well ossified but edentulous. It is laterally compressed with the dorsal and ventral sides converging towards the tip of the snout. The skall consists of the cranium and the visceral skeleton.

THE CRANIUM

The *cranium* (plate II, figs. 1-4) is elongated and wedge shaped, the thin end of the wedge being anterior. It is about one and a half times-as long as it is wide and in its broadest region, it is half as broad as deep. On either side of the cranium in the posterior region, is an elongated supratemporal groove in which lies the temporal foramen. Behind the temporal foramen is the pre-cpiotic fossa, characteristic of the Clupeoid fishes. On the roof, in front, is a median longitudinal cleft, the ethmoidal fontanelle.

The cranium can be distinguished from behind forwards into the occipital, otic, orbitotemporal, and ethmoidal regions.

THE OCCIPITAL REGION

The occipital region is composed of four bones, a dorsal supraoccipital, a ventral basioccipital and lateral exoccipitals. All the bones of this region are replacing bones.

The *supraoccipital* (plate III, fig. 6) is an irregular bone distinguished into a dorsal superior part and a ventral inferior part. The superior part is elongated and spear-shaped, the point of the spear being directed backwards and produced into the occipital spine. Below the superior part lies the dumble-shaped inferior part, each half of which is pierced by the posterior vertical semicircular canal of the internal ear. The supraoccipital is overlap-ped by the frontals in front and articulates with the parietal and epiotic on either side.

The *exoccipital* (plate III, fig. 7) is a large and irregular bone. From its lower side is given off an inwardly directed process, which articulates with a similar process from the other side to form the base of the foramen magnum. The dorsal and lateral boundaries of the foramen are also formed by the exocci-pitals. The exoccipital is produced behind into a process which articulates with its side of the occipital condyle and projects a little beyond it. On its ventral side-is a large oval foramen for the glossopharyngeal and vagus nerves. The exoccipital joins the pterotic, prootic and opisthotic in front, the supraoccipital and epiotic above and the basioccipital below.

The *basioccipital* (plate III, fig. 8) is an elongated bone, narrow in fron (and broad behind. It terminates behind into a deeply concave occipital condyle, Above it has two depressions-the fovea saccuh, for the internal ear, and below it are a pair of linear projections, which articulate with the similar projections of the parasphenoid, to enclose the eye muscle canal. The basi-occipital articulates with the prootics in front, exoccipitals above and para* sphenoid below.

THE OTIC REQION

It comprises of a pair of auditory capsules fused to the sides of the posterior region of the cranium. Each capsule is ossified by five bones—the prootic, epiotic, sphefiotjc, pterotic and opisthotic. All the bones are replacing bones.

The *prootic* (plate III, fig. 5) lies on the ventral side forming the major portion of the cavum cranii. It is rohmboidal in form and has a foramen on the upper side for the seventh nerve. On its inner face it has a bulla for the vesicle of the swim bladder. The prootic unites with the pleurosphenoid in front, the frontal above and the pterotic, opisthotic and basioccipital behind. Tee two bones unite with each other and join with the parasphenoid below to enclose the eye muscles. With the exoccipital and basioccipital, the prootic forms auditory fenestra.

The *epiotic* (plate III, fig. 2) is a thick roughly conical bone, ossified in the posterior region of the auditory capsule. On its upper surface is a longitudinal facet for the post-temporal and on the inner side is a groove for the passage o£ the posterior semicircular canal of the internal ear. With the pterotic and parietal it bounds the preepiotic fossa. Behind, it is free and projects beyond the cranium. The epiotic joins the supraoccipital and parietal in front, the exoccipital on the inner side and the pterotic on the outer side.

The *sphenotic* (plate IV, fig. 26) is located on the anterior side of the auditory capsule, partly overlapped by the frontal. It is roughly triangular with its anterior end pointed. On its lower side is a depression for the anterior head of the hyomandibula. The sphenotic joins with the prootic below and pterotic behind.

The *pterotic* (plate III, fig. 4) is a thick sturdy bone ossified in the outer region of the auditory capsule. It has an elongated groove below for the posterior head of the hymandibula and a deep groove in front for the horizontal semicircular canal of the internal ear. Its inner face has a bulla for the vesicle of the swim bladder. The bone is produced behind into a long pointed spine projected behind the cranium. Over the base of the spine is a hole for the passage of the postorbital canal of the lateral line system. The pterotic joins the frontal and shpenotic in front, the parietal and epiotic above, the prootic, opisthotic and exoccipital below.

The *opisthotic* (plate III, fig. 3) is a small triangular bone on the ventral side of the otic region. Its narrow end is produced behind and articulates with the posttemporal. The opisthotic articulates with the prootic in front, the exoccipital on the inner side and the pterotic on the outer.

THE ORBITOTEMPORAL REGION

The orbitotemporal region may be distinguished into the temporal region and the orbits. * The temporal region comprises of a parietal segment and a frontal

segment. The parietal segment includes the parietals, pleurosphenoids and basisphenoid, while the frontal segment is formed by the frontals, lateral ethmoids and orbitosphenoid. Underlying the two segments is a long parasphenoid bone. The pleuiDsphenoids and orbitosphenoid are replacing bones while the rest are investing bones.

The *parietal* (plate III, fig. II) is a flat irregular bone on the dorsal side of the temporal region. Its anterior margin is produced into two processes, the inner articulating with the frontal and the outer with the pterot?c. The two processes thus form the temporal foramen along with the frontal. The parietal articulates with the supraoccipital on the inner side, with the epiotic behind and pterotic below.

The *pleurosphenoids* (plate III, fig. 12) are small irregular bones, ossified in the anterior region of the brain case. A median process from each pleurosphenoid joins a similar process from the other and divides the space between the two bones into an upper and a lower cavity. The upper cavity encloses the front part of the brain while the lower serves as a conduit for the optic nerves. The trigemino-facial nerve complex comes out of an aperture left between the joint of the pleurosphenoid and prootic. The pleurosphenoid joins the orbitosphenoid in front, prootic behind, frontal above and basisphenoid below.

The *basisphenoid* (plate III, fig. 10) lies between the lower* edges of the pleurosphenoids. It is a small triangular bone with its apex directed forwards as a small spicule, which fails to reach the parasphenoid. Above it has a depression for the hypophysis.

***The frontals* (plate V, fig. 42) are most prominent bones of the temporal region and they roof two third of the length of the cranium. Each frontal is a flat elongated bone joined to the frontal of the other side in the middle line. Over each is an oblique ridge, on the inner side of which runs the supraorbital canal of the lateral line system. The frontal is attached to the ethmoid and lateral ethmoid in front, sphenotic on the outer side and supraoccipital behind.**

The *lateral ethmoid* (plate III, fig. 9) is a thick irregular bone, perforated for the olfactdTy nerve. It sends out a projection behind which applies on the orbitosphenoid. From the outer side of the bone is given off another process which^ besides supporting the second supraobital bone, limits the orbit anteriorly. The two lateral ethmoids join in the middle line and are covered over by the frontals and ethmoid.

The *orbitosphenoid* (plate III, fig 11) is a single median bone which lies below the frontals and separates the orbits. The bone bifurcates behind to join the pleurosphenoids and encloses the front part of the brain. The orbitosphenoid extends down and meets the parasphenoid before reaching the lateral ethmoids.

The *parasphenoid* (plate III, fig. 15) is a long splint-like bone in the mid ventral region of the cranium. Its posterior third is produced below into a pair oi closely applied wings which extend back, articulating with the basioccipital, beyond the occiput. On outer side of the wings articulate the first pair of pharyngobratfchials. Above the bone, is a deep longitudinal groove for the eye muscle canal.

THE ORBITS

The *orbits* occupy a large area on the lateral sides of the skull. The anterior region o£ each orbit is filled with the tough adipose tissue and into the posterior region projects the orbital process of the hyomandibùla. The circum-orbital ring is formed by the two supraorbitals, three suborbital pieces and two infraorbitals, which are invested around the eye.

The first *supraorbital* (plate V, fig. 33) is a small papery bone underneath the nasal capsule. The second *supraorbital* (plate IV, fig. 34) lies behind the first supraorbital and is twice as large. Through the two supraorbitals runs the supraorbital branch of the lateral line system.

The *suborbitals* (plate V. fig. 37) are united into a large fan-shaped bone, forming the posterior boundary of the orbit. The three pieces join the preopercular by their posterior margins. Of these the upper one is the smallest and the lower one largest. Through the suborbitals runs the infraorbital canal of the lateral line system, in its course to the infraorbitals.

The *infraorbitals* (plate V, fig. 31 & 36) are flat papery bones which form the lower boundary of the orbit. The posterior infraorbital is more prominent and its forked hind end applies over the suborbital. It may be pointed out here that the second infraorbital, according to some authors is included m the suborbitals and the first infraorbital is termed as lacrymal as it receives the terminal part of the suborbital branch of the lateral line system.

THE ETHMOIDAL REGION

The ethmoidal region comprises of the ethmoid, vomer and paired nasals. The ethmoid is a replacing bone, while the vomer and nasals are investing.

The *ethmoid* (plate III, fig. 14) is an irregular shield-Kke bone, having a stout projection on either side to support the palatines. Dorsally it has a ndge, which expands above into a shield, and forms a groove in front for the articulation to the premaxillae and maxillae. The bone is produced into two, Processes behind, which with the frontals enclose the ethmoidal fontanelle. Below, it bears a deep groove for the voraer.

The *vomzr* (plate III, fig. 13) is an elongated triangular bone, distinguished mto a thicker head and a backwardly directed splint-like process. The head

fits into the groove of the ethmoid and the process articulates with the parasphenoid.

The *nasal* (plate V, fig. 32) is a very small boat-shaped bone, placed inverted over the nasal capsule. It articulates ia front with the ethmoid and in it enters and terminates the supraorbital branch of the lateral line system.

VISCERAL SKELETON

The visceral skeleton is made up of seven arches which encircle the buccal cavity and the pharynx. They are distinguished into the mandibular, hyoidean and branchial arches.

THE MANDIBULAR ARCH

The mandibular arch is composed of two similar halves, each formed of an upper palatopterygoquadrate part and a lower Meckel's cartilage. The palatopterygoquadrate gets replaced by the palatine, metapterygoid and quadrate bones to which are added the ectopterygoid, entopterygoid, premaxilla and maxilla of dermal origin. The Meckel's cartilage is unossified but angular and dentary invest around it forming the lower jaw. The bones of the mandibular arch are laterally compressed and lie vertically.

The *palatine* (plate IV, fig. 17) is a triangular bone with the lower side curved and apex directed forwards. Its basal edge interdigitates with the ectopterygoid and entopterygoid and the apex bears a facet above for the attachment to the lateral process of the ethmoid. Below the apex of it, is another facet for the articulation to the maxilla.

The *entopterygoid* (plate IV, fig. 18) is a thin and irregular bone which lies between the palatine and metapterygoid. It joins the ectopterygoid below but is completely separated from quadrate in the fish.

The *ectopterygoid* (plate IV, fig. 21) is an elongated splint-like bone, having an elbow type bend in the middle. Its front end lies over the symphysis of the palatine and entopterygoid, while the pointed hind end is applied to the lower edge of the quadrate.

The *quadrate* (plate IV, fig. 20) is a triangular bone with the apex extending forward up to the bend of the ectopterygoid. Its base is thickened and bears a V-shaped notch on the upper side for the symplectic and a concave facet on the lower side for the angular. Near the V-shaped notch is another facet for ine metapterygoid. The quadrate suspends the lower jaw.

The *metapterygoid* (plate IV,, fig. 19) is an irregularly expanded bone which lies between the entopterygoid, quadrate and hyomandibula. It sends out a slender process in front which lies between the entopterygoid and hyomandibula, while the rest of the bone is fixed into a groove on the hvmandibula.

The *premaxilla* (plate V, fig. 27) is comparatively very small. It joins with the premaxilla of the other side in front and the symphysis articulates in a groove on the anterior end of the ethmoid. Behind, the premaxilla is applied to the maxilla of its side. It contributes to the formation of the notched tip of the snout.

The *maxilla* (plate V, fig. 28) is a dagger-shaped bone with its handle part in front and blade-like part behind. The handle part is stout and curved to join its fellow of the other side below the premaxillary symphysis. At its front end is a facet for the articulation with the ethmoid. A little behind this facet is a surface for the articulation with the palatine. The blade -like part of the maxilla is free and covers the ectopterygoid, quadrate, angular and dentary bones. The maxilla forms most of the gape of the mouth.

To the dorsal edge of the blade-like part of the maxilla are attached, two scale-like *supramixillaries* (plate V, fig. 29 & 30).

The *angular (articular)* (plate IV, fig. 25) is a triangular bone with its base in front. Its apex bears a concave facet for the articulation with the quadrate, inner face of the angular is seen a small nodular *sesamrid angular.*

The *dentary* (plate IV, fig. 25) is abo a triangular bone with the apex forward. Behind it is produced into two arms which are applied to the angular. The two dentaries join in front into the mandibular symphysis. The lower margin of the angular and dentary is thickened for the passage of the mandibular lateral line canal.

THE HYOID ARCH

The hyoid arch is made up of two half loops, joined in the middle to a median basihyal bone. Each half loop is made up of a dorsal hyomandibula and a ventral hyoid cornu. The hyomandibula is composed of two bones, the hyomandibula and symplectic. The hyoid cornu comprises of the epihyal, ceratohyal and two hypohyals. Intervening between the hyomandibula and hyoid cornu is an interhyal bone. Connected to the hyoid arch are the four dermal bones which form the operculum.

The *hyomandibula* (plate IV fig. 24) is a stout and irregular bone. The upper margin of the bone is provided with two articular heads, an anterior small and a posterior elongated heads which fit into the depressions on the sphenotic and pterotic. Behind it has a prominent rounded head, the hyomandibular knob, to which articulates the opercular bone. From its front side is given off a slender curved pterygoid process, which articulates with a similar process from the metapterygoid. From the outer surface of it arises a spinous process, the orbital process, which forms the posterior boundary of the orbit. The pterygoid and orbital processes with the metapterygoid, enclose between them a space for the ligamentous muscles. In the centre of the hyomandibula is a large

foramen for the hyomandibular embrassure muscles and branch of the fifth nerve. The hyomandibula is abruptly produced below into a triangular process which articulates with the symplectic and interhyal bones. The front margin of this process is deeply grooved for the attachment of the metapterygoid.

Tne *symplectic* (plate IV, fig, 22) is a small bony rod, which lies between the hyomandibula and quadrate and forms part of the suspensorium.

The *interhyal* (plate V, fig. 40) is also small and is situated between the hyomandibula and epihyal, on the inner side of the preopercular.

The *epihyal* (plate V, fig. 39) is a broad triangular bone with its base forwards. Its pointed end rises up, and articulates with the hyomandibula through the interhyal. The upper part of the bone is thickened and on its outer side runs a groove which is continued over the ceratohyal also.

The *ceratohyal* (plate V, fig. 39) is plate-like and thickened. It is slightly longer than the epihyal. Its lower margin is curved and bears three holes for the articulation to the branchiostegals. Behind it interdigitates with the epihyal. According to AUis, the epihyal and ceratohyal are two ossifications on one ceratohyal bone.

The *hypohyals* (plate V, fig. 39) are two small bones situated one over the other. The upper or first hypohyal is more or less triangular wjiile the lower or second hypohyal is dome-shaped. The two hypohyals are attached behind with the ceratohyal, in front with the basihyal and below with the urohyal.

Tne *basihyal* (plate VI) is a small rod-like bone which lies above the upper hypohyals and supports the muscular tongue of the fish.

The *urohyal* (plate IV, fig. 23) is a long bone tapering anteriorly and articulated by its front tip with the lower hypohyals. Behind it is expanded and grooved and runs up to the region of the pectoral girdle.

Attached to the epihyal and ceratohyal are six membranous *branckiostegals* (plate VI), which support the branchiostegal membrane. The first three of these articulate by their heads into the holes into the ceratohyal, while the fourth one simply applies to the ceratohyal. The fifth branchiostegal similarly applies over the junction of the ceratohyal and epihyal, while the sixth branchiostegal remains attached to the epihyal. The branchiostegals gradually increase in size from in front backwards. The first four of them are pointed distally while the rest two are expanded.

THJJ OPERCULUM

Each side operculum is formed of a series of four thin and expanded bones-the preopercular, opercular, subopercular and interopercular.

The *preopsrcular* (plate V, fig. 35) is a*crescent-shaped bone lying over the hyomandibula, quadrate and symplectic. Its anterior edge is concave and thickened for the passage of the operculomandibular canal of the lateral line system. «It joins the sphenotic through the small subtemporal bone.

The *opercular* (plate IV, fig. 16) is a broad fan-shaped bone overlapped in front by the preopercular. At its anterior end is a socket for the hyomandibular knob.

The *subopercular* (plate V, fig. 38) is the smallest bone of the opercular series and is some what triangular in form. Its upper margin is curved and overlapped by the opercular, while in front it joins the interopercular.

The *interopercular* (plate V, fig.41) is triangular in form with its pointed end anterior. A small projection from its upper edge attaches it with the preopercular.

THE BRANCHIAL ARCHES

* There are five *branchial arches* (plate VI) which surround the pharynx and form the branchial basket to support the gills. Each arch is composed of two similar halves, uniting in the middle to a basibranchial bone. Each half comprises of four bony rods, two dorsal—the pharyngobranchial and epibranchial, and two ventral—the ceratobranchial and hypobranchial. They are grooved on their outer ^ides and join with one another by connecting cartilages. The first four arches are of usual type while the fifth is represented by the ceratobranchial only. The first arch bears an additional beak-like, cartilagenous suprapharyngobranchial, in front of the bases of the first pair of pharyngobranchials.

The first *pharyngobranchials* are not grooved and are attached to the sides of the parasphenoid. The pharyngobranchiah of the second and third arch fuse in the middle line, while those of the fourth arch are separate. The second and third and to some extent the fourth pharyngobranchials from a median rod.

The *epibranchials* articulate with the corresponding pharyngobranchials in front and ceratobranchials behind, through connecting cartilages. A process from the first epibranchial unites with a process from the second pharyngobranchial and similarly a process from the second epibranchial unites with a process from the third pharyngobranchial, while the processes from the third epibranchials unite with one another. The first three epibranchials are of usual type but the fourth one is modified into a broad irregular plate. From its hind end arises a cartilagenous flap which arches above the bone to form the pharyngeal pocket.

The first three *ceratobranchials* are similar, while the fourth differs in having a backwardly directed process for attachment to the fifth ceratobranchial

The fifth ceratobranchial is flattened and joins behind with the connecting cartilage joining the fourth ceratobranchial and epibranchial.

The *hypobranchials* are connected to the basibranchials in front, and ceratobranchials behind through connecting cartilages. The first two are of usual type while the third is a small piece of bone which unites by its tip, with the one of the other side, below the hind end of the third basibranchial. The fourth hypobranchial is unossified.

The first thres *basibranchials* lie in a line one behind the oïher and form a rod in the mid ventral line. The first basibranchial is a small triangular piece below the basihyal, while the second and third are grooved rods, lying one behind the other in a row. Behind the third basibranchial is an unossified cartilagenous strip, which runs up to the hind end of the branchial basket and represents the fourth basibranchial.

SUMMARY

The skull is elongated and wedge-shaped, with a characteristic ethmoidal fontanelle in front. It bears on each side a large temporal groove, having an oval temporal foramen. Behind the temporal groove is a small preepiotic fossa. The parietals are separated by the intervention of the supraoccipital. The foramen magaum is bounded by the exoccipitals only. The opisthotic is present and provides articulation to the posttemporal. The sphenotic and the pterotic bear depressions for the articulation of the two heads of the hyomandibula. The basisphenoid is present but its tip does not reach the parasphenoid. The orbitosphenoid is prolonged downwards and forwards to meet the parasphenoid and lateral ethmoids. The circumorbital ring is formed of seven bones.

The premaxillae are very small as compared to the long maxillae, but both of them take part in the formation of the gape of the mouth. A pair of supramaxillaries are present over each maxilla. The quadrate articulates with the hyomandibula through the symplectic , while the cpihyal does so through the interhyal. The hyomandibula lies vertically and provides articulation to the opercular. The sesnmoid angular is present and the articular is absent. There tire only six branchiostegals which support the branchicstegal membrane. The first three branchial arches are complete except that the first pair of pharyngobranchials hang the branchial skeleton, articulating with the parasphenoid. The first arch also bears a beak-like cartilagenous suprapharyngobranchial. The hypobranchials of the fourth arch are unossified, while its epibranchials are flattened and bear cartilagenous straps to form pharyngeal pookets. The fifth arch is represented by the leaf-like ceratobranchials only, which are attached to the processes of the fourth ceratobranchials. All the bones of the skull of *Hilsa ilisha* are edentulous.

EXPLANATIONS OF THE ABBREVIATIONS USED

aecpt., articular surface for ectopterygoid; *aenpt.,* articular surface for entopterygoid; *af.,* auditory fenestra; *afq.,* articular surface for quadrate; *ahh.,%* articular surface for hypohyals; *ahn.9* aperture for°the hyomandibular embrassure muscles; *alsph.,* pleurosphenoid; *antes.,* articular surface for ethmoid; *apa.,* articular surface for parietal; *appa*.,* articular surface for parasphenoid; *apt.,* articular surface for palatine; *apmx.,* articular surface for * premaxilla ; *apttmp,* articular surface for posttemporal ; *art.,* angular ; *ast.,* articular surface for subtemporal ; *avo.,* articular surface for vomer ; *bbr.,* basibranchial ; *bmx.,* blade of maxilla; *brstg.,* branchostegal ; *bshy.,* basihyal ; *bsph.,* basisphenoid; *boc.,* basioccipital; *cart.,* cartilage; *cartp.,* cartilagenous process; *ccart.,* connecting cartilage; *ccr.y* cavum cranii; *cerb.>* ceratobranchial; *cerhy.,* ceratohyal; *clt.,* clithrum; *cpsphn.,* covered part of sphenotic; *dn.,* dentary; *drvo.,* dorsal ridge over vomer; *dsyml.,* depression for symplectic; *ebr.,* epibranchial; *ecpt.,* ectopterygoid; *enpt.,* entopterygoid; *epot.,* epiotic ; *epihy.,* epihyal ; *ethf.,* ethmoidal fontanelle ; *exo.y* efxoccipital ; *falsph.,* facet for pieurosphenoid ; *fboc.,* facet for basioccipital; *fenpt.,* facet for entopterygoid. ; *//.,* foramen for the external carotid artery*;fihy.,* facet for interhyal; *frms.* facet for the articulation with the ethmoid; *fmg.,* foramen magnum; *fmp.,* facet for metapterygoid; *fprot.,* facet for prootic; *fqu.,* quadrate facet ; *Jr.,* frontal; *fsyml.,* facet for symplectic; *frnx.,* facet for the articulation with the maxilla; *glvgf.,* foramen for the glossopharyngeal and vagus nerves; *gmp.9* groove for the metapterygoid ; *hbr.>* hypobranchial ; *hbrstg.,* holes for branchiostegals ; *hh.,* hypohyal ; *hmx.,* handle part of maxilla ; *hphbr.,* hole for the tips of second pair of pharayngobranchials; *hplot.y* head for the articulation with the pterotic; *hsphn.,* head for the articulation with the sphenotic; *hyjm.,* hyomandibula., *ihy.,* interhyal; *in/orb.,* infraorbital., *lie,* lateral line canal; *Ipuh.,* lateral process of urohyal; *lpDp.y* limb of the preopercular., *m?cpt.>* margin for the articulation with ectopterygoid; *mes.,* ethmoid; *mqu.,* margin for the articulation with the quadrate; *mrllc,* mandibular lateral line canal., *mtpt.,* metapterygoid; *mx.y* maxilla., *na.,* nasal; *occ,* occipital condyle; *olf.9* olfactory foramen; *op.,* opercular; *opllc,* opercular lateral line canal ; *orbhyom.,* orbital process of hymandibula; *orbllc,* orbital lateral line canal., *orbsp.,* orbitosphenoid; *pa.,* parietal; *t)as.y* parasphenoid; *pasw.,* wings of the parasphenoid; *pef.,* preepiotic fossa; *pmpt.,* process for entopterygoid ; *bf.,* lateral ethmoid ; *pfr.,* process for frontal ; *phbr.,* pharyngobranchial ; *phyom.,* process of the hyomandibula ; *$p_m$es.,* process of ethmoid; *pmx.,* premaxilla; *pmp.,* process for metapterygoid; *pm'pt.,* process of metapterygoid; *pollc,* postorbital lateral line canal; *pip.,* preopercular; *porbsp.,* process of orbitosphenoid; *ppf.,* process of lateral ethmoid ; *ppmx.,* process of premaxilla; *prot.,* prootic; *psoc,* process of supraoccipital; *plot.,* pterotic; *'ptotsp.,* pterotic spine; *pthyom.,*

pterotic depression for hyomandibular head ; *pttmp.,* post-temporal; *pvo.>* process of vomer; *qu.,* quadrate; *qur* quadrate ridge; *sart.,* sesamoid angular; *soc.,* supraoccipital; *socsp.,* supraoccipital spine; *sop.,* subopercular; *sphbr.,* suprapharyngo-branchial; *sphn.,* sphenotic; *sphyom.,* depression on sphenotic for hymandibular head; *spttmp.,* surface for articulation to the posttemporal ; *stg.,* supratemporal groove; *subtmp.,* subtemporal; *suporb.,* supraorbital; *sumx.,* supramaxillary; *syml.,* symplectic; *tf.,* temporal foramen; *tg.,* tongue; *uh.,* urohyal; *uhw.,* wings of urohyal; *vo.,* vomer.

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BlBUOGRAPHY

1. BOULENGER, G. A. 1895 Remarks on some cranial characters of the salmonids. *Proc. Zool. Soc.* London, pp. 299-302.
2. BERG, LEO S. 1947 Classification of the fishes both recent and fossil, (English Edition) Michigan, U.S.A.
3. BHIMACHAR, B. S. 1932 The cranial osteology of *Ophiocephalus striatus* (Bloch.) J. Mysore Univ. vol. VI (1), pp. 72-86.
4. CHAPMAN, W. M. 1934. The osteology of the Haplomous fish, *Novumbra hubbsi* Schultz, with comparative notes on the related species. J. Morph. vol. 56 (2) pp. 371-405.
5. CHAPMAN, W. M. 1942 The osteology and relationships of the osmerid fishes. J. Morph., vol. 69, pp. 279-301.
6. CHAPMAN, W. M. 1944 On the the osteology and relationships of the South American fish, *Aplochiton zebra.* Jenyns. J.Morph. vol. 75, pp. 149-165.
7. CHAPMAN, W. N. 1944 The osteology of the pacific deep-bodied anchovy, *Anchoa compressa.* J. Morph., Vol. 74, pp. 311-329.
8. DHARMRAJAN, M. 1936 The anatomy of *Otolithus ruber.* part I, Endoskdeton. Journ. Roy. Asia Soc. Bengal, vol. II, pp. 1-72.
9. GREGORY, W. K. 1933 Fish skulls. A study of the evolution of the natural mechanisms. Trans. Amer. Phil. Soc. Philadelphia, n.s. vol. 23, pt.2, pp75-481.
10. JORDAN, DAVID S. 1923 A classification of fishes, including families and genera as far known. Stanford Univ. Publ., Univ. ser., Bio Sci., vol. Ill (2).
1 I.OTOSHI, M. S. & BAL, D. V. 1953 The skeleton of*Coilia dussumieri-The* skull. Journ. of the Uni. of Bombay, vol. XXI, pt. 5, pp. 93-105.
12. MOONA, J. C. 1958 The skull of *Hilsa ilisha* (Ham.). Science and Culture, vol.24, pp. 97-98.
13. MOONA, J. C. 1959 The skull of *Setipinna phasa.* (Ham.) Science and Culture, vol. 24. pp. 385-387.
14. NAIR, R. V. 1953. Key for the field indentification of the common Clupeoid fishes of India. J. Zool. Soc. India, vol. V, pp. 108-138.
15. N«RMAN, JOHN, R. 1923 A revision of the Clupeoid fishes of the genus Ilisha and allied genera. Ann. Mag. Nat His., ser. 9, vol. 11, pp. 1-22.
16. PHILLIPS, J. B. 1942 Osteology of the Sardine *(Sardinops caerulia),* J. Morph., ^ vol. 70, pp. 463-500.
17. RIDEWOOD, W. G. 1904 On the cranial osteology of the fishes of the family Elopidae and Albulidae, with remarks on the morphology of the skull in the lower Telcostean fishes generally. Proc. Zool. Soc. London, 1904(2) pp. 35-81.
18. RIDEWOOD, W. G. 1905 On the cranial osteology of Clupeoid fishes. Pro. Zoo. London, vol. II, pp. 448-493.

19. STARKS, E. G. 1908 On the orbitosphcnoid in some fishes. Science, New'York, vol. 28, n. s., pp. 413-415.

20. STARKS, EDWIN G. 1926 Bones of the ethmoidal region of the skull. Stanford Univ. Publ., Univ. ser. Biol. Sci., vol.1 V (3) pp. 139-338.

21. SAUAHI, D. S. 1932 The endoskelton of *Labeo rohita.* Journ. Roy. Asia. Soc. Bengal, vol. XXVIII n.s., pp. 295-347.

22. WELLS, F. g.. 1923 On the morphology of the chondrocranium of the larval Herring *(Clupea harengus).* Proc. Zoo. Soc. London, vol. 23, pp. 1213-1229.

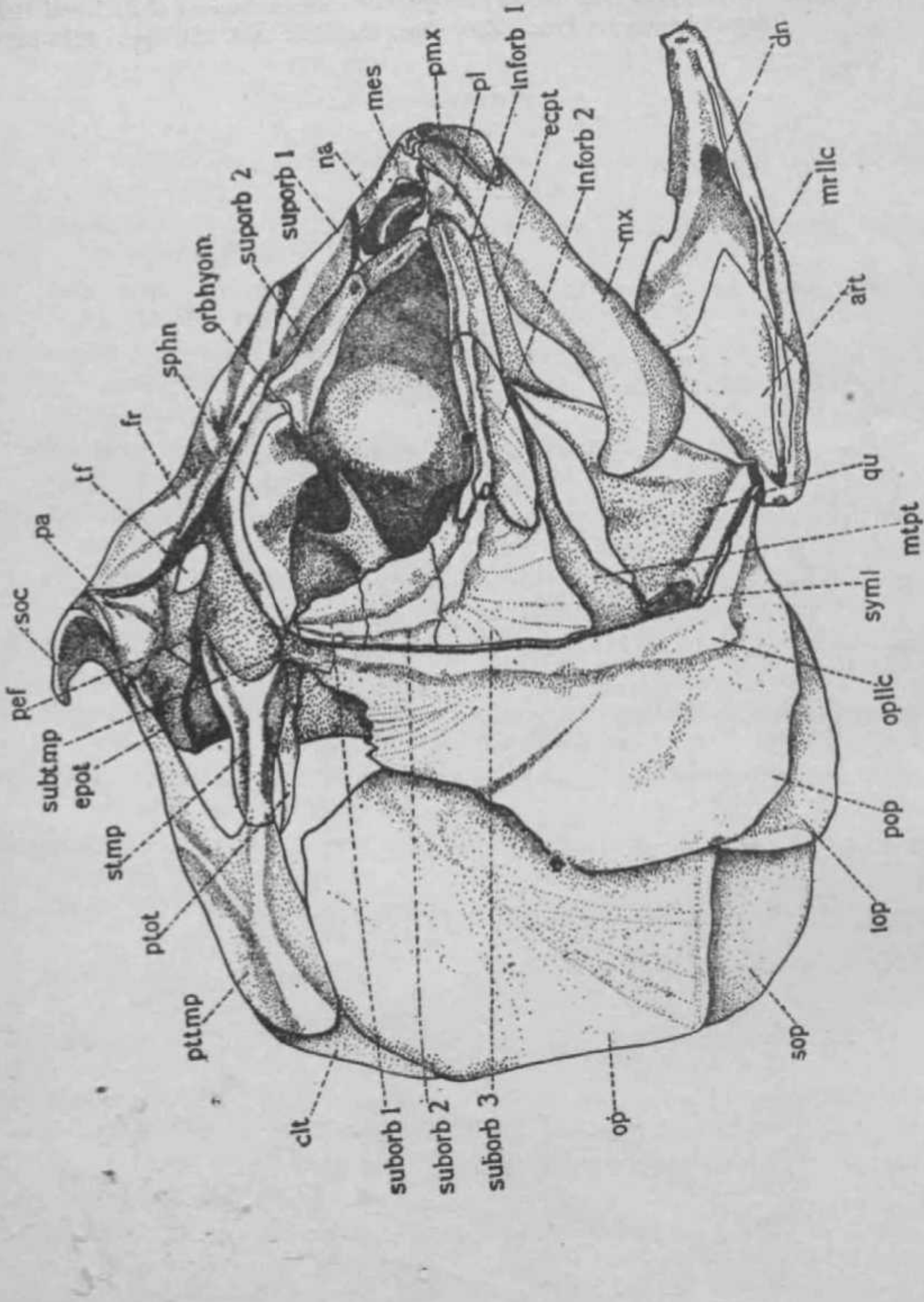

Plate I. Lateral view of the skul of *Hilsa ilisha* (Ham.)

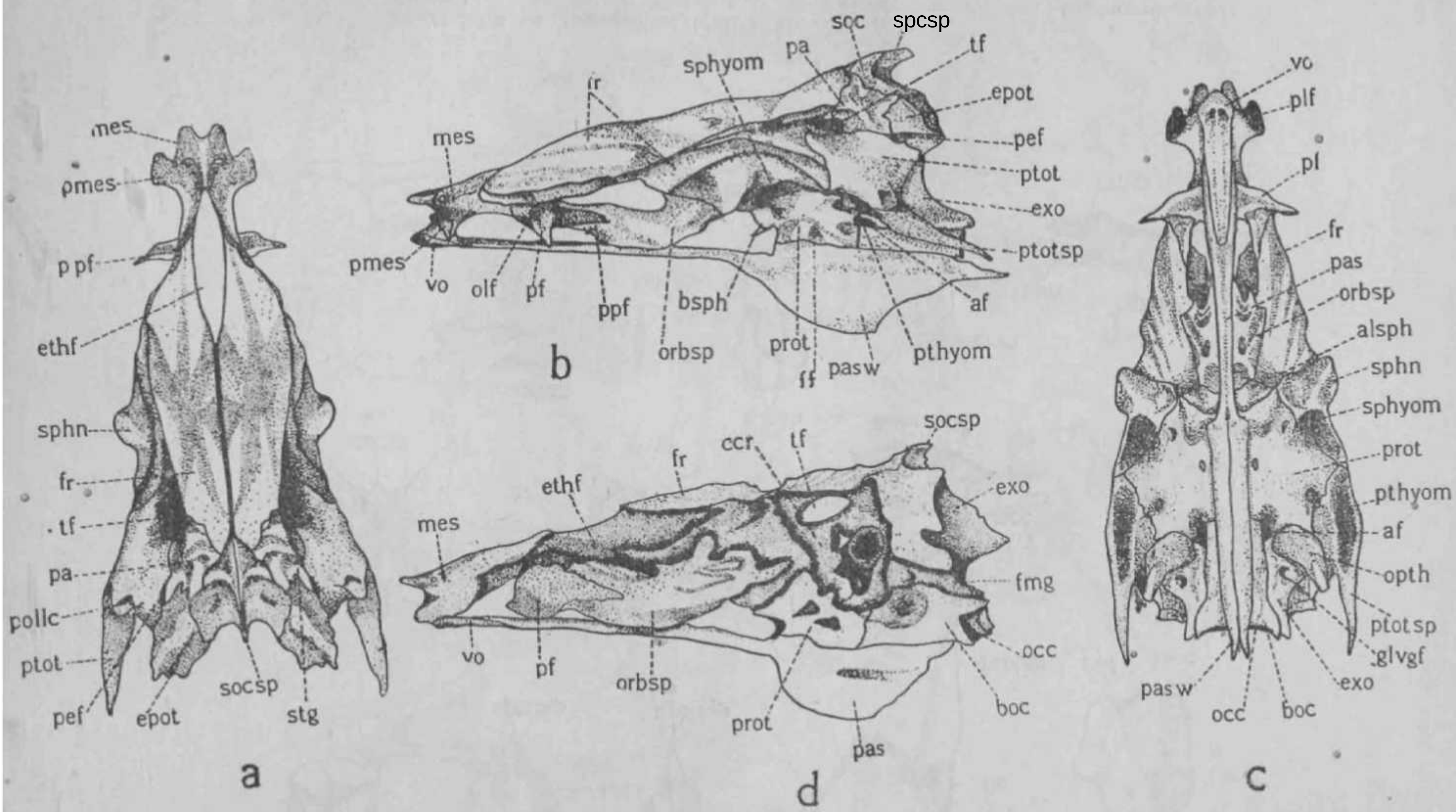

Plate II. Views of the cranium of *H. Uisha* (Ham.)
Figs. a. Dorsal view; b. Lateral view; c. Ventral view; d. Longitudinal section.

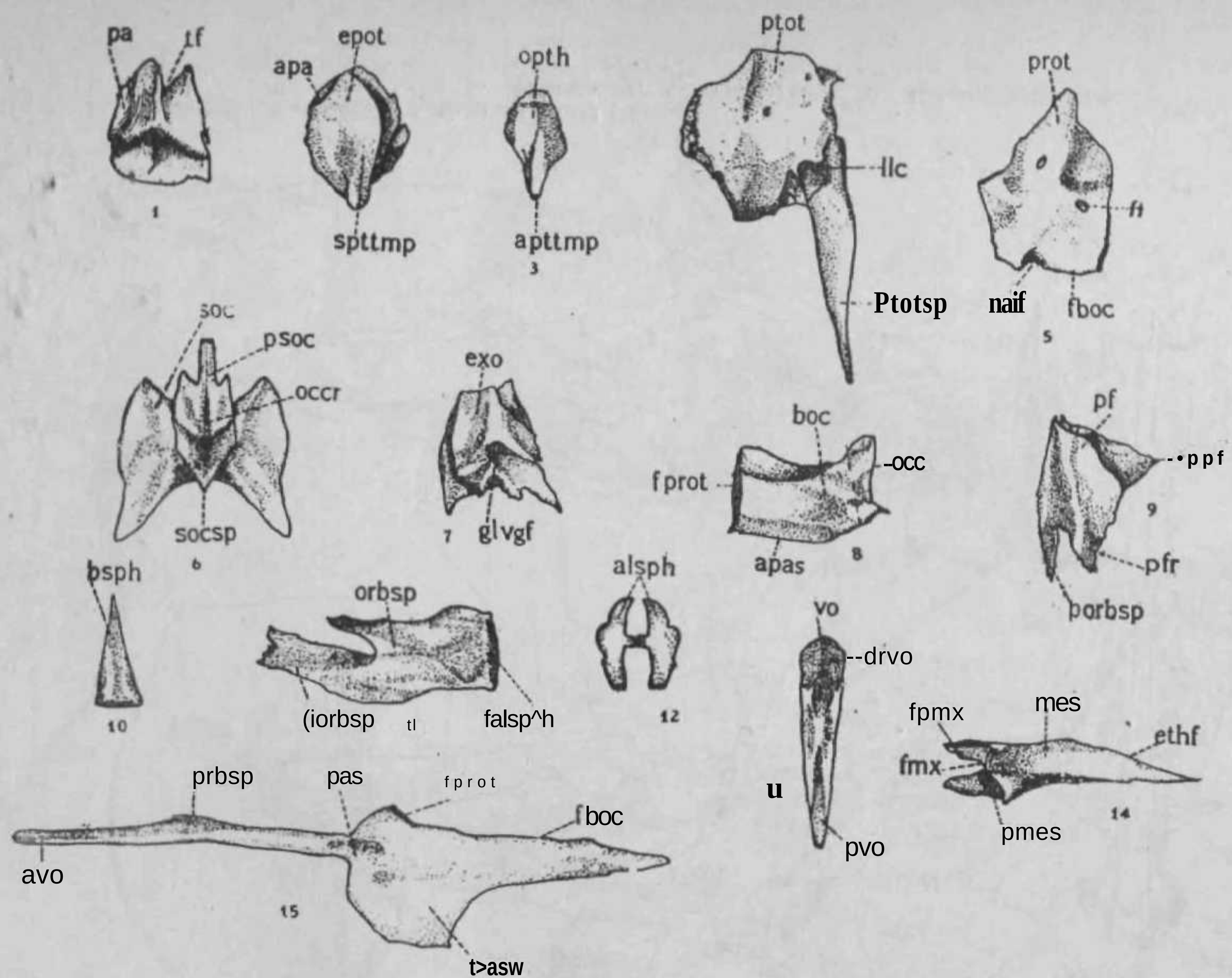

Plate III. Disarticulated bones of the skull of *H. ilisha* (Ham.)

Figs. 1. Parietal; 2. Epiotic; 3. Opisthotic; 4. Pterotic; 5. Prootic; 6. Supraoccipital; 7. Exoccipital; 8. Basioccipital; 9. Prefrontal; 10. Basisphenoid; 11. Orbitosphenoid; 12. Pleurosphenoids; 13. Vomer; 14. Ethmoid; 15. Parasphenoid.

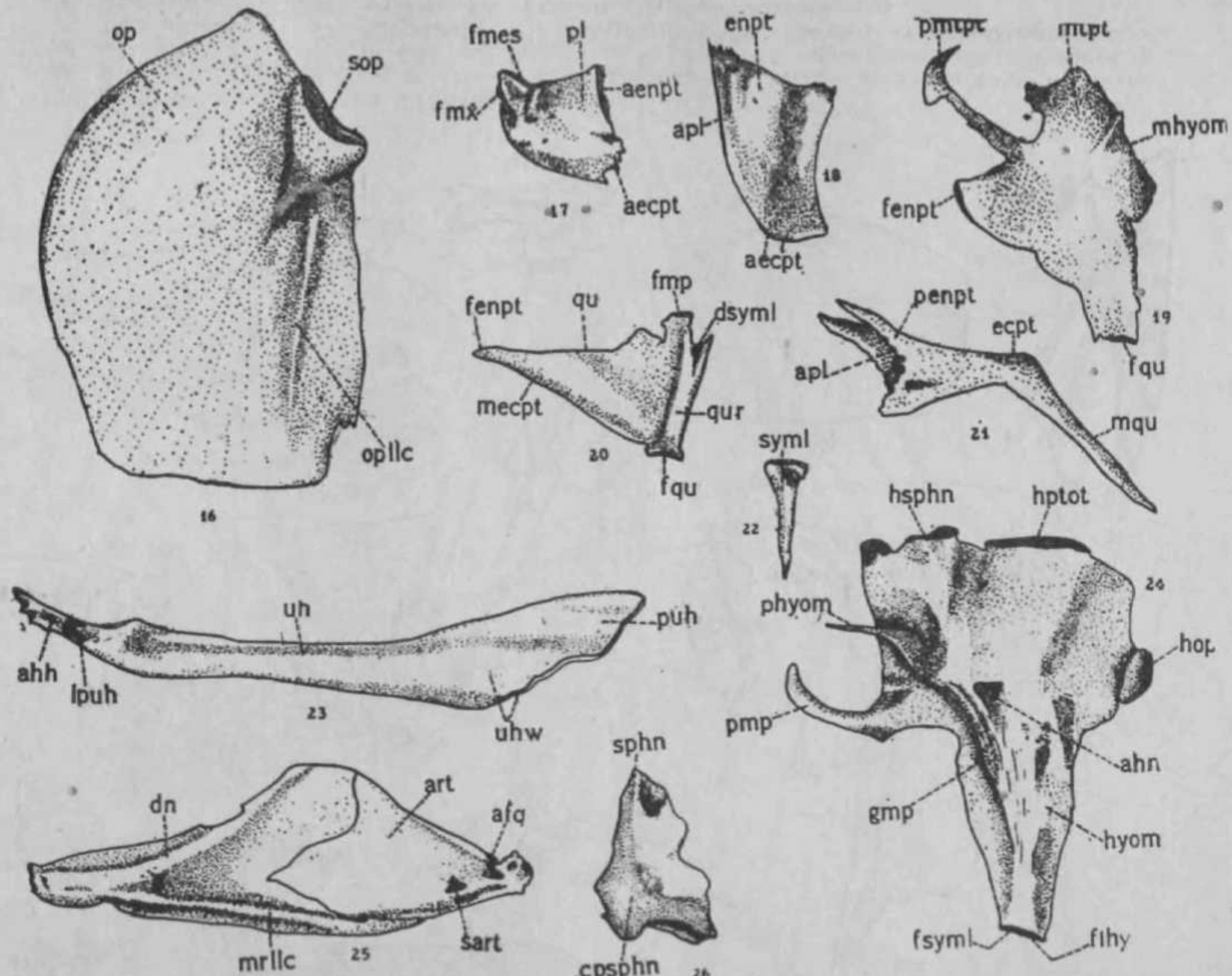

Plate IV. Disarticulated bones of the skull of *H. iihha* (Ham.)
Figs. 1<\ Opercular; 17. Palatine; 18. Enloptcrygold; 19. Mrlapterygoid; 20. Quadrate; 21. Ectopterygoid; 22. Sytnplectic; 23. Urohyal; 24. HytmandibuJar; 25. Lower jaw; 26. Spcnotic.

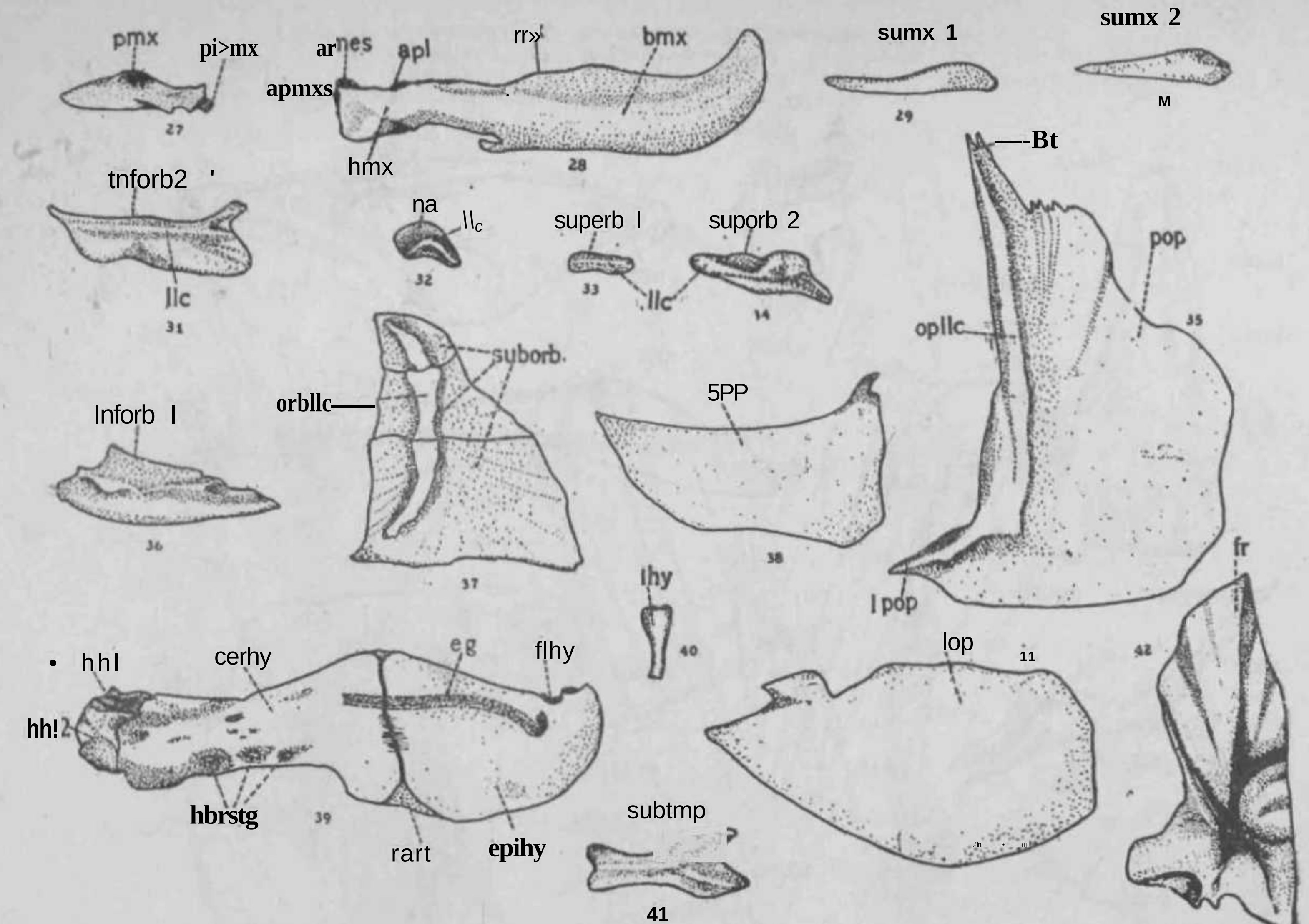

Plate V. Disarticulated bones of the skull of H. itisha (Ham.)

Figs. 27. Premaxilla; 28. Maxilla; 29. First supramaxillary; 30. Second supramaxillary 31. Second infraorbital; 32. Nasal; 33. First supraorbital; 34. Second supraorbital; 35. Preopercular; 36. First infraorbital; 37. Suborbitals; 38. Subopercular; 39. Epihyal, ceratohyal and hypohyals; 40. Interhyal; 41. Interopercular; 42. Frontal; 43. Subtemporal.

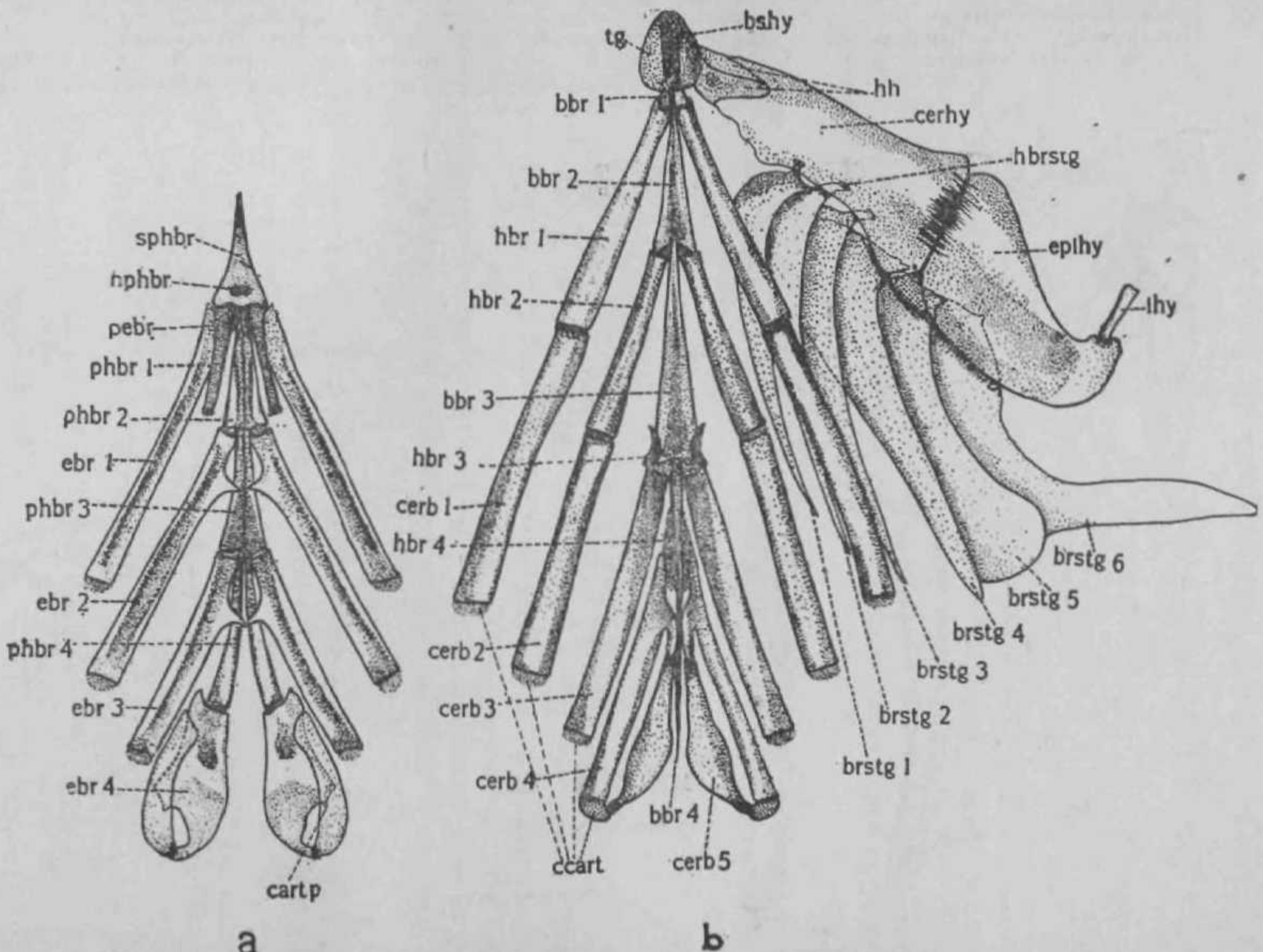

Plate VI. **Branchial skeleton of *H. ilisha* (Ham.)**
Figs. **a. Dorsal half; b. Ventral half with a part of the hyoid arch.**

STUDIES ON THE CATAPHORETIG VELOCITY OF COLLOIDAL PARTICLE.S BY BOUNDARY METHOD.... PART II

By P. D. BHATNAGAR AND A. K. BHATTACHARYA, D. SC,

Department of Chemistry, Agra College Agra.

INTRODUCTION

The electrophoretic investigations had been directed more towards obtaining information of specific systemsthan to providing fundamental knowledge of the process involved. In addition to many important factors, such voltage and current stability, the effect of colloid concentration and of the solute -solute interactions on the electrophoretic mobility yet remain undeveloped in the field of electrophoretic study.

Noteworthy contributions of J. N. Mukherjee on the measurement of boundary potentials, Abramson's nonpolarisable electrodes, Tiselius electrophoretic cell and Schilierinis optical system are the main landmarks towards improving the techniques of measuring the cataphoretic velocity of colloidal particles.

Svedberg* Burton, Rolla, Whitney & Blake, Galackee, Edward, J. N. Mukherjee, B. N. Ghosh, and others studied the electrophoretic velocity of colloidal particles, but each one of them met with wide discrepancies in their derived results. The effect of Voltage, Current reversal and the variations of the concentration of the electrolyte used as supernatant layer in the Burton's tube do not seem to have received adequate attention in the study of electrophoretic velocity.

Mukherjee, Tiselius, and Abramson had experienced the necessity of arresting the changes in the potential gradient that invariably take place dueto electrolysis and polarisation of the electrodes. We further visualise that the third factor responsible for changing the potentials gradient during the boundary migration may also emerge from any change in the double layer charac. teristics of the particle during migration under the tension of the electric field.

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1. Nov. Act. Reg. Sci. Upasala 4(2) 1, 147, 1907, p-190.
2. Phil. Mag. 6, 11, 1906 , p-436.
3. Acad. Lincli. Atti. 17. p-650. 1908.
4. Jr. Am . Chcm. Soc. 26. 1904, p-1339.
5. Z. Anorg. Chmc . 74, 1912, p-147-206.
6. Compt. Rend. 1908, 146, p-826-829.
7. Jr. Ind. Chem Soc. 13, 372, 1929.
8. Jr. Cpiem. Soc. 267-270, 1 2 .

With this view, we are communicating our striking observations on the cataphoretic velocity of $Fe(OH)_3$ & $As_a S_3$ sols under the conditions which are developed in **the** system by (1) Voltage, (11) Current reversal and **(III)** Equlcondacting concentration of the supernatant electrolyte, observed in a Burtons tube.

EXPERIMENTAL

Voltage was stabilised by means of a V.R. Tube (V R 105). The desired voltage was tapped by mea^s of a variable resistance. No fluctuations of voltage were observed in the voltmeter which remained connected in parallel to the circuit during the experiment, (fig.l)

Siabitiscd Voltage Supply

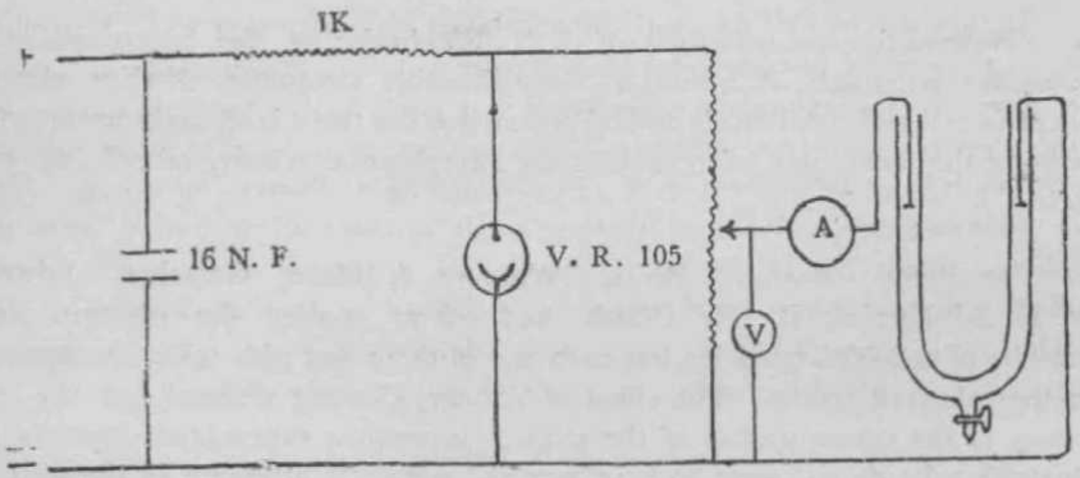


Fig. 1.

There was an unavoidable effect of diffusion of small particles at the boundary which made it comparatively less sharp in the beginning in spite of our extreme care. In the case of $Fe(OH)_3$ sol, the boundary was slightly yellow coloured at the top, deepening into a sharp reddish colour just below. In the same way , the boundary of As_8S_3 sol was very faint yellow at the top and a deeper yellow down the diffused layer.

OBSERVATIONS

1. * *Effect of voltage variations*

a. By altering the applied voltage from 15 to 150 volts in the case of $Fe(OH)_3$ sol, it was observed that the period of constancy of velocity of the boundary decreased with increasing voltage, (Curves Nos. 1,2,3,4,5,6,7,8), while in the case of As_aS_ssol the velocity showed a tendency of gradual diminution **with** time as the voltage was increased . (Curve. 9,10,11,12).

b. ***Relation between the changes in current & velocity of the boundary..***

Under constant voltage a sensitive milliammeter readable up to *02 amps was placed in the circuit and it was observed that both in the case of Fe(OH)j, . & As2S_3 sols? the quality of the result was the same, and varied in degree only. The corresponding changes in the current and velocity were plotted and a linear relation was observed between them (vide curve 13,14,15,& 16)

2. ***Current Reversal:—***

By reversing the current, an appreciable decrease in the velocity was observed, both in $Fe(OH)_3$ and As_2S_3 sols. But the behaviour of As_2 S_3 sol alters much more than the $Fe(OH)_3$ sol during electrophoresis as was evidenced by the greater change in the velocity of As_2 S_3 particles and also by the loose formation of the boundary by reversing the current.

3. a. ***Characteristics of the mhvsnent of the boundary in the equi-conducting supernatant layer of a suitable electrolyte.***

In the case of $Fe(OH)_3$ sol, the red layer gradually over took the yellow one, and then the boundary became sharper within a few minutes of passing the current. Tne migration velocity of the particles increased gradually for a short period, then remained practically constant for a certain period of time in the middle, (vide curve 5, 6, & 7)- On passing the current for a longer time the boundary was ruffled and the time taken for this ruffling varied with the applied voltage. But in the case of As_2S_3 sol, instead of the boundary being ruffled, a deeper yellow patch began to be formed in the ascending limb. The patch began to spread more and more downwards by passing the current further (vide colourdiagram).

b. ***Difference in the sharpness of the boundary layers*** **o/As_2S_3andFe $(OH)_3$** ***sols in the two limbs of the U-tube.***

In the medium of equiconducting solution of supernatant electrolyte (KCI in case of Fe $(OH)_3$ and Acetic Acid in case of As_2S_3sol), the rising boundary of Fe $(OH)_3$ sol was sharper than the receding boundary, while the reverse was the case with As_2S_3 sol, in which the descending boundary became sharper than the ascending one.

Discussion:—

Yellow to red shade of the boundary in the case of $Fe(OH)_3$ and very faint yellow to deeper yellow of the boundary of As_2S_3 sol, can be explained, a priori, as being due to the very small and the bigger particles of the colloidal solution. It is , however, not like the demarcation of the boundary layers formed by the monomers and the high polymers in the system of soap solutions, the reason being*that the sols were completely dialysed and practically freed from chloride ions, and the dialysate gave no tests for ferric ion. Hence, the greater diffusion of the smaller particles seems to be the most probable cause for the difference in the shade if colours at the colloid boundary surface.

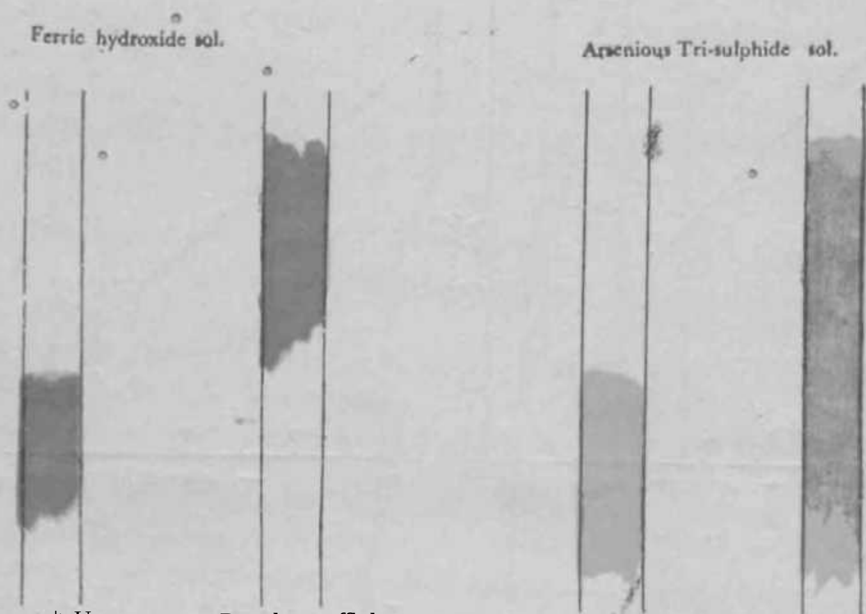
The effect of voltage variation in altering the velocity seems to depend upon the characteristic stability of the sol particles and also on the nature of the supernatant liquid. High voltage in the case of Kcl (supernatant electrolyte)means a greater and more rapid change in the potential gradient, due to electrolysis and other factors. Hence, if there is any constancy of velocity observed due to certain conditions developed in *he system under the electric field, it will be disturbed rapidly as the voltage is increased, and consequently, the period for which the velocity remains constant will be larger when the voltage is low. This is what has been actually observed in the case of $Fe(OH)_s$ sol.

In the case of (As_2S_3) sol, the electrolysis products of Acetic Acid (Supernatant layer) are of quite different nature from those of Kcl which was used in the case of $Fe(OH)_3$ sol. The resistance of the supernatant layer of Acetic acid system gradually increases due to the liberation of CO_8 and G_2H_6 and decrease of H ions by the formation of H_2. The tendency of decrease of potential gradient during the migration of As_2S_3 particles can thus be visualised.

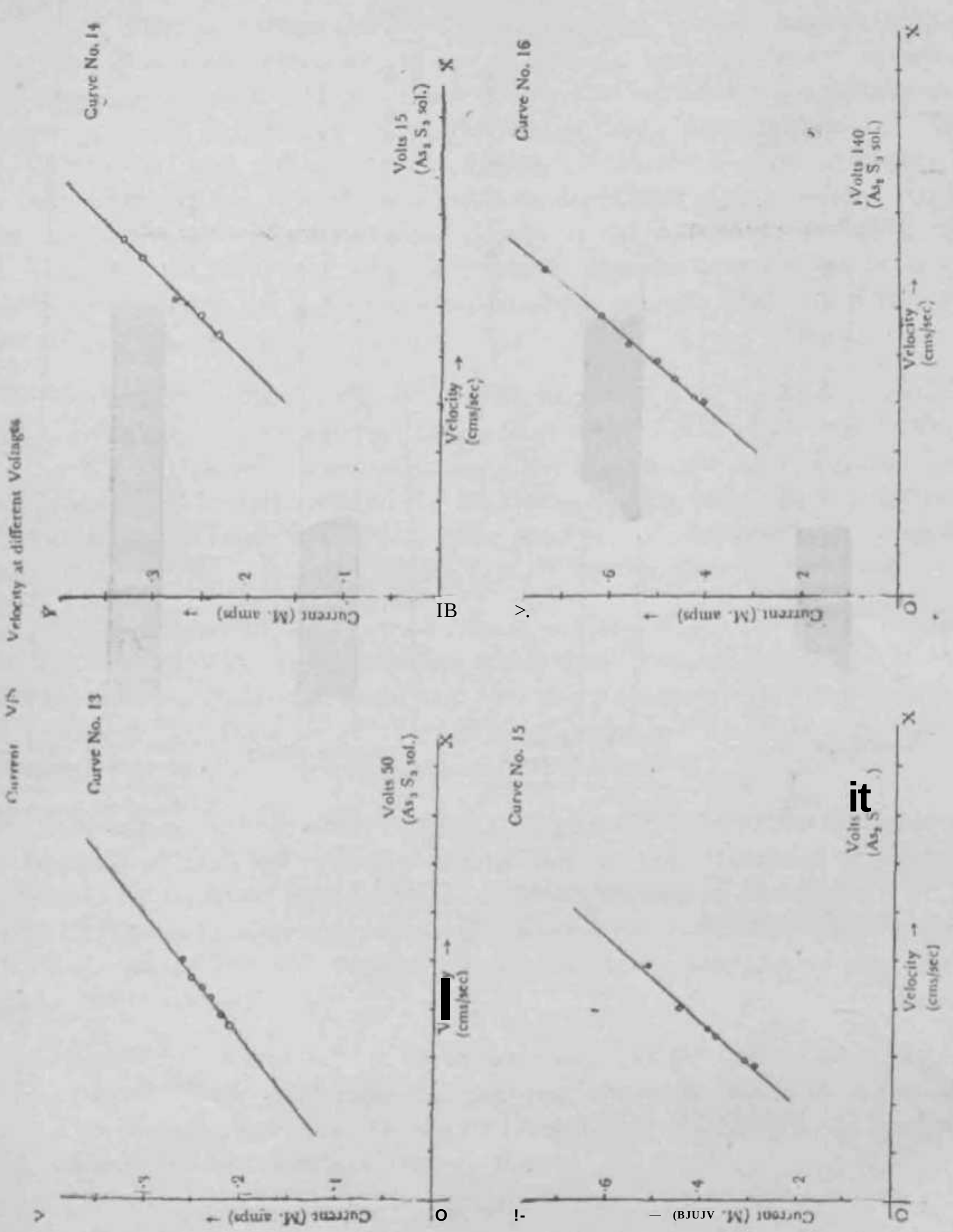
When the current was reversed , there was an evidence to show that the colloidal micelles of As_2S_3 sol were less stable than those of $Fe(OH)_3$. It was observed that As_2S_3 particles could not form sharp boundary by reversal of the current, while in the case of $Fe(OH)_3$ its capacity for sharp boundary formation was lost by reversing the current twice.

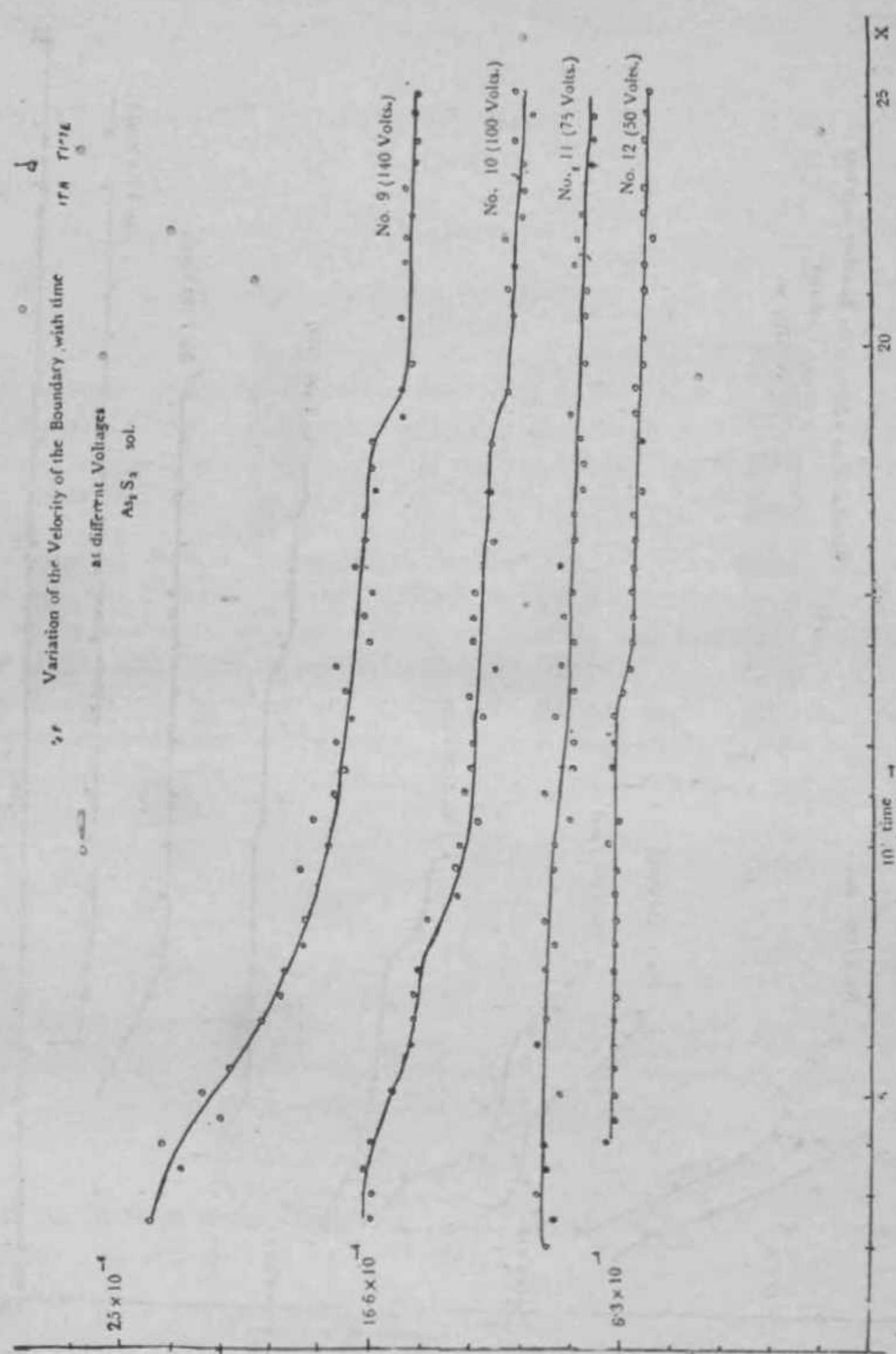
The ruffling at the boundary of $Fe(OH)_3$ sol and the formation of the deep yellow patch of As_2S_3 sol in the ascending limb of the U-tube after passing the current for a certain period require more elaboration of facts before such characteristics can be adquately explained. Since the experiment was performed in a thermostat at $21 \pm .5°C$ the possible effect of convection current does not seem to responsible.

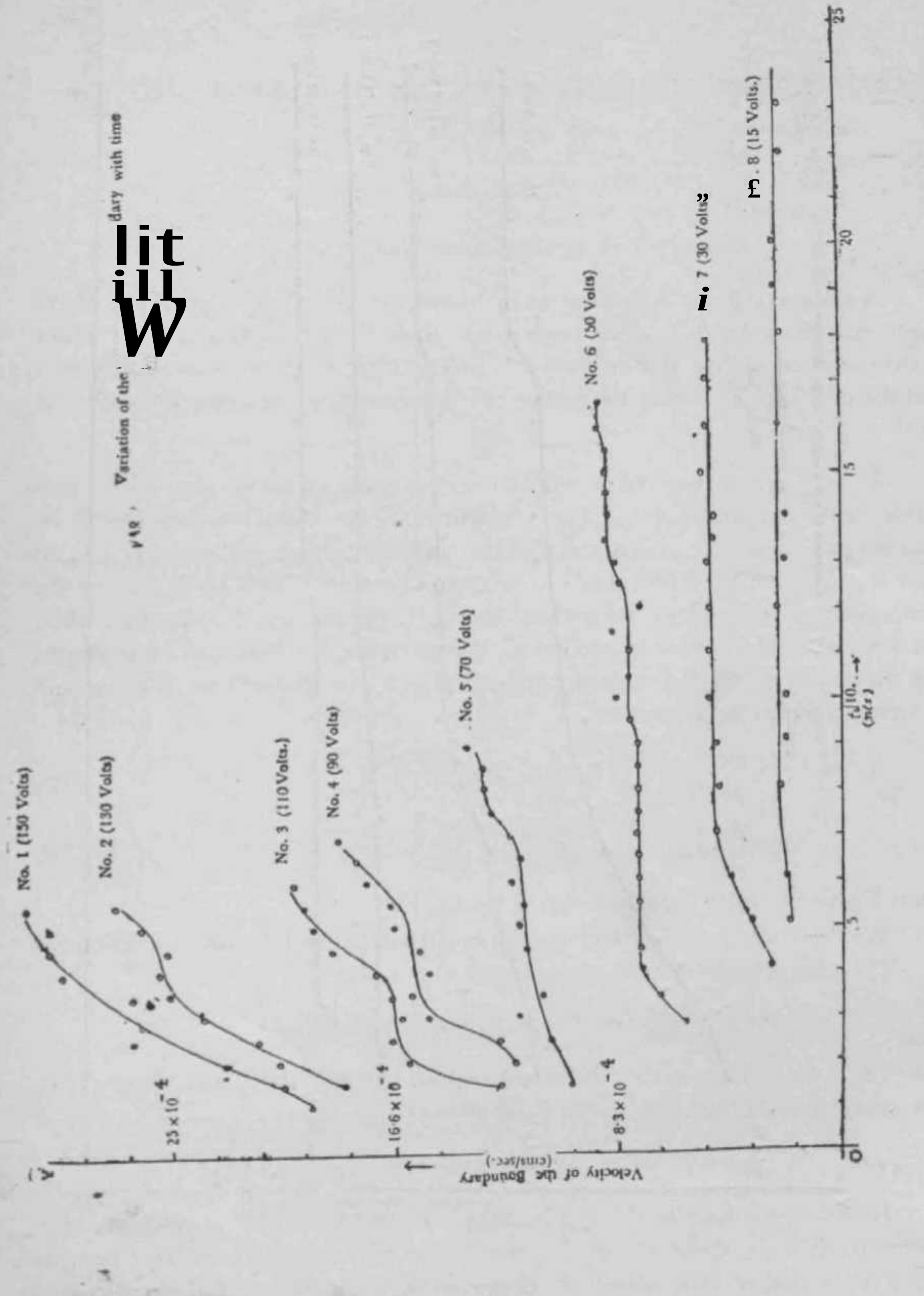
Other factors, which are yet to be understood on the basis of more data, are being investigated. Efforts in this direction are being made by a special device of keeping the current constant on the lines of J. N. Mukherjee and Tiselius supplemented by an electronic valve circuit.



[Colour diagram]


Current V/S Velocity at different Voltages
Curve No. 14
Volts 15
($As_2 S_3$ sol.)
Curve No. 16
Volts 140
($As_2 S_3$ sol.)
Curve No. 13
Volts 50
($As_2 S_3$ sol.)
Curve No. 15
Current (M. amps)
Velocity →
(cms/sec)


Variation of the Velocity of the Boundary with time
at different Voltages
As_2S_3 sol.
No. 9 (140 Volts.)
No. 10 (100 Volts.)
No. 11 (75 Volts.)
No. 12 (50 Volts.)
25×10^{-4}
16.6×10^{-4}
6.3×10^{-4}
Velocity of the boundary (cms./sec.)
10 time (mts.)
20
25
X
Y
O



Variation of the dary with time

ON A TYPE OF DISTURBANCE IN THE TURBULENT MOTION OF A LIQUID

By M. RAY,

Agra College, Agra (India)

A stream of liquid is flowing with a uniform velocity U in a given direction and a simple harmonic disturbance is given to the liquid in a given plane in the direction of the undisturbed flow. The flow tends to become turbulent and the problem is to study the nature of the disturbance and how it is affected by the turbulence.

Taking any section perpendicular to the given plane as (xy) plane and x-axis along the direction of the uniform flow, the disturbed region will be symmetrical about the x-axis and will be confined to two portions $y = \pm y_0$, at the edge of which the flow retains its uniform character. Let $(U+u, v)$ be the components of the mean velocity so that u/U, v/U are small such that their squares and products may be neglected. The pressure-gradient may be neglected and the equations for the first approximation to u, on momentum transfer and vorticity transfer theories, are

$$\frac{\partial u}{\partial t} + U\frac{\partial u}{\partial x} = \frac{\partial}{\partial y}\left\{l^2\left(\frac{\partial u}{\partial y}\right)^2\right\}, \qquad \text{(1P)}$$

$$\frac{\partial u}{\partial t} + U\frac{\partial u}{\partial x} = l^2\frac{\partial u}{\partial y}\frac{\partial^2 u}{\partial y^2}, \qquad \text{(1T)}$$

where l is the mixture length.

We have to solve the above equations subject to the following conditions:—

(a) Since the motion is symmetrical about x-axis,

$$\frac{\partial u}{\partial y} = 0 \quad \text{when } y = 0 \qquad \ldots(2)$$

and (b) at the edge of the disturbed region, in order that the velocity may pass smoothly over into that in the main stream,

$$u = 0, \text{ and } \frac{\partial u}{\partial y} = 0, \text{ when } y = y_0 \qquad \ldots(3)$$

In order to solve the above equations, we first make the assumption, due to Prandtl, that l is constant over anyone section of the region. Further remembering the harmonic character of the disturbance, we introduce a non-dimensional quantity η in terms of which and in terms of x and t, we write as follows:—

*''' 00?) exp (~int), ^ a = ^ §) " ex ^ (~int)j l=l W exp (2int)-(4)

where $\phi(x)$ and $\psi(x)$ have the dimension of length, b being a typical length.

These substitutions in (1) reduce them to in {/ + Vf (,)> + * {vf (,) £ g $+ f(\eta) \dfrac{\psi'(x)}{\psi(x)}\Big\}$

$$——2/* Vb \ \dfrac{f'(\eta) f''(\eta)}{\wedge \ \# (x) \phi^3(x)}, \qquad (5P)$$

or

$$= - \ \dfrac{''(\eta)}{\#(x) \ 4^*(x)} \qquad \ldots \quad (5T),$$

where dashes denote differentiations with respect to the corresponding arguments.

The two equations are identical except in place of $2Z^a$ in (5P) we get Z^2 in (5T). Hence both the theories give the same velocity distribution, only the value of / being different. We shall now solve (5P).

In order that the resulting equation may be an equation in *y* only, we put with suitable choice,

$$U \frac{\phi'(x)}{\phi(x)} = U \ \frac{}{\psi(x)} \ - - \ \frac{}{\psi(x)\phi^3(x)} \qquad (6$$

Then the equation (5P) becomes

$$f+vf'=fV> \ldots \ldots \quad (7)$$

$$\text{or} \quad \frac{d}{d\eta}\Big(\eta f\Big) = f'f''.$$

Therefore on integration we get

$$\eta f = \tfrac{1}{2} f'^2 ,$$

the constant of integration being zero, since when 17=0 *(i.e.y=0)* we have from condition (2),/'=0.

Further integration gives

$$f = \tfrac{2}{9}\, \eta^3_0 \left\{ 1 - \left(\frac{\eta}{\eta_0} \right)^{\frac{3}{2}} \right\}^2, \qquad \ldots \quad (8)$$

since from condition (3), when 17=^0 (corresponding to the edge of the disburbed region),/=0=/'.

Also from the relations (6) we have

$$*(*) - « \text{ exp. } (— \wedge) , \#(*) - * \text{ cxp. } (- \frac{**}{U}) , \qquad \ldots \quad (9)$$

$$\text{and } l^2(x) = \frac{in}{2U} a^3 \exp.\left(-\frac{8inx}{U}\right), \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (10)$$

where a is a typical length.

Thus from (4), the complete solutions are

$$\bullet\text{-}\bullet \ U_n\backslash \text{ exp. } \{in\ (ljL-t\ )\} \quad \{ 1- (\wedge y\}\backslash \ldots \quad (11)$$

$$l^3 = \frac{ina^3}{2U} \exp. \left\{ -4in\left(\frac{2x}{U} - t \right) \right\}, \qquad \ldots \quad \ldots \quad \ldots \quad (12)$$

andj>=fiTjexp. -/—in #- ^ $\dfrac{2x}{}$——1)\\ . . . . (13)

Taking real part in each case, we have

«= I U ij$^8_0$ Cos nl $\dfrac{}{U}$ -/ H 1— I $\dfrac{}{y_0}\Big)^{\frac{3}{2}}\Big\}^2$, ... (14)

$$\eta = \frac{na^3}{2U} \sin 4n\left(\frac{2x}{U} - t\right), \qquad \text{.........(15)}$$

$$\text{and } y = a\eta \cos\left(\frac{2x}{U} - t\right) \qquad \text{.........(16)}$$

$$\text{so that } y_0 = a\eta_0 \cos\left(\frac{2x}{U} - t\right) \qquad \text{.........(17)}$$

To correlate these results with the initial conditions, let the initial disburbance be represented by

$u=u_0 \cos mx$ in the plane $y=0$. . . . .(18)

Then comparing with (14) when $t=0=y$, we get

$$u_0 = \frac{a}{9}(U\eta)^3_0 \quad \text{and} \quad \frac{2n}{U} = m, \qquad \text{.........(19)}$$

so that *m* has the dimension of length.

Then the equations (14), (15) and (17) give

$$u = u_0 \cos m\left(x - \frac{U}{2}t\right) \ldots \qquad \text{(20)}$$

$$\eta^3 - \ldots \sin 4\left(\ldots\right), \qquad \text{(21)}$$

$$\text{and } y_0 = \ldots \left(\frac{u_0}{W}\right)^{\frac{1}{3}} a \cos m\left(x - \frac{U}{2}t\right) \qquad \text{(22)}$$

These equations show that the original simple harmonic disturbance imposed on the liquid develops into a progressive wave travelling with velocity $\frac{U}{2}$.

Thus the tendency of the turbulence is to change the simple harmonic character of the disturbance into a progressive wave character.

PATHOLOGY OF JOHNE'S DISEASE IN SHEEP* -

By BHAGWAN SARAN RAJYA, *Department of Pathology and Bacteriology, U. P. College of Veterinary Science and Animal Husbandry, Mathura.*

Studies on the pathology of Johne's disease were undertaken to illucidate the relationship of the clinical manifestations, haematological picture, gross and microscopic lesions in various stages of the allergic positive sheep.

Investigations were conducted by dividing the 19 sheep in three groups; Group I consisted of all the emaciated animals in advanced stage of the disease: Group II had slightly weak animals : Group III sheep were almost apparently healthy.

The chief symptoms in advanced stage of the disease were, extreme loss of body condition, constant scouring without any loss of appetite,. The bowel wash examination of this group of animals was positive for acid fast like *Myco. Paratubsrculosis* organisms. However, oedema, lesions of the eye in the form of opacity of cornea was exhibited by extremely weak cases in prostrated condition. No apparent symptoms were noticeable in the early stages of the disease amongst the cases of group III.

Haematological picture also, did not reveal any significant variations in the three groups.

The naked eye lesions in advanced cases of the disease were characterised by absence of body fat and its replacement by myxomatous tissue. Necrosis of fat was also indicated in some of the cases of group I.

The gross changes in the intestines varied from the congested focal patches of mucosa of early stages, to the extreme congestion with or without thickness and also the presence of corrugations of the mucous membrane involving considerably large areas of the bowel wall of sheep in advanced stages of the disease. Some of the sheep of group I also showed involvement of duodenum and abomasum. The extensive lesions of the advanced stage of the disease were almost always associated with teaming organisms in the instestinal smears. However, no acid fast bacilli could be detected in the smears fronv the cases in the early stage of the disease. The surface of the mucosa was invariably covered with a viscid creamy exudate, characteristic of catarrhal enteriteis.

The enlarged and oedematous condition of the contiguous lymph nodes was a marked feature in the advanced stage of the disease. The smears from these nodes were heavily positive for acid fast bacilli. The lymph nodes of the

* This is an abstract of the thesis submitted for ths Degree of M. V. Sc. (Vet. Sc.) in advanced Pathology of the Agra University.

cases of group III appeared to be very little affected and also exhibited a few or absence of acid fast rods in the smears. The caseated and calcified foci were commonly observed in the mesenteric and ileocaecal lymph nodes.

Besides the microscopical changes in small intestines and lymph nodes, the liver, lung, heart and tonsils exhibited lesions with the presence of acid fast rods. Lesions in some of the sheep were also seen in spleen, cornea and mediastinal lymph nodes but no acid fast organisms could be seen.

The histopathological reactions of the intestinal and lymph nodes were characteristic of granulomatous type of inflammation. But the reactions amongst the three groups could be distinguished by the types of reacting cells, intensity of reaction, effects of reaction and the association of acid fast bacilli in these lesions.

The lesions in the advanced stage of the disease were characterised by diffused hyperplastic reaction mainly by epithelioid cells, giant cells and macrophages, containing lot of acid fast organisms. The hyperplastic reaction extended in the muscularis mucosa and submucosa and replaced the crypts. The intense hyperpLioin along with the obliteration of lymph vessels was suggested to be the cause of degeneration and necrosis of the superficial mucosa and of the crypts in some of the ca-.es. Clumps of extracellular organisms were evident in the necrosed portions.

The lesions in the apparently healthy group of sheep were focal aggregation of a few macrophages, lot of plasma cells and lymphocytes without the presence of acid fast organisms. These could well be represented as early manifestations of the disease. The presence of scanty amou it of organisms in such early lesions were suggested to be due to the lysis of organisms by the macrophages and also the increased proportion of the reacting cells. The proportion of the type of cells further differentiated the lesions in group II sheep, where less number of epithelioid cells and macrophages were present, but plasma cells and lymphocytes were in an appreciable amount.

The lymph nodes of cases in advanced stage showed diffused hyperplastic reaction with lot of acid fast rods, involvement of medullary sinusoids and hyperplasia of germinal centres. In the lymph nodes of cases in the early stage* of the disease there was focal type of raction. The presence of necrosis in the lymph nodes was suggested as a result of secondary effects of hyperplasia leading to the nutritional disturbances of the tissue. The necrosed material subsequently might have undergone caseation and calcification.

The histopathological changes further suggested that the primary lesions co:Timenced in the stroma of the villi, after the entry of the acid fast rods through the breaks in the continuity of the epithelium. This was followed by the proliferative and phagocytic activity of the mononuclear phagocytic cells. The lesions appeared to be related in the absorptive part of the intestinal tract.

The infection in the lymph nodes reached by way of the lymph stream. But the possibility of the escape of organisms in blood vessels had been explained on the basis of the formation of thrombus in vein and localization of acid fast rods in other organs. The organisms might have also reached in the blood through the thoracic or right lymphatic duct.

An apparent positive correlation could be inferred between the number of organisms and pathological changes. It also appeared that the variation in lesions might be due to the stage of disease.

A NEW VACUUM TUBE CONTROLLED DEVICE FOR MEASURING VERY SMALL VARIATIONS IN THE CURRENT OF POTENTIAL GRADIENT OF A CIRCUIT THROUGH CONDUCTING LIQUIDS

By P. N. RAO, P. D. BHATANAGAR AND A. K. BHATTACHARYA,
Department of Chemistry, Agra College, Agra.

There is no suitable method to study very small changes in current that take place when a current is passed through a conducting liquid under constant voltage. Tne importance of this phenomenon arises mainly in the study and measurement of cataphoretic velocity of colloidal particles. It has been observed by previous eminent workers Burton, J. N. Mukherjee and Svedberg that the migration velocity of the boundary of colloidal particles was not constant in the electric field under a constant voltage.

• With this end in view we have been able to construct a very reliable electronic instrument by which the potential difference between any two points in the circuit can be balanced to zero in the initial state, and any further changes in the potential with time can be very accurately measured by means of the device which has been diagrammatically represented as follows:

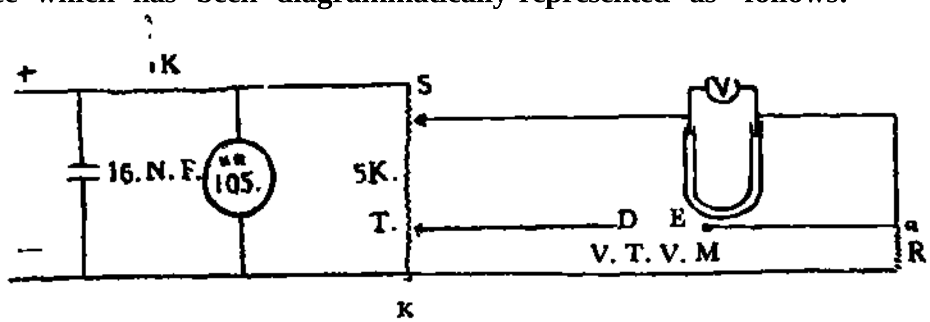


Fig. 1.

MEASUREMENT OF SMALL VARIATIONS FOR CURRENT THROUGH A CONDUCTING LIQUID IN THE U-TUBE CIRCUIT

Rectified and stabilised voltage is supplied with the help of a voltage regulating tube (VR 105). (See fig 1)

Tne desired voltage is applied to the electrodes of the LJ-tube by means of a potential divider between S & K, whose one end K is joined to the end of the resistance R which is approximately one hundredth of the resistance of the liquid in the U-Tube. Tne potential *of* the point Q is balanced by connecting a valve voltmeter between D and E at the initial stage of pasisng the current. Tnis equlpotentialty is given by the zero deflection in V. T. V. M. It has been possible to measure very minute changes (0.02 to 0.002m.amps.) in the current of the liquid circuit by a sensitive galvanometer of the V. T. M. V.

Tne changes in the potential between any two points on the limb of the U-tube containing the conducting liquid have also been measured by extending the foregong device. Platinum terminals were fused in one of the limbs of the U-tube, to supply the connections at the desired points. The instrumental device is as follows:

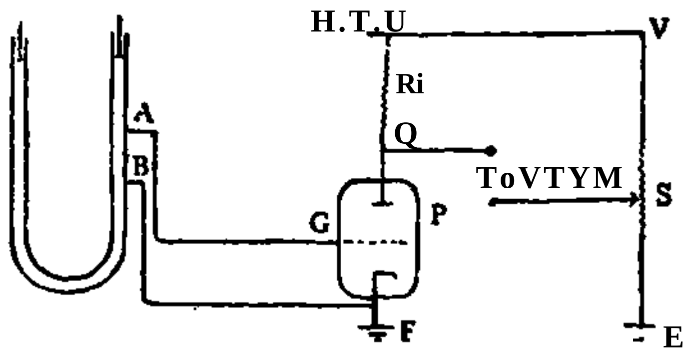


Fig. 2

MEASUREMENT OF SMALL CHANGES OF POTENTIAL ACROSS ANY TWO POINTS *In the U-Tube*

A & B are the two points in the limb of the U-tube. Tne initial potential developed across AB is fed to the grid of a valve operated with in the region of its linear charateristics. A certain potential is developed at Q,which is balanced with an equipotential point S on the branch VSE by means o[r] a V.T.V.M. A change fn the voltage with time of flow of the current between A & B can be recorded by the V.T.V.M. as in the previous case.

Thanks are due to Sri D. P. Chakarverty of Engineeiing College, Dayal bagh, Agra for giving us occasional facilities to check up this instiument and for helpful discussion.

1* Burton Trans. Can. lust. Toronto. 9, 1909, p—53.
2. J. N. Mukhcrjre Proc. Roy. Soc. A, 1923, 103, p-102.
4. Svcdberg Nov. Act. Reg. Sci Upasala. N (2) 1. 147, 1907. p~109

CECIDOTHECA INDICA*

By M. S. MANI, M.A., D.SC., F.LS., *Professor of Zoology & Entomology, School of Entomology, St. JohrCs College, Agra*

INTRODUCTION

This paper is the outcome of my thirty years' studies on the plant galls and the -different organisms associated with them from India. During this period, I have made extensive collections of galls and insects from different parts of the country and also received considerable collections from various collaborators. I have described numerous new galls in earlier papers and in 1948 summarized the available information on the cecidozoa and zoocecidia from India.J Since then considerable fresh material has been examined. This paper presents a comprehensive account of the plant galls, produced by insects, mites, nematodes, fungi and bacteria, so far known from India. A little over 650 galls on about 370 species of plants, belonging to about 80 Natural Orders, mostly of the Dicotyledonae, are included here. Large numbers of galls on Graminae and some other Monocot Orders are not dealt with here.

Taken as a whole, the galls produced by gall midges (Itonididae = Cecidomyiidfre : Diptera) are extremely abundant in the Indian flora and constitute about 45% of the total. Of the midge galls, nearly 50% are found on leaves, 30% on stem or other parts of branches, 15% on flowers and about 3% on bud. The galls produced by mites (Eriophyidae : Acaiina), amounting to nearly 20% of the total, stand next importance. The greatest bulk of the mite galls, viz. over 80%, are found on leaves and only relatively small proportion of them develop on other parts of plants. The midge and mite galls are nearly equally abundant in the tropical, subtropical and parts of the temperate zones of the country. The galls by the Homopterous insects of the family Psyllidae represent about 10% of total and nearly 90% of the Psyllid galls form on leaves. The aphid galls are relatively scarce, constituting at present only 3%, and are also mostly confined to the leaves of plants growing in the subtropical and temperate zones. The galls by the Cynipid wasps, so numerous in Europe and North America, represent hardly 5% of our gall flora and almost half of these cynipid galls are on leaves of plants on the southern slopes of the foot hills of the Himalaya. The galls by Thysanoptera, Coleoptera, Bacteria and Fungi each represent about 5% and are more or less widely distributed. The galls caused the other agencies together constitute about 2%.

•Contribution No. 75 from the School of Entomology, St. John's College, Agra.

,tSince this paper was submitted, the authrv is in the Zoological Survey of India, Calcutta.

tMani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14(2) : 27-195; *Agra Univ. J. Res.* (Sci.) 1 (1) : 47-54 (1952) ; 2(2) : 247-266 (1953); 2(3) : 135-158 (1953) ; 3 (1): 13-42(1954); 4(1) : 187-208 (1955;.

It would thus be evident that a relatively high proportion, about 55%, of the galls in our country are leaf galls. The stem galls stand next and amount to about a quarter of the number. Nearly a tenth of the known galls are^flower galls. The bud and fruit galls occupy a minor place and the root galls are relatively sparsely found and are mostly caused by Nematodes.

Most galls have a curiously localized distribution but some are widely distributed in India, at least on the plains. The great bulk of our galls are also endemic, but many are common to Ceylon, Burma, Malaya, Java, Sumatra, Siam, Philippines and Formosa. Nearly every gall from the Himalaya is endemic. There is also a certain amount *oF* unmistakable Malayan facies in the galls from the south Coromandal Coast, Travancore-Cochin and Assam. Mediterranean affinities are distinctly seen in some of the galls from the North-West Himalaya and a slight Ethiopian element pervades galls from as far south as Hyderabad. Although galls of one kind or another may be found on different plants throughout the year in our country, they are most abundant during the spring and monsoon rains. While many galls are nearly equally abundant year after year, some exhibit more or less irregular periodicity, appear only after an interval of some years and are either extremely rare or even totally absent in the long intervening period.

Considering the rich and extremely diversified flora of India, it must be evident that so far only the fringe of the vast field of cecidology has been touched. My recent experience of collecting has convinced me that even at a very moderate estimate, the number of galls which still avait discovery can in no case be less than 8000. Though some parts of the "country have been relatively fairly explored for galls, extensive areas of the Western Ghats, the Vindhya and Satpura, the Khasi Hills and the foot hills of the Himalya present virgin fields for the gall collector. It is to be hoped that this paper will stimulate further research in this most fruitful field of natural history.

The photographs, which illustrate (his paper, were all made by me, mostly from specimens preserved dry or in 10% formalin, with the help of leica camera, using 135 mm Hektor f. 4.5 lens and continuous focussing bellows with reflex mirror housing, on Ilford HP3 35 mm film, under artificial illumination and processed by me at about 18°C. The line drawings were also prepared by me. Microfilms* of the photographs of the galls described here are to be deposited with the Linnean Society of London.

I take this opportunity of expressing my indebtedness to my students and other .collaborators for collections and other valuable help. I am also grateful to the authorities of the St. John's College, Agra for facilities.

Natural Order MENISPERMACEAE

Gocculus hirsutus Diels

Gall No. 349 by *Schizomyia cocculi* Mani on flowers

PI. X

Mani, M.S. 1953. *Agra Univ. J. Res.* (Sci.), 2:247; 3:109-111, fig. 1-4(1954).

Irregular, subglobose, solid, fleshy, brown, indehiscent, lobuJated and

•Contact prints on positive film from original negatives.

tubercled, densely and closely villous tumescence of entire staminate flowers, with the floral envelopes and stamens greatly swollen and fleshy and enclosing irregular, narrow, tortuous passages, containing numerous red-coloured midge larvae. In the young gall the tips of the biscriate sepals are mose or less unaltered and flat, but swollen and greatly altered basally, especially in the outer series. The enormously **swollen** stamens (fig. 1) often bear vestigial and empty anthers and arc embraced by the intumescent and malformed petals. The entire flower is thus greatly deformed and transformed into a solid fleshy mass, with irregular bulging lobes and larger or smaller fleshy pubescent tubercles on the surface. The epidermal cells disorganized, hypertrophied. Trichomes rusty-brown, long, simple unicellular, unbranched, acutely pointed dense outgrowths from the epidermal cells, nearly straight or somewhat curly distally, occasionally subclavate, short or irregular; rarely arising in fasciculate bundles, but never multicellular. The trichogenous epidermal cell is produced into a short, truncated proximal base, beyond which is the hair cell proper. The great mass of the gall comprises closely packed parenchyma cells. Fully mature gall measures about 20-25 mm in diameter. Occurrence abundant : nearly every flower being galled.

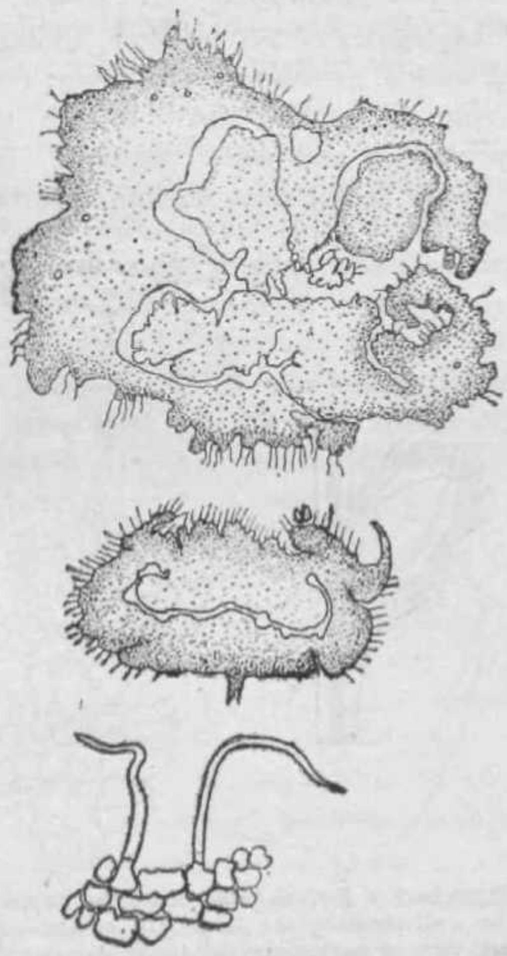


Fig. 1. Gall No. 349 on flowers of *Cocculus hirsutus* Diels by *Sehiz°myia* ***cecadi*** Mani. Top figure is transverse section showing the greatly swollen sepals and petals; middle figure is sagittal section, with vestiges of anthers sticking up as small tubercles ; the bottom figure is a magnified view of the surface layer of cells.

Pupation probably in gall after a slight larval diapause.

Distribution.—South India.

Tinospora **cordifolia** Miers

Gall No. 374 by midge on branch

Nayar, K. K., 1948. J. *Bombay not. Hist. Soe.*, 47 (4): 669.

Irregular, solid succulent, fleshy, multilocular, local or sometimes also diffuse, indehiscent outgrowths on branches, about 5-15 ^nm long, 10-20 mm thick, glabrous, yellowish-green to greenish-brown, with numersous exit holes. The gall midge larvae are parasitized rather heavily by Hymenoptera.

Distribution.—Travancore.

We have a somewhat similar gall on the branches of *Tinospora crispa* Diels (= *uliginosa* Miers), with irregularly striated surface and caused by an unknown midge from Java.[1]

Natural Order BERBERIDACEAE

Berberis lycium Royle

Gall No. 420 by unknown Trypetid fly on bud

PI. XXXI

Mani, M.S. 19&2. *Agra Univ. J. Res.* (Sci.) 2 (1) : 136-137.

Regular, sessile, aggregates of 5-6 or more, globose, ovoid, indehiscent, fleshy, unilocular, thick-walled, persistent, dark brown; covered with imbricating scaly outgrowths representing the tips of the leaves, the bases of which become greatly swollen and fused together. Each gall about 5 mm in diameter. Larval cavity large, oval, smooth, central and communicating

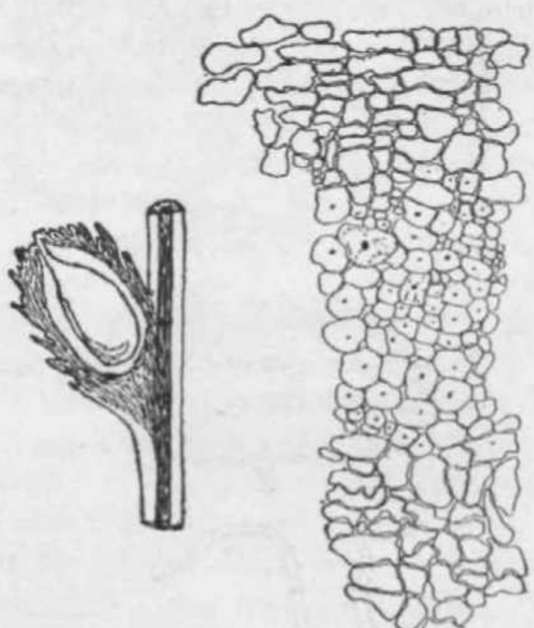


Fig. 2. dall No- 420 on bud of *Berberis lycium* Royle by Trypetid fly. On the If ft is a longitudinal section of the gall ihowing ihe large gail cavity and the imbricating scales • *on* the right is a magnified view of part of the gall li«ue showing the three layer of cells.

[1] Docters van Leeuwcn-Rcijnvann, J. & W *Bull. Jardin bat. Buitenzorg 2* : 54, No. 494 fig. 226 (1914); Houard, C, Les Zooceridies des Planles des d Africnic <f ' Asie etd'Occanie, I : 260, No. 945, figs. 533-534 (1922).

to the outside by an irregularly circular apical ostiole; with a single larva or puparium. The gall tissue has 3 layers; the outer layer of thick-walled dead cells in 4-5 rows; the middle layer of closely packed, simple, spongy parenchyma of uniform globose cells; and an innermost, zone of of empty cells lining the larval cavity and nearly as thick as the external layer of dead cells, but with the .cells somewhat more closely packed (fig. 2). In the base of the gall irregular parenchymatous emergences project into the gall cavity from the cortex of the branch. At the seat of gall formation the branch is also conspicuously hypertrophiedj especially the cortex. Near the ostiole at the apex, the gall tissue is composed largely of uniform large parenchyma cells without differentiation into the three zones. A somewhat similar but solitary gall by a midge on *Berberis darwini* and *B. emetrifolia* is described from Argentina by Trotter[2]. Dr. Elmo Hardy, Hawaii, considers the fruitfly breeding in the fruits of *B. (ycium* in the Kumaon Himalaya to be close to *Rhagoletis.* It is not however known whether the same fly, breeding in the bud, gives rise to galls.

Distribution.—North west Garhwal Himalaya.

Gall No. 425 by fungus on branch

Mani, M.S. 1953. *Agra Univ.* J. *Res.* (ScL) 2 (I) : 136 ; (1954) 3 (1) : 27.

Regular, globose, unilateral, solid, hard woody, indcliisent, persistent, uni-Iocular, solitary cortical swellings of blanches, with rough dark brown bark, cracked and peeling off when old; about 20-25 in diameter; sometimes 2-3 galls close together but never aggregate. The gall is 'argely composed of closely packed, small parenchyma cells, elongated radially and derived from the subepidermal layer of cortical tissue (fig, 3). An outermost layer of large dead cells surrounds a cortex of large closely packed parenchyma, the cells of which increase in size towards the interior. This is followed by a zone of moderate-sized closely packed cells. In the centre, forming a sort of medulla and constituting the great bulk of the gall, are small, very closely packed elongate cells, with radial groups of thick-walled wood cells. The fungal

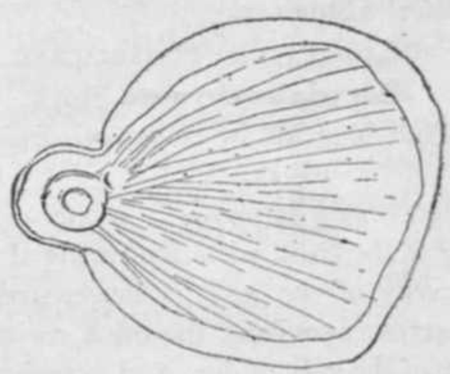


Fig. 3- Gall No. 425 on stem of *Berberis lyrium* by fungus ; transverse section through stem and gall, showing the radiating cells.

2. Trotter, A. 1902. Descrlzione di alcune gaile dell' America del Sud- *Firenze Boll. Soc. bot.* t(a/., p. 101, Nos. 4 & 5 ; H»UARD, C. 1933. I.es Zoocecidies drs Plante* del' Amerique du sud ct dr 1' Amcrique Centrale, p. 72. Nos. 1 74 & 175, fig. 75-76. TavaresJ. da SHva. 1915. *BroWria (fool.)* 13 : 107-108, No. 3!. pi. iv. fig. 2-4-

myceiia pass radially straight in the gall medulla and are intercellular, sometimes branching. The perithecia are found in the outermost zone of the gall tissue.

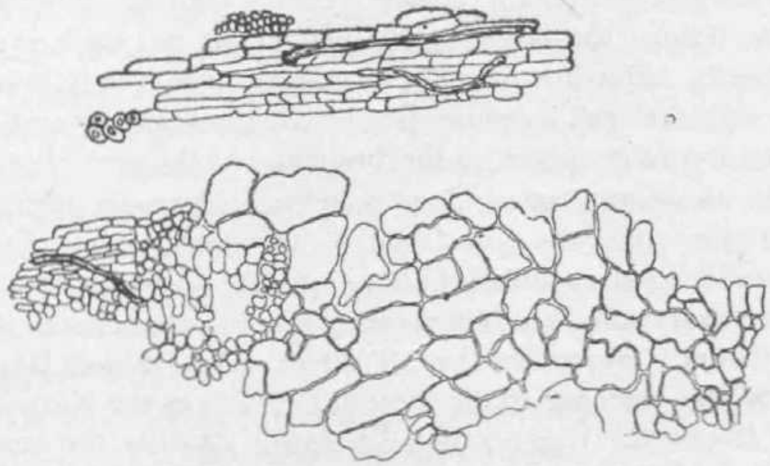


Fig. 4. Gail No. 425 on *Btrberis Lycium* by fungus ; upper figure shows the fungal myceiia and the lower figure shows the general structure.

This gall is extremely abundant and frequently grows up to sizes varying from 30 mm to 50 mm in diameter on nearly every branch and every plant. Often also medium-sized galls occur in open patches and clearings, especially on the southern slopes of the ranges.

Distribution,—Kumaon, Garhwal, Simla-Hill and Dhauladhar Himalaya.

Holboelia latifolia Wail.

Gall No. 423 by unknown midge on branch

Mani, *Agra Unv.J.Res.* fSci.) 2(1} : 137-138 (1953).

Irregular, extensive, tuberculated, cortical swellings on branches, 10-15 mm thick and often involving about 100 mm length of the branch, multiloculai, solid, parenchymatous. Epidermis broken longitudinally through by the growth of cortex. Each superficial tubercle on the gall corresponds to one larval chamber. Vascular bundles penetrate into the tubercles (fig. 5).

Distribution.—Garhwal Himalaya.

Natural Order FUMARIACEAE

Corydalis cornuta Roy It-

Gall No. 588 by midge on fruit

PL XVI.

New gall. Inflated, suhcompressed, ovate or ellipsoid, legume-like, yellow, smooth swelling of the fruit, with the vestigial style persisting on the Spcx of the gall, the cavity of the gall is large, irregular, often filled with irregular short fleshy excrescences from the thick coriaceous walls. Each gall May contain 1-4 larvae of the gall midge and occasionally 1-2 almost normal seeds may be present in the distal part, but mostly seeds undeveloped, ovules usually absent or disintegrated. The gall grows to about 10 mm length and •5 mm thickness. Such galled fruits develop in enormous numbers, with immature normal fruits and are also easily mistaken lor ripening normal fruits.

Distribution.—Narkanda (2900 m above mean sea level) Himalaya; Hindustan-Tibet Road 243 kilometres. Coll. Santokh Singh, 6-X-1954.

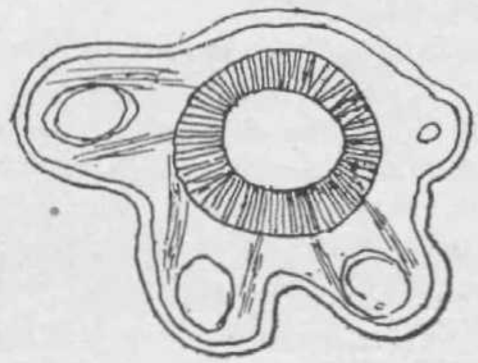


Fig. 5. Gall No. 423 on *Holboelia lat'tfolh* Wall, by midge j transverse section of the galled branch lo show the larval chambers and the stele of the branch.

Natural Order PAPAVERACEAE

Argimone mexicana Linn

Gall No. 758 by *Eriophyes* sp. on leaf

. Hypophyllous, irregular, lobed, often agglomerate beutch>alls, with large, wjde epiphyllous ostioles ; gall cavity spacious ; with dense white tomentum, giving a conspicuous cottony appearance to the gall : each leaf may bear up to a dozen galls ; size of the individual galls 8 mm in diameter and 5 mm thick.

Distribution.—Deccan.

Natural Order CRUCIFERAE

Brassica campestris Linn.

Gall No. 567 by *Urocyslis brassicae* Mundkur on root

Mitra, M-, *Agric. J. India,* 23:104-106 (1928).

Mundkur, B- B., *Pliytopathotogj,2&;\34-\42$_t$* figs. 3, (I938).

Root galls of variable size, ranging from about 5 nun to over 30 mm in diameter, irregularly bubglobose, warty, dirty-white, smooth and turning grey when mature; mostly cortical cell proliferations; mature galls break off easily; fungal mycelium intercellular and usually confined to the cortex, without hausteria, in mature galls the mycelia penetrate into the stele. As a result of gall formation in roots, the plants appear pale and flower somewhat earlier than normal and the pods arc few or stcrilr. The same fungus forms root galls on other plants also, viz. *Brassica nigra* Koh., *B. juncea* Coss., *B. napus, B. rapa lalffolia* Bailey, *B. oteracea capitals* and *Rapfianus sativus* Linn, **in** India.

Distribution. —Bihar.

Brassica juncea Hook. & Thomas

Gall No. 357 **by Agrobacterium** (?) on bud

PL X.

Irregular or subglobose, solid, fleshy, indehiscent, localized or often diffuse swellings of axillary buds and of the cortex of tender branches, 5-25 mm thick, with smooth surface or with obscure fleshy tubercles and irregular fissures, especially when old.

Distribution.—Delhi and Punjab.

Natural Order CAPPARIDACEAE

Gadaba indica Lamarck

Gall No. 4 by *Eriophyes* sp. on leaf

Mani, M. S. 1948. *J. R Asiatic Soc. Bengal* (Sec.) 14 (2) : 97/ fig. 10.

Epiphyllous, large, irregular, globose beutelgalls about 10 mm in diameter; glabrous or with fleshy verrucose surface ; green, thicker than the normal leaf-balde; cavity single, large, covered by very fine, white erineum inside; ostiole large, irregular and hypophyllous. Sometimes an entire leaf blade becomes galled.

Distribution.—Coromondal Coast. (Previous record from Udaipur is erroneous).

Gapparis aphylla Roth.

Gall No. 149 by unknown Lepidoptera on stem

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal (Sci.)* 14 (2) : 129.

Globose, brownish, hard, woody, solid, local, sometimes extensive swellings of branches about 10—20 mm in diameter. The larval tunnels tortuous; pupation in gall. Scarce.

Distribution.—Tanjore. A somewhat similar gall is known from Egypt on C. *aegyptiaca* Lamarck.[3]

Gappris brevispina DC

Gall No. 150 by unknown Lepidoptera on stem

Mani, M.S. J. 1948. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 129.

Globose or subglobose, hard, solid woody branch galls, very similar to Gall No. 149 on *G. aphylla,* but sometimas somwehat larger. Pupation in the gall.

Distribution.—Coromandal Coast.

Gapparis sepiaraia Linn

Gall *No. 169 by unknown midge on leaf*

Mani, M. S. 1935. *Rec. Indian Mus.,* 37 (4) : H2; *J.R. Asiatic Soc. Bengal* (Sci.) 14 (2) :132 (1948); Barnes, H.F. Gall Midges of Economic Importance, 6:164 (1949).

Spongy, solid, deep pinkish-red fleshy, irregalarly tuberculated, legume-like, compressed, elongate, yelJowish-green, indehiscent, glabrous, multilocular .swellings of the whole leaf blade, caused by oviposition by the midge in between the longitudinally folded leaf in the side, with the fusion of the folded halves and swelling up to an elongate-oval mass, nearly 20 mm long, 10 mm broad and 5 mm thick, presenting a curious resemblance to a fleshy legume, with the veins and midrib marked out on the surface conspicuously. The larval chambers are oval ^ and irregularly scattered in the *flesh of* the gall. The galls appeared in large numbers on clumps of the plants, growing

3 Houard, C. Les Zoocecidies des Plantes d'Afrique, d'Asie et d' Oceanie 2 • 294, No. 1C65, fig. 611-612 (1922).

in the old ruins of the rampart walls in the Sivaganga Garden to the south of the Big Temple in Tanjore during August-November 1928. The midge larvae were heavily parasitized by chalcids (probably family Tetrastichidae). The gall is remarkable for the pronounced development of the beautiful pink-red pigment within its tissue.

Distribution.—Coromandal Coast.

"Gall No. 405 by Lepidoptera on stem

PL VIII

Regular, solid, indehiscent, hard, woody, globose or ovoid, simple, solitary, local, greenish-fellow or reddish-brown, glabrous, often unilateral swellings of branches; with 1-4 tortuous irregular larval chambers in the middle, leading to the large, circular exit holes when old and filled with brown frass. Bark and cortex relatively small, but still greatly swollen compared to the normal branch. The larval cavities as a rule occur in the medulla of the branch. This gall has also a great similarity to the Lepidoptera gall on branches of *C. aegyptiaca* Lamarck but is of larger size[4]. Pupation in gall. The empty pupal casts left behind in the larval tunnel just within the exit hole. The gall occurs in great abundance on the dry parts of Marudamalai Hills north of Coimbatore.

Distribution.—South India

Gapparis stylosa DC

Gall No. 151 by unknown Lepidoptera on branch

Mani, M. S. 1948. J./?. *Asiatic Soc. Bengal* (Sci.) 14 (2) : 129.

Solid, indehiscent branch galls similar to Gall No. 149 on *C. aphylla.*

Distribution.—Coromandal coast.

Gapparis viminea Hook.

Gall No. 170 by *Oligotrophus indicus* Kieff. on branch

Kieffcr, *J.J.Mareellia,7:153-152,* pi. iii, flg, 9,10, pi. iv, fig. 3 (1908); Houard, G. Les Zoocecidics des Plantes d'Afrique, d' Asie et d'Occanie, 2:295,'No. 1067, fig. 614-615 (1922^; Sundar Raman, A. H., *J. Indian bot. Soc., 4: (1924) ;* Mani, *J. R. Asiatic Soc. Bengal (Sci.)* 14(2) : 132 (1948); Barnes, H. F. Gajl midges of Economic Importance, 6 : 164 (1949).

Irregular, solid, indehiscent, *local* or *often* extensive unilateral galls on branches, petioles, midrib or larger veins of leaf, hard and fleshy when young but woody especially when old, brown and glabrous, 5-12 *mm long,* 5-8 mm thick, with numerous irregularly scattered elongate larval cavities. Leaf galls visible equally on both sides of the blade. Kieffer *{loc. cit.)* records that pupation occurs in soil and adults emerge in January, ,but describes the species from larvae only. The larvae are pale-yellow and are parasitized by *Bracon* sp.

Distribution.—Kurseong : Eastern Himalaya.

Gleome monophylla Linn. ?

Gall No. 470 by unknown midge on bud

Regular, subglobose or conspicuously biconvex, semi-solid, fleshy, soft,

*** Houard, C. Les Zooecidies dcs plantes d'Afrique, d'Asie et d'Oceanie, 2:294, No. 1065 (1922).**

pale green or yellowish-green, smooth, unilocular, indehiscent galls on leaf buds or on leaves, about 3 rnm in diameter and covered by minute glandular hairs.

Distribution.—South India.

Crataeva religiosa Forst.

Gall No. 171 by *Aschistonyx crattievae* (Mani) on bud, leaves, etc.

PI. XXX

Mani, *Rec. Indian Mils.*, 36 (4) : 428 (1934). 430, fig. 21—22, plxii. Sakscna, R. D. *J. R. Asiatic Soc. Bengal*, (Sci.) 8:13, fig. 5, pi. i (1942).
Mani, *J. R. Asiatic Soc. Bengal*, (Sci.) 14 (2) : 133 (1948).
Rao, S. *N. Pec. Indian Mus.*, 48 (3-4) : 37-41, fig. 5 (1950).

Irregular, solid, fleshy, indehiscent, globose or pyriform, succulent bunched masses, composed of the enromously swollen terminal or axillary vegetative buds, groups of several buds or leaflets; greenish-yellow or yellowish-white, with fleshy tuberculae or rugose surface, enclosing numerous irregular tortuous narrow passages in which are found several reddish or yellowish larvae. Size of the gall varies from 5 mm to 15 mm in diameter.

Tne eggs being deposited within the folds of the unopened tender buds, the leaflets enlarge enormously but no fusion together of the parts resulis ;'the leaflets folded along the midrib in the bud fail to unfold and also do not unite even if swollen up irregularly. Cell proliferation is largely confined to the leaf parenchyma, but the midrib and some of the larger veins also undergo a certain amount of hypertrophy. The hypertrophied midrib is indicated by a reniform series of vascular bundles on one side of the fleshy mass of the gall parenchyma. The other veins are represented by irregular and isolated patches of vascular bundles, which are mostly normal otherwise.

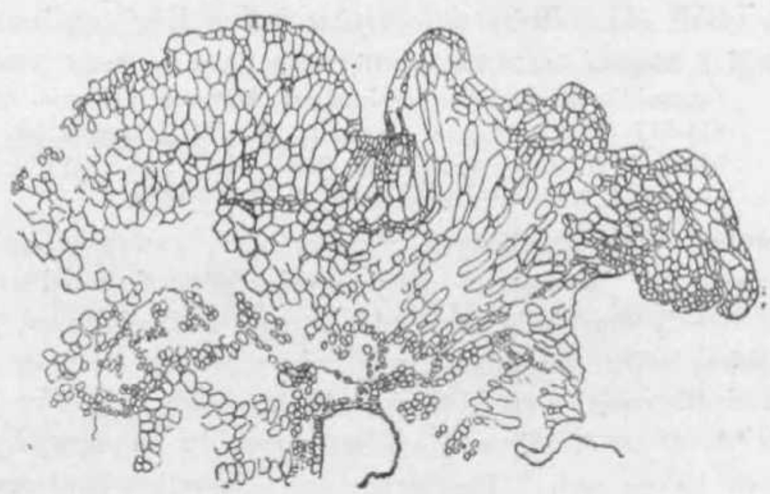


Fig. 6. Part of the parenchyma of gall No. 171 on *Crataew religiosa* Forst. by *Aschistonyx crataevat* (Mani).

The bulk of the gall is composed of large parenchyma cells, closely packed together, without intercellular spaces. Epidermis undiflVrentiated, but occasionally with a few flat cells. On the side of the midrib and near the base, a mass of large parenchyma cells bulge **outward** in irregullar emergences. Apically and on the opposite s·dc we see transition from the greatly hypertrophied spongy and palisade tissues to the wholly undifferentiated gall parenchyma. Fleshy parenchymatous outgrowths from the cortex of the branches and petioles become closely associated with the swollen leaflets.

When tender buds develop into galls, entire buds or groups of Buds turn into closely crowded swollen masses. With older buds further down on the branch, which have already commenced spreading, the gall formation is restricted to the bafts of the leaflets only.

With the axillary biftl as the seat of gall formation, irregular fleshy outgrowths of undifferentiated parenchyma from the cortex of the branch just above the axil meet similar outgrowth from the cortex of the base of the leaf petiole and fleshy swellings of the bud, to form together an irregular mass, in which the emergences from different centres of cell proliferation, however never coalesce at places of contact.

The galls decay very rapidly after the escape of the larvae for pupation underground and leave behind dry brown irregular scars.

This gall is widely dsitributed throughout India and frequently occurs in astonishingly enormous numbers on certain trees, while others closeby remain practically free. In the south there are 2-3 generations of the midge, but in the north there is usually but a single generation and the galls first appear in early spring. A prolonged larval diapause in the soil is followed by pupation in April and the emergence of adult synchronises with the leaf-fall and unfolding of new buds.

Distribution.—Throughout India.

Gall No. 172 by *Neolasioptera cralaevae* Mani on flower

Mani, *Me Indian Mus.,* 36 (4): 399-401, fig. 11 (1934); J. *R. Asiatic Soc Bengal* (Sci.) 14(2) : 133(1948).

Regular, subglobose, solid, hard, woody, indehiscent swellings of usually the thalamus and the base of the gynophore, but often also of the whole flowers, somewhat flattened above, funnel-shaped basally, solitary, clustered or sometimes agglomerated, with irregular, obscure, large, subconical elevations superficially, yellowish-green or brownish-yellow, often also tinged red, measuring from 20 mm to 30 mm in diameter. Basally the surface is covered by crowded horizontal, swollen fleshy, flat emergences (representing the sepals and petals), often also with numerous short, conical or pyramidal fleshy recurved stamens. Often the sepals and petals are represented by green leafy short processes. The aborted and sterile (?) ovary may occasionally be seen on an exceedingly short gynophore on the summit of the gall (Fig. 7).

Distribution.—The gall is very widely distributed on the east coast of South India and occurs in large numbers during May, June and early July.

Gall No. 334 by *Aschistovyx cralatvae* (Mani) on flowers

PI. VII ,

Regular discoid or subglobose, semi-solid, soft, fleshy, compound, indehiscent, yellowish-white, parenchyma gall, formed by the complete flower; composite irregular cortical outgrowths from the bases of stamens, of the entire stamiaal stalk, even also of the anthers partially or wholly, of the ovary, style and of

Fig. 7. Gall No. 1 72 on flower *otCrataeva religiosa* Forst- by *Neolnsioptera craiaeoae* Mani.

i\ui fleshy swellings of the petals. Irregular narrow interspaces between the fleshy lobes of the gall contain over a dozen yellow-coloured larvae of the midge. Where the staminal bases alone are moderately swollen, the much enlarged anthers enclose some pollen, but usually when the gall is mature, the entire stamen is enormously swollen, so that the sterile anthers remain sessile. Where the gynophorc is swollen, the ovary remains partly normal and may occasionally contain a few ovules. Although the gall is indehiscent, it decays rapidly after the escape of the midge larvae that crawl out to pupate in soil. Thematurega.il measures about 10-15 mm in diameter. Occurrence abundant in May and early June.

Distribution.—Utlar Pradesh (Western parts)

Gynandropsis pentaphylla DC

Gall No. 302 by *Hderodera marioni* on root

Mani, J. *R. Asiatic Soc. Bengal* (Soc.) 14 (2) : 95 (1948).

Fusiform, solid, often irregular and extensive tumescence of the main and lateral roots.

A somewhat similar gall on root of the same plant by *Htterodera* is known from Java[6].

Distribution.—Coromandal Coart.

Maerua **arena ria** Hook. & Blume

Gall No. 173 by *Schizomyia maeruae* Felt on leaf

PL XXX

Mani, *Agra Univ. J.Res.* (Sci.) 2 (2) 249 pi, vii, (1953).

Regular, solid, pod-shaped, laterally compressed, indehiscent, spongy, parenchymatous gall on leaf, about 40 mm long and 15 mm thick, smooth and glabrous or with irregular surface, yellowish to greenish-yellow; formed

a Docters van Ucuwcu-Kcijnvaan, J. & W. *Maredlia,* II. 74, No. 291, (1912); Hnuard, J. Le* ZoocectdicB des Plaiitcs d' A.Vique, d* Asic ct d* Oceanic, 1:29+, No. 1062 {1922).

by the fusion and enormous swelling of the basal portion of the leaf blade on either side of the midrib, with the leaf margin often remaining unaltered and extending along the whole length of the gall above as a pair of narrow leafy outgrowths, between which is a more or less deep, iregular sulcus containing numerous irregular flashy tubercles. The gall bears a superficial resemblance to a fleshy, irregular indehiscent legume, winged along one margin. The

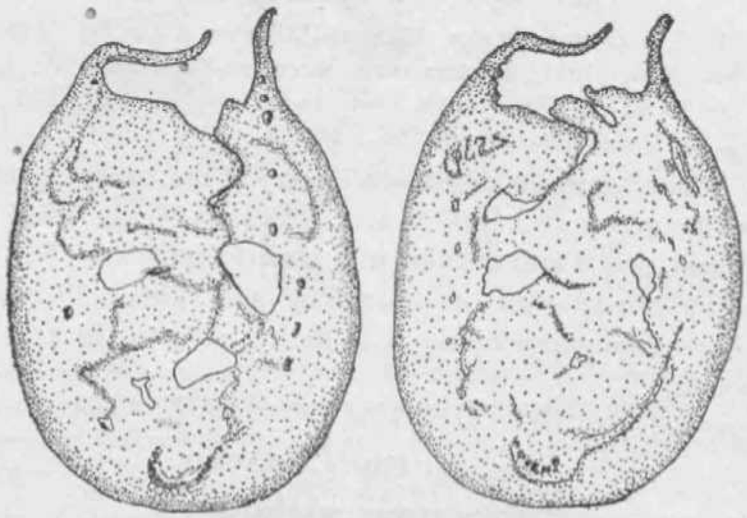


Fig-8. Two sections of Gall No. 173 on leaf of *Maerua artnana* Hook. & Blurae by *Schirjomyia matruae* Felt.

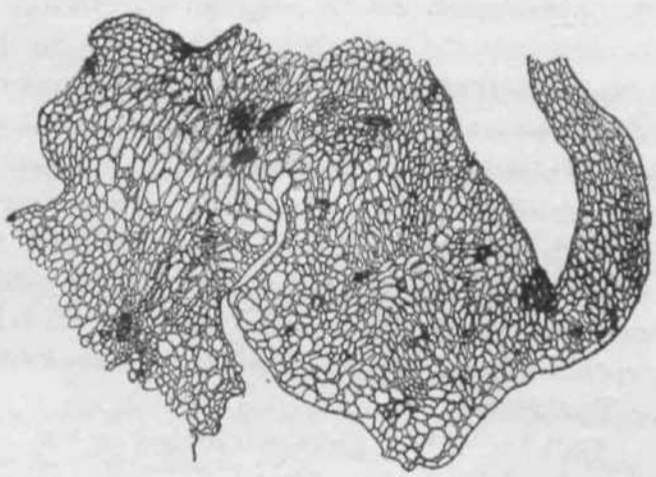


Fig. 9, Part of the parenchyma in section of Gall No- 173 on leaf of *Magma artnana* Hook. & Blurae by *Schizom/ta matruae* Felt, (near the top of the section in fig. 8).

surface of the gall corresponds to the lower surface of the leaf. In a transverse section can be seen an outer parencyma with chlorophyll and a central core of larger, white parenchyma. The larval galleries occur in the latter zone. In mature galls several circular exit holes open irregularly on the surface. Pupation in gall.

by a narrow zone of minute, elongate, branched, irregularly lobed, reticulately interlacing mass of cells, greatly resembling a net-work of fungal hyphae. This cellular mass is derived directely from the parenchyma cells nearby by extremely rapid and irregular growth.

I

The midrib and veins hypertrophied, with the vascular bundles separated by proliferation of cambium and of medullary rays. Stretching of the xylem elements is often noticeable.

Distribution.—South India.

Polanisia viscosa Linn.

Gall No. 3 by *Eriopkyes* sp. on ovary

Houard, C. Lcs Zoocecidies des Flames d'Afrique, d'Asic ct d'Oceanic, 1 : 294, No. 1063, (192!); Docters van Lecuwen-Rcijnvaan, W. & J. The Zoo-cccidia of the Netherlands East Indies, p. 211, fig. 336 (1926). Mani, *J. R. Asiatic Soc. Bengal*, (Sd.) 14 (2) : 96-97 (1948).

Baccatej inflated ovarian gall; hypertrophy of the ovary en masse; rest of the flowers become green and leafy bracts. Axillary buds often arise in the axils of sepals and petals and develop into dwarf branches. The ovarian gall proper measmes about 10 mm in diameter and about 30 mm long. The ovarian wall consists of parenchyma, with fleshy outgrowths and erincal processes on the inside.

Distribution.—South India and Java.

Natural Order BIXACEAE

Hydnocarpus wightiana Bl

Gall No. 339 by *Eriophyes* sp. on leaf

Nayar, K. K., J. *Bombay nat. Hist. Soc.*,47 (4) : 674 (194IJ).

PI. X

Epiphyllous, irregularly bullate, solitary or agglomerate, subglobose beutelgaiis, 2-20 mm long and 2-12 mm in diameter, greenish-yellow, glabrous or finely tubcrculale, thick-walled, indehtsccnt, with hypuphyllous, wide, irregular and non-operculate ostiole. Gall cavity large, **irregular** and covered by white erineum, which gradually turns brown as tlie gall matures. Raiely the outer surface of the gall is finely pubescent. Usually the galls develop in very large numbers, so that very little of the normal leaf is left. Erineum of the gall cavity comprises simple, elongate, straight or curly hairs.

Distribution.—Travancore.

Gall No. 461 by unknown midge on leaf

PI. XIX

New gall. Regular, mostly hypophllous, unilocular galls visible on both sides of the leaf, solid, circular, biconvex, discoid swelling of leaf blade, nearly 4 mm in diameter, with a prominent solid, fleshy, but hard, cylindrical, somewhat curved hypophyllous, obtusely pointed, smooth projection, nearly 2 mm long and 1.5-2 mm thick at base; on the upper surface with a circular disc-like operculum, umbilicately depressed above and flat below. This operculum falls off when the gall is ripe and exposes a single moderately deep, circular concave, horizontal gall cavity. The originally epipfiytlous ostiole wholly obliterated and is represented by the umbilicate pit in the operculum. In the young gall there is on the upper surface of the leaf blade a truncated, short, subconical solid elevation, wit,h the ostiole, as the development of the gal] proceeds, this elevation gradually flattens out and becomes transformed into the operculum.

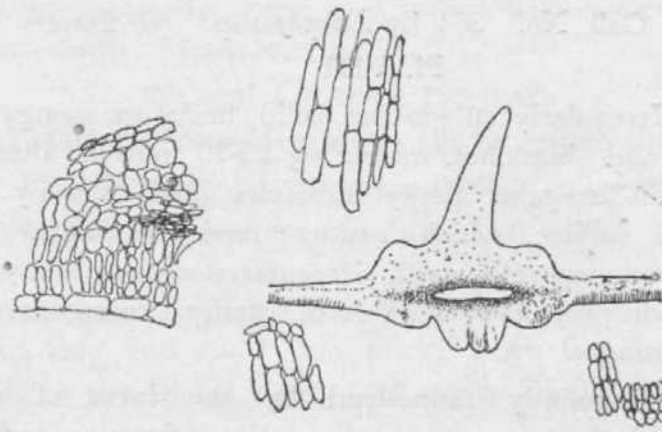


Fig. 10, Gall No. 461 on leaf *of Hydnocarpus wigktian* ff Bl. by midge. In the centre is a gross section of the gall ; to the left a part of the parenchyma at the base of the gall ; above is the parenchyma of the horn of the gall and below arc two views of the parenchyma near the larval chamber.

The bulk of the gall is composed of greatly hypertrofied parenchyma cells, which are elongated parallel to the axis of the gall. The larval cavity is immediately surrounded by a few layers of dead and collapsed cells. The operculum begins as a mass of rapidly proliferating, small-sized parenchyma cells, which soon decay, dry and become loosened from the rest of the mass of gall parenchyma. At the edges of the disc of the gall, the palisade parenchyma cells show simple hypertrophy, gradually passing on to absence of differentiation.

Dislrib ution. —Trava ncor e.

Natural Order FLACOURTIACEAE

Flacourtia ramontchi 1 / Herit

Gall No. 287 by unknown midge on stem

Mani, *J. R. Asiatic Soc, Bengal,* (Set.) 14 (2) : 151, fig. 61 (1948).

Irregularly oval, subglobose, generally fusiform, unilateral, solid, woody, reddish-brown, sometimes extensive and moniliform stem tumescence, about 20-30 mm long and 5-6 mm thick; larval cavities elongated oval, narrow, axial, single, surrounded by spongy parenchymatous tissue; cortex is the sea of cell proliferation.

A gall very similar to this has been described on *Flacourtia rukam* Z. & M. from Java.[8]

Distribution.^ Delhi.

[n] Hoiiard, *C,* Les ZooCecidics des Plantes d'Afrique, d'Asie et d'Oceanic, 2:582, No. 2104 (1922). Dr* van Leoimcn-Reijnvaan, W. & J., *Bull. Jardin b0l. RuiUnzors,* **1:46,** No. **588,** fig. 5f!ft (1918); The Zoocecidia of the Netherlands Kast Indies, p. 394, No. 1015 (1926).

Natural Order TAMARISGAGEAE

Tamarix articulata Vahl.

Gall No. 364 by *Eriophyes* sp. on flowers

PL VIII

New Gall. Irregularly subglobose, solid, fleshy or spongy, agglomerate galls on flowers and branches, measuring 25-30 mm in diameter, brown or grey, often with irregular fleshy tubercles arid gummy and sugary exudations on the surface, which attract numerous ants. The gall is composed of parenchyma cells, with irregular tortuous flesh} galleries and cavities, into which project a number of fleshy emergences. The mites occur in these passages.

The gall is frequently tunnellend by the larva of an unknown Lepidoptera (moth) that eats away the entire substance and leaves only the leathery epidermis intact. The larva than pupates inside this empty bag and emerges by a circular hole which has been previously cut out. The empty cavity is filled with faecal pellets webbed together by silken threads.

Distrbution.— Rajasthan and Western Uttar Pradesh.

Remarks.—There are two eriophyid galls on the same plant recorded from Egypt, Eritrea, Moracco, Algeria and Turkey[7]. These appear however to be different from the one described above.

Gall No. 152 by *Amblylapis olivierella* Ragonot on branch

Houard, C, Les Zoocecidies des Plantcs d'Afrique, d'Asie et d'Oceanie. 2 : 571-572, No. 2070, figs. 1194-1195(1923).

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 129.

Regular, oval or fusiform, hard, woody, indehiscent, unilocular, thick-walled, solitary and sometimes unilateral tumescence of branches, about 10-18 mm long and 6-12 mm thick, with a single larva in each gall cavity large.

Distribution.—India, Algeria, Tunisia.

Tamarix dioica Roxb.

Gall No. 174 by *Misospatha tamaricis* Mani on stem

Mani, *Rec. Indian Mus.,* 37 : 432 (1235); *ibid.*, 40 : 312 (1947); *J. R. Asiatic Sec. Bengal* (Sci.) 14(2) : 133 (1948).

Globose or irregular, solid, hard, woody, multilocular, cortical swellings of branches, abcut 5-10 mm in diameter, brownish-black when dry. A single larva in each gall cavity. Pupation in gall.

Distribution.—Multan, Bahawalpur (Pakistan)

Tamarix gallica Linn.

Gall No. 175 by *Amlardiella tamaricum* Kieff. (?) on stem

Houard, G., Lcs Zoocecidies *dx* Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 563. No. 2042(1923).

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7 Houard, O., Les Zoocecidies des Plantes d'Afrique, d'Asie ct d'Oceanie, 2:570, No. 2067, fig. 1184-1186, No. 2068, fig. 1187,(1923).

Mani, M. S. 1948. ***J. R. Asiatic Soc. Bengal*** **(Sci.) 14 (2) : 130.**

Regular, globose or fusiform, subtermiaal or internodal, solid, hard, woody, unilocular swellings of young branches, about 6-9 mm long and 4-8 mm in diameter, partly green and tinged with violet-red.

Distribution.—India, Moracco, Algeria.

Natural Order GUTTIFERAE

Calophyllum decipiens Wight *(=wightiana)*

Gall No. 382 by unknown Psyllid on petiole

Nayar, K. K.f 1948. J. *Bombay nat. Hist. Soc.*, 47 (4) : 672.

Reniform' or globose, fleshy but hard, brown, solitary, unilocular, rarely agglomerate galls on petioles and occasionally on branches, measuring about 10-25 mm long and 10-17 mm thick; when forming on the petiole, the growth is from the under side. Gall cavity lined by a zone of unpigmented cells.

A somewhat similar psyllid gall on *Calophyllum inophyllum* is reported from Java[8].

Distribuion.—Travancore.

* **Mesua ferrea** Linn.

Gall No. 371 by unknown midge on leaf

Nayar, K. K. 1948. *J. Bombay nat. Hist.,tf* (4) : 679.

Globose or irregularly globose, solitary or localised or also more or less extensive and reniform, epiphyllous, fleshy, succulent, soft, multilocular, greenish-brown, indehiscent galls, measuring 3-50 mm long and 3-50 mm thick, sometimes also extending on the midrib and part of the leaf petiole or also forming as regular, globose, sessile, free galls on branches with a single larval cavity.

The remark by Nayar *(loc.cit.)* that this gall is probably caused by *Oligotrophus quadrilobatus* Kieff., is erroneous and is perhaps to be traced to a confusion with *Maesa perotettiana.*

Distribution.—Travancore.

Gall No. 123 by *Amorphococcus mesuae* Green on stem

Green, E. E., *Ent. Mag.y* (2) 3 : 261, fig. 2 (1902); Coccidae of Ceylon, 4, pl.cxxxl, **fig. 1-2 (1909).**

Houard, C, 1922. Les Zooceddies des Plantes d'Afrique, d'Asie ct d'Oceanie, p. 560.

Mani, M. S. 1948. J. ***R. Asiatic Soc. Bengal,*** **(Sci.) 14 (2) : 124.**

Regular globose or conical tumescence of branches^ about 4-5 mm thick and enclosing a conical cavity.

According, to Drs van Leeuwen-Reijnvaan[9], this gall is similar to a coccid gall on branches of the same plant produced by *Lecanium domesticum* Jack, from Java.

Distribution.—Ceylon, South India.

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[8] **Drs. van Leeuwen-Reijnvaan, W. & J. 1960. The Zoocecidia of the Netherlands East Indies.**

* **Drs. van Leeuwen-Reijnvaan, W. & J.,** ***Marcellia,*** **10 i 79 (1911).**

Natural Order TERNSTROEMIAGEAE

Camellia drupifera Lour.

Gall No. 176 by *Lasioptera longispatha* Kieff. on bud

Kieffer, J. J., *Marcellia,* 7 : 187 (1908).

Houard, C, Les Zooceidics des Plantes d'Afrique, d'Asie et d'Asie, 2 : 557, No. 2023 (1922).

Sundar Raman A. H., *J. Indian bot. SoC,* 4 : 39, No. 70 (1924).

Mani, J. *R. Asiatic Soc. Bengal* fSci.) 14 (2) : 133 (1948).(

Barnes, H. F., Gall midges of Economic Importance, 6 : IJ4 (1949).

Regular globose or ovoid, solid, fleshy, indehiscent swellings of axillary buds, about 10 mm in diameter; with irregular surface clothed by acute and recurved emergences, representing the apices of the leafy vestiges, which often project 2-3 mm long; the substance of the gall is described as brown in the outer zone and darker brown in the middle, with the subglobose hard gall cavities scattered irregularly and about 3 mm in diameter and each cavity enclosing one or two larval cavities, containing bright yellow larvae. The adult midge has not so far been reared from this gall.

Distribution.—Kurseong (Eastern Himalaya)

Eurya japonica Thunb.

Gall No. 177 by *Schizomyia incerla* Kieff. on leaf

Kieffer, J. J., *Marcellia,* 7 : 153, pi. Hi, fig. 8, pi. iv, fig. 2 (1908).

Houard, C, Les Zoocecidies des Plantes d'Afrique, cVAsie et d'Oceanie, 2 : 558-559, No. 2028, (1923).

Mani, J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 133-134 (1948).

Subglobose, shortly pedicelled, solid, fleshy, smooth, unilocular button-like galls on leaves, about 8-12 mm high and 6-8 mm thick, with a single larva in each gall.

Distribution,—Kurseong (Eastern Himalaya).

Gall No. 568 by unknown midge on leaf

Kieffer, J. J., *Marcellia,* 7 : 154, No. 2, pi. iii. fig. 11-12 (1908).

Houard, C, Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 559, No. 2029 (1923).

Sundar Raman, A. H., J. *Indian bot. Soc.,* 4 : 46, No. 72 (1924).

Mani, J. *R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 134, No. 177a (1948).

Subglobose, bilocular, hypophyllous, fleshy, shortly-pedicelJed galls inserted on one of the veins of the leaf, aboul 5-8 mm in diameter.

Distribution.—Kurseong (Eastern Himalaya).

Gall No. 178 by *Lasioptera trilobata* Kieff. on leaf

Kieffer, J. J., *Marcellia,* 7:157-158, pi. iv, fig. 6 (1908).

Houard, C, Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 558, No. 2026(1923).

Sundar Raman, A. H., *J. Indian bot. Soc.* 4:40, No. 71 (1924).

Mani, J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 134 (1948).

Regular, globose, solid, 'fleshy, unilocular, thick-walled, greenish, glabrous galls, occurring on either side of the leaf blade, about 5-6 mm in diameter, larval cavity central ?nd hard, with a single pale or yellow larva.

Kieffer (loc. cit.) records this gall on a plant which he mentions may be either *Schima wallichii* or *Echinocarpus dasycarpus.*

Distribution.—Kurseong (Eastern Himalaya).

Thea chinensis Linn.

Gall No. 124 by *Chionaspis manni* Green on stem

Green, E. E., *Mem. Depart. Agric. India* (Ent.) 1:344-347, pi. xvi, fig. MO (1907).

Houard, C, Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 557, No. 2021, fig. 1155(1923). •

Mani, *J. R. Asiatic Soc. Bengal,* (Sd.) 14 (2): 125 (1948).

Irregular fusiform, extensive, diffuse, solid, indehiscent swellings of branches.

Distribution.—"India".

Gall No. 319 by *Heterodera marioni* on root

Barber, G. A., Madras Depat. Lands Rec. Agric, (Agric), Bull., 45:227, pl.i (1901).

Delacroix, G.,J. *Agric. Trop.* Paris, p.4 (1902). Houard, C, Les Zoocecidies des Plantes d'Afrique, d'Asie et 'dOceanie, 2 : 556, No. 2020 (1923).

Mani, M. S., 1948 *J. R. Asiatic Soc. Bengal.* (Sci.) 14 (2); 95.

Root galls recorded from South India.

Natural Order DIPTEROGARPAGEAE

Hopea parviflora Bedd.

Gall No. 179 by an unknown midge on flowers

Mani, M. S., 1948. *J. R. Asiatic Soc. Bengal, (Sti.)* 14 (2) : 134.

Compare with gall No. 569 on *H. wighliana.*

Distribution.—Western ghats near Coimbatore.

Hopea wightiana Wall.

Gall No. 569 by unknown midge on flowers

Mani, M. S., 1935. *Rec. Indian Mus.,* 37:447; 1943 *J.R. Asiatic Soc. Bengal, (Sci.),* 14 (2) : 134, No. 179a.

Regular, globose, hard, woody, simple spiny galls of flowers, with numerous larval cavities, each gall about 10-15 mm in diameter, the spines stout apically. Marudamalai Hills. Also on sheet Nos. 3384-3389,3391-3395 in Madras Herbarium, Agricultural Research Institute, Coimbatore, coll. in South Canara.

Similar galls on *Hopea fagifolia* Mig. are described from Java and Borneo.[10]

Shorea robusta Gaertn.

Gall No. 52 by *Phylloplecta* sp. on Leaf

Mathur, R. N. 1935. *Indian Forest Rec.* 1 (2) : 58, pi. i, fig. 6.

Mani, M. S. 1941. *J. R. Asiatic Soc. Bengal, (Sci.)* 14 (2) : 111.

Epiphyllous, Bhallow, beutelgalls, with open, hypophyllous ostiole, pit-like from the lower side of the blade, paie yellow; occurring in extremely

!° Drs. Van Leeuwen-Reijnvaan. Zoocccidia of Netherlands East Indies, p. 391, No. 1005, fig. 720(1925).

large numbers on leaves; about 1-1.5 mm in diameter.

Distribution.— Dehra Dun.

Natural Order MALVACEAE

Althea rosea Linn.

Gall No. 512 by *Eriophyes* sp. on leaf

New gall. Regular, epiphyllous or hypophyllous, subglobose, beutelgalls, also most frequently visible equally on both sides of the blade; free and solitary or irregularly agglomerate; crowded in enormous numbers on leaves, often as many as 300 galls on a single blade; uni-or multilocular, hollow, soft, fleshy, sparsely pubescent*; with ostiole below or sometimes above; a single gall about 3 mm in diameter, agglomerate galls often reaching upto 7-8 mm. with white erineun inside. Mites attacked by the predatory larvae of a midge.

Distribution.—Central Travancore; coll. Koshy Mathew, 21-iv-l953.

Gossypium herbaceum

Gall No. 5 by *Eriophyes gossypii* Banks on shoot

Banks, N. 1904. J. *New York ent. Soc.*, 12:59.

Mani,M. S., 1918. *J. R. Asiatic Soc. Bengal (Sci.),* 14 (2):64,97.

Misra, C, 1922. *Rep. Proc. third ent Meet. Pusa,* p. 547.

Thacker, B. J. & M. H. Desai, 1929. *Agric.J. India,* 24- (3) : 175-182, fig. 2.

Irregular, more or less extensive, silky-white filzgalls on leaves, petioles and tender branches; rarely in the form of erineal blistergalls on leaves.

Distribution.—Gujerat and South India. The gall is known from West Indies, Gold Coast and other parts.

Gossypium sp.

Gall No. 127 by *Alcidodes* sp. on stem

Mani, M. S., 1918. *J. R. Asiatic Soc. Bengal, (Sci.),* 14 (2) : 125.

Globose or diffuse tumescene of branches.

Distribution.—Tanjore (South India).

Gali No. 128 by *Pampherulus qffinis* (Faust) on stem

Mani, M. S , 1948. *J. R. Asia ic Soc. Bengal (Sci.).* 14 (2) : 88, 125.

Regular and local or irregular and extensive, globose, oval or fusiform, often noded, solid, indehiscent swellings of cauline branches, with irregular larval cavity.

Distribution.—South India.

Hibiscus esculentus Linn.

Gall No. 288 by *Heterodera marioni* on root

PI. XI

Mani, M. S., 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 95, fig. 40.

Sakscna, R. D., 1944. *J. R.* Asiatic Soc. Bengal (Sci.), 10 : 119-120, pi. iv, fig. 1.

Irregular, extensive, agglorrferate, globose or fusiform or beaded, solid, fleshy, often wholly cortical swellings of main and lateral roots.

Distribution.—Calcutta.

Hibiscus micranthus Linn.

Gall No. 6 by *Eriophyes hibisci* Nalepa (?) on leaf

PI. XXIII

Mani, M. S., 1948. *J. R- Asiatic Soc. Bengal. (Sri.)* 14 (2) : 64, 97.

Regular, globose or almost pyriibrm, solitary, free and simple or closely crowded and sometimes agglomerate, uni-or multilocular, thick-walled, holJow, fleshy, soft, pale or blight yellow galis, visible equally on both sides of the leaf blade, about 2-4 mm iti diameter, densely covered by stellate hairs, which unlike on the normal parts of leaf are stiff and erect; ostiole minute, hypophyllous, often on* **an** obscure, fleshy nipple-like eminence; gaJl cavity sometimes incompletely separate or also with fleshy emergences ; usually 6-7 on a single leaf but also as many as 50 to a leaf; occasionally developing on the tender branches also. When young the gall is more prominent on the lower side of the blade than above, but as growth progresses, the epiphyllous bulging becomes more pronounced. The wall is of undiflfbrentiated hypcrtrophied cells, with irregular and large mucilage spaces, large stellate oxalate crystals and somewhat undiflTerer.dated bundles of vessels, mainly xylem in the early stages and in most galls, the epiphyllous side of the wall shows a certain degree of simple stretching without differentiation; the palisade cells are present, but somewhat greatly elongated. The main seat of cell proliferation thus appears to be in the cells of the epidermis and spongy parenchyma (Fig. 11, 12). Some of the cells derived from the latter are very large and show enlarged and irregularly shaped nuclei. Inside some of the cells lining the gall cavity, the larvae of the mites penetrate.

Distribution.—South India,

Hibiscus rosa-sinensis Linn.

Gall No. 7 by *Eriophyes hibisci* Nalepa on leaf

Nalepa, A., 1906. *J.eeon. BioL.i :* 147-151, pi. x; 1908. *W'ten. Densk. Akad. Wiss.,* 84 :523, pi. ii. fig- 1, 2; pi. iii, fig. 1.

Houard, C, 1923. Lcs Zoocccidies d« Plantcs d'Afrique, d'Asie ct d'Occanie, 2 :544, No. 1975.

Mani, M.S., 1948. *J. R. Adiatic Soc, Bengal, (Sei.),* 14 (2) : 64, 97.

Generally epiphytlous, irregular, isolated, flattened beutelgalls on leaf, about 1-5 mm large, with wide open hypophyllous ostiole; rugose, pale yellow

Fie. II. Gross section of Gall No. 6 on leaf of *Hibiscus micramthus* Linn, by *Eriophyts hibisci* Falepa.

or green; gall cavity with fleshy excrescenes and a few simple hairs. Rare gall.

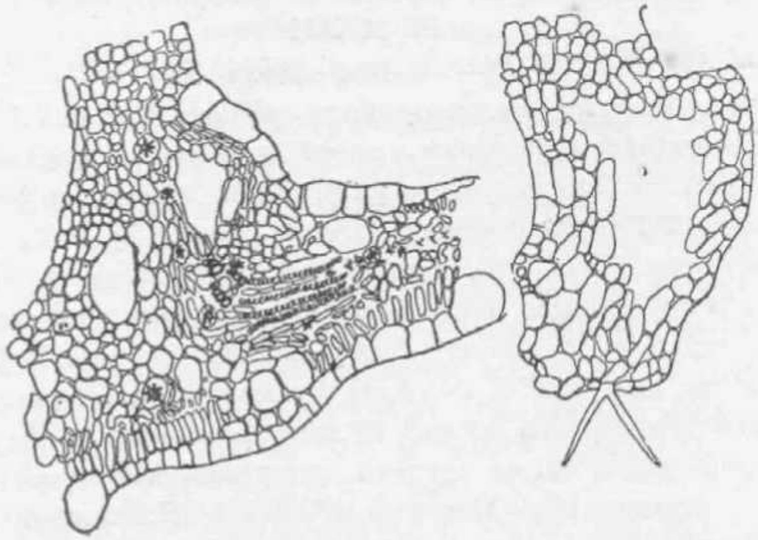

Fig. *VI.* Parts of sections of Gall No. 6 on leaf of *Hibiscus mkranlkus* Lion, by *Eriophjres hibisd* Nalcpa, to show the transition from normal leaf to gall tissue.

Distribution.—Delhi. Tins gall is already known from Fiji and Samca.

Hibiscus solendra L'Her.

Fungal gall No. 342 on leaf

Bund Baretta—Bharatpur, coll. M. S. Mani, 23. ix. 1951.

Hibiscus tiliaceus Linn.

Gall No. 8 by *Eriopkyes k'tbiscitileus* Nalepa on leaf

Rübsaamen, E. H., 1905. *Marcellta,* 4: 13. Drs van Leeuwen-Reijnvaan, W. & *J.*, 1926. The Zoocecidia of Netherlands East Indies., pp. 372-373, fig. 678, 679.

Mani, M. S., 1948. *J. R. AsiaticSoc. Bengal, (Set.)* 14 (2) : 98.

Epiphyllous, rugose, pustuloid, pale yellow, unilocular, beulelgafls, wilh gall cavity large, filled up with irregular fleshy emergences and hairy outgrowths; size about 10-15 mm diameter ; ostiole hypophyllous, occasionally the galls develop on the tender branches and stipules.

Distribution.—Calcutta. This gall is already known from Hongkong, Celebes, Malaya, Bismark Archipelago, Samoa and Java. A somewhat similar gall is described by Houard[11] on leaf of *Hibiscus similis* Bluue from Java; on *H. titiaceus* is recorded an Eriophyid gall from Brazil, but is somewhat different.[11]

Hibiscus vitifolius Linn.

Gall No. ISO by an unknown midge on stern

Irregular, globose, solid, rugosely-tuberculatedj fleshy, indehiscent, pubescent, pale greenish galls on tender branches, about 5 mm in diameter.

Distribution.—South India.

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[11] Houard, C. 11)23. Les Zoocccitfics des Plantes d'Afriquc, d'Asic et d'Oceanie 2: 545. No- 1978.

[li] Houard, C. 1933. Lcs Zoocecidies des Plantes de t'Amcrujue du Sud et de I'Amcrique Centrale, p. 233, No. 665.

Gall No. 452 by unknown fungus on stem

Irregularly globose, solitary or conglomerate, solid, fleshy, partly succulent, rugose or fleshy-tubercled, indehiscent, often unilateral; sometimes, especially when large, hard, dirty-white swellings from cortex or from lateral buds of branches, occurring in large numbers; covered by thin pale brown scaly pieces of variable size, some of the solitary galls measuring from 5-15 mm, the conglomerate masses often reaching upto 25 mm in diameter, but most usual size ranging about 10* diameter.

The bulk of the gall consists of irregular, mostly greatly hypertrophied, often distorted parenchymus cells, with vascular elements twisted, stretched and irregularly scattered in groups of simple pitted cells and vessels, rarely with a few spirals, mucilage spaces and crystals sparse and irregular. There is no true epidermis, but the superficial layer of the gall is composed of several layers of collapsed callous cells. The fungal hyphae unicellular and intracellular, mostly concentrated just beneath the superficial layers of cells of the gall and moderately also in the neighbourhood of some of the vessels.

Distribution.—Walayar Forests near Coimbatore.

Kydia calycina Roxb.

Gall No. by *Pauropsylla* sp. on leaf

Mathur, R.N., 1935. *Indian For. Rec.* (N.S.), 1 (2) : 44, pi. 1, fig. 2.
Mani, M.S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 111.

Epiphyllous, shallow, yellowish-green beutelgalls, with wide open pit-like ostiole beneath ; about half a dozen galls on a single leaf blade.

Distribution.—Dehra Dun.

Sida acuta Burm.

Gall No. 187 by unknown midge on stem

Mani, M.S. 1948. *J.R. Asiatic Soc. Bengal (Sci)* 14 (2) : 135.

Regular, fusiform, solitary, rugose, unilocular, indehiscent tumescence of young branches, about 10-20 mm long and 5 mm thick, with larval cavity elongate. Pupation in gall.

Distribution.—South India.

Sida rhombifolia Linn.

Galf No. 303 by *Heterodera marioni* on root

Barber, G.A. 1901. *Madras Dept. Land Rec. Agric.* (Agric. Branch), Bull. No. 45 : 229.
Houard, G. 1922. Less Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 542, No. 1966.
Mani, M.S. 1948. *J.R. Asiatic Soc. Bengal (Sci)* 14 (2) : 95.

Root galls from "India".

Eriolaena quinqueocularis Wight

Gall No. 572 by *Eriophyes* sp* on leaf

Stefani-Perez, T. de 1912. *Boll, orto hot. Giardino colon. Palermo,* 11 : 72
Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 548 No. 1990.

Regular, conical, small beutelgalls on both sides of the leaf blade, scattered in very large numbers, apically with a tuft of brown hairs ; ostiole elongate.

Distribution.—Parts of Bengal.

Natural Order STERCULIACEAE

Mehlama futteporensxs Munro

Gall No. 338 by an unknown midge on leaf

PI. X

Mani, M.S. 1$53. *Agra Univ. 3. Ret. (Set.)*, 2 (2) 250, pi. vii.

Regular, solitary, free, discoid, hard, beutegalls, visible almost equally on both sides of the leaf blade, as many as 20 galls on a single leaf ; brownish or reddish-brown, smooth, finely pubescent ; ostiole hypophyllous, rarely epiphyllous, on narrow short, cylindrical or subconical chimney-shaped fleshy prolongation ; on the upper surface there is a small circular discolourised spot in the centre ; semi-persistent, indehiscent, bilocular, atriate ; the atrium hypophyllous, with ostiole and constituting the cavity of the chimney-shaped prolongation ; the atrium is lined largely by dead cells, surrounded

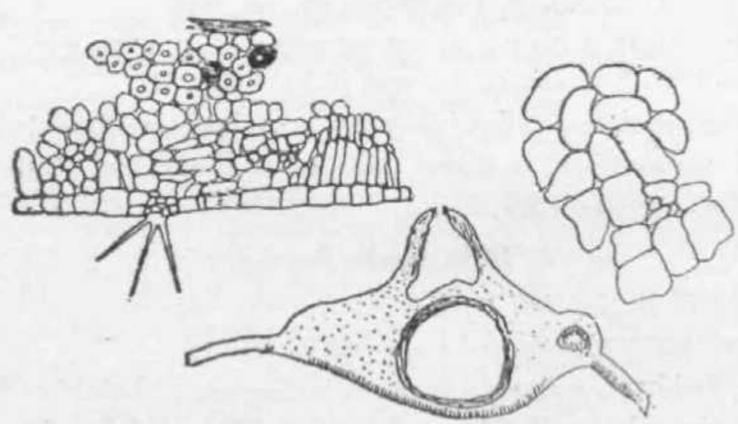

Fig. 13. Gall No. 338 on leaf of *Malhania futttparensis* Munro by midge, showing 'he larval chamber and atrium in the gross section below and part of the gall parenchyma on left and right above.

by a few layers of parenchyma cells elongated parallel to the axis of the chimney. The gall cavity large, depressed-oval, central and surrounded by a thick zone of closely packed thick-wallcd mechanical rolls, within the peripheral zone of larger parenchymatous cells. A part of the palisade tissue sometimes present but somewhat of greatly elongated cells. The seat of cell proliferation is in the spongy parenchyma. Size of full grown gall 4 mm diameter and 2 mm thick. Larva orange-red, single in each gall. Pupation in gall after prolonged larval diapause, in one rase extending to more than two years. The dry leaves with the galls fall off on the ground and remain in debris till next season.

Distribution.—Reserve forest, Bund Bareta in Bharatpur State.

Natural Order TILIACEAE

Grewia microcos Linn.

Gall No. 9 by *Eriophyes* sp. on leaf

Rübsaamen, E. H. 1899. *Ent. Nachr.*, Berlin, 25:254, No. 8, fig. 2-3, pi. ii, fig. 5-6.

Drs van Lecuwen-Reijnvaan, W. & J. 1916. *Bull. Jard. Bot. Buitenzorg,* (2) 21:10, No. 19, fig. 19.

Houard, 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2:536, No. 1939, fig. 1119-1120; p. 537, No. 1943 ((?. *paniculate).*

Drs. v. Leeuwen, W. M*. 1925. *Marcellia,* 22:27, fig. 3, No. 4.

Mani, M.S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) :98.

Epiphyllous, multicellular, pimple-like beutelgalls, rarely with one large cavity. Size about 4 mm in diameter. Ostiole closed by whitish hairs. Gall cavity with irregular fleshy emergences and densely covered by erineum of simple, short, straight hairs directed downward. Surface corniculate, hirsute, often reddish or reddish-brown when old. Seveial galls scattered irregularly on a single leaf. According to Rubsaamen, the mite *Pediculoides grewiae* Rübs, is predaceous on the cecidozoa.

Distribution.—Walayar Forest near Palghat (Malabar). The gall has beelx previously recorded from Malabar (South India), Malacca, Sumatra and **Java.**

Gall No. 413 by *Eriophyes* *p. on leaf

PI. V.

Drs. van Leeuwen, W. M. 1925. *Marcellia,* 22:28, No. 5, fig. 6. gall 21610; Siam.

Regular, epiphyllous, solitary and free but mostly greatly crowded or agglomerate, conspicuously but shortly pedicillate beutelgalls, abruptly enlarged, compressed and branched irregularly apically; reddish-brown, striate or smooth, with fine pubescence; coriaceous, hollow; gall cavity large, with dense stellate white erineum directed downwards; when young regular cylinderical but somewhat clavate; when full grown greatly swollen and branched irrregularly; 10-15 mm long and often as much thick at apex; ostiole hypophyllous. A single leaf often with over 100 galls, so that the blade is much crumpled and malformed. The leaf-veins near the seat of insertion of the gall usually crowded up swollen and curved.

The mites are attacked by the predatory larvae of an unknown midge.

Distribution.—Travancore Cochin and also Siam.

Grewia (Eugrewia) orientalis Linn.

Gall No. 182 by an unknown midge on leaf

PI. XXX

Mani, M. S. 1935. *Rec. Indian Mus.*, 37 (4) : 442-443, fig. 11; 1918. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2): 135.

Regular, globose, pyriform or rarely ovoid, mostly simple, solitary and free, but occassionally crowded or partly agglomerate, hypophyllous,

•Same as *Grewia rhamnifolia* Heyn.

unilocular, hollow, operculate, brown, densely villous and coriaceous beutel-galls, about 5 mm in diameter. The epiphyllous narrow ostiole is plugged by a circular and hairy operculum that is pushed off at the slightest touch in ripe galls. The ostiolar edge is fringed with long villous hairs. In the young galls the trichome is white but when old turn brown; the trichomes arise in fascicles from fleshy tubercles. Gall cavity spacious, with a single larva. Frequently large numbers of galls arise in series on leaf blade.

Distribution.—Coromandal Coast.

Grewia spp. incertae

Gall No. 355 by *Eriophyes* sp. on leaf

New gall. Regular, mostly epiphyllous, but some times also hypophyllous, hemispherical or subglobose, nearly solid, sessile, free, solitary, sometimes agglomerate, yellowish-brown, densely pubescent, beutelgalls, frequently visible on both sides of the leaf blade, about 5 mm in diameter; ostiole hypophyllous. Gall cavity nearly obliterated and filled up by irregular fleshy septa, emergences and dense white long erineum.

Distribution.—Malkapur (Nalgonda) : Hyderabad : Deccan

Gall No. 330 by unknown *Psyllid* on leaf

New gall. Epiphyllous, irregularly globose, verrucose; semi-sessile, dehiscent and deciduous, yellowish, finely pubescent beutelgalls, with irregular gall cavity and variable hypophyllous ostia; 8-12 mm in diameter; gall cavity with white fluffy wax; with 3-4 nymphs of the Psyllid; free, never agglomerate; 3-4 galls on a single leaf.

Distribution.—Dehra Dun.

Triumphetta rhomboidea Jacq.

Gall No. 10 by *Eriophyes javanicus* Nalepa on leaf

Drs van Lceuwcn-Reijnvaan W. & J. 1909. *Marcellia,* 9 : 35, No. 23, fig. 17.

Nalepa, 1918. *Verh. Z<>ol.-bot. Ges. Wien,* 68 : 49—50,90.

Houard,C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2: 541, No. 1959,

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14 (2) : 98.

Usually extensive, bright pink coloured filzgalls on tender branches, petioles, flower stalks and leaves; when on leaf usually accommpanied by more or less pronounced fleshy bulgings on either sides; trichomes simple, unicellular, nearly straight or twisted and curly.

Distribution.—South India. The same gall is known previously from Java and Celebes also.

Gall No. 315 by *Heterodera marioni* on root

Barber, C. A. 1901. Madras Dept. Land Rec. Agric. (agric. hranch) 2 (45).

Houard, G. 1923. Les Zoocecidies^des Plantes d'Afrique, d'Asie et d'Oceanie 2 • 541 No. 1960.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14 (2) : 95.

Root galls from "India".

Triumphetta rotundifolia Lamarck

Gall. No. 463 by unknown midge on leaf

New Gall. Irregular, oval, local or often extensive, fleshy, open, densely pubescent swellings of leaf, which is folded upwards along the midrib; about 10 mm long, 5 mm thick; the pubescence composed of dense, stellate hairs, denser inside the irregularly open gall cavity than on the outer surface. Very often the entire leaf blade is converted into a hollow, coriaceous, open-pod-shaped, elongate-oval gall? Pupation probably is soil.

Distribution.—Western Ghats.

Natural Order ELEOCARPAGEAE

Eleocarpus serratus Linn.

Gall No. 508 by *Eriophyes* sp. on leaf

Regular or irregular hypophyllous, subglobose, oblate or hemispherical, hollow beutelgalls, with fully open, wide, deep pit-like cavity above, covered by dense, short, brown erineum of matted hairs; gall surface rugose and warty but otherwise glabrous; size variable, 10-20 mm in diameter, 5-8 mm high.

Distribution.—Travancore. We know of similar, but somewhat smaller Eriophyid galls on *E. macrophyllus* Bl., occurring **on both** sides of **the leaf** from **Java.**[13]

Natural Order GERANIAGEAE

Impatiens balsamina Linn.

Gall No. 393 by *Heterodera marioni* on root

Drs. van Leeuwen-Reijnvaan, W. & J. 1910. *Marcellia,* 9 : 182, No. 178.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique d'Asia et d'Oceanie, 2 : 519, No. 1867.

Mani, M. S. 1943. J. /?. *Asiatic Soc. Bengal* (Sci.) 14 (2) : 95.

Irregular, solid fusiform swellings of the roots.

Distribution.—South India. The gall is previously known from Java also.

Impatiens micranthemum Edgen.

Gall No. 587 by *Lasioptera* sp. (?) on stem

New gall. Regular, globose, oval or short-fusifrom, isolated or also serially moniliform, smooth, pale green, solid, fleshy, succulent, indehiscent swellings of the branches, about 15-20 mm thick and upto 25 mm long, often several galls developing closely crowded one above the otfier on the same branch, which may then come to be a swollen mass with a regular series of constrictions. The larval chambers axial, central and elongated, slender, cylindrical, with moderately thick layer of sclerenchyma cells. Seat of cell proliferation is the medulla of the stem.

Distribution.—Narkanda, 2900 mm above mean sea level, near stream, Himalaya, 243 kilometres, Simla-Tibet Road.

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[13] **Drs. van Leeuwen-Reijnvaan, W. & J. 1911. *Marcellia,* 10 : 72, No. 214.**

Compare gall by *Lasiopterafulva* (Beuten.)[14] on stem of *Impatiens biflora* and other species of the jewel-weed from America. Differs in being shorter, more globose and often also being collected into moniliform swellings of an entire branch.

Natural Order RUTACEAE

Aegle marmelos Corr.

Gall No. 129 by *Cliteapicta* Baly on leaf

Fletcher, T. B. 1914. Some South Indian Insects and other Animals of Importance, Madras, p. 22, fig. 15.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 125.

Diffuse, fusiform, solid tumescence of petioles, leaf midribs and of the stipular thorns.

Distribution.—Bengal and Bihar.

Gall No. 183 by *Ceddomyia dattai* Mani

Mani, M. S. 1925 *Rec. Indian Mus.*, 37 (4) : 444; 1937. *ibid.*, 39 (3) : 285 ; 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 135.

Regular, subglobose or oval, hollow, thick-walled, pod-like utriculate galls of leaflets, usually clustered in threes, with a valve-like slit running the whole length on one side, unilocular, with 1-2 larvae. The ovipostion by the midge is betwen the folds of the leaflets in the unopened bud, leading to the formation of an inflated gall, in which the margins of the affected leaflets never fuse. The larvae escape from the mature gall and pupate under soil.

Distribution.—Coromandal Coast and Bengal.

Ghloroxylon swietenia DC.

Gall No. 54 by *Arytaina ramakrishni* Crawf. on leaf

Crawford, D. L. 1924. *Rec. Indian Mus.*, 25 : 618.

Ramakrishnayyar, T. V. 1924. *Rec. Indian Mus.*, 26 : 624.

Mathur, R. N. 1935. *Indian Forest Rec.* (N. S.) (Ent.) 1 (2) : 39.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 111.

Epiphyllous, hemispherical beutelgall, with hypophyous ostiole.

Distribution.—Coimbatore.

Citrus medica acid a Linn.

Gall No. 361 by fiungus *Sphaeropsis tumfaciens* Hedg (?) on branches

Pl. XI

Regular, globose, solid, indehiscent, hard, woody, yellowish-brown localised and often unilateral swellings of branches, about 25-35 mm in diameter, with brown scaly pieces of dry bark on surface. Galls usually crowded in fairly large numbers close together like enormous beads; persisting on branches for several months.

Distribution.—Western U. **P.**

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14 **B«u}fnn*'uUer, W. 1908. *Canad. Ent.*, 40 : 73-75. Felt, E. P. 1940. Plant galls and Gall makers, Ithaca: New York, p. 286.**

This gall is perhaps identical with the one described from Jamaica on different varieties of orange and lime by Trotter.[16]

Evodia roxburghiana Forst.

Gall No. 529 by *Eriophyes* sp. on leaf

Irregular, bypohyllous patches oferineum.

Distribution.—S*nuh India.

Gly cosmos **cochinchinesis** Pierre *(peniaphyila)*

Gall No. 380 by unknown midge of leaf

Nayar, K. K. 1948. *J. Bombay Mt. Hist. Soc,* 47 (4) : **671.**

Irregular, hypophyllous green galk on the sides of the>midrib of leaves, about 1-3 mm long and 1-2 mm thick.

Distribution.—Travancorc.

Murraya exotica Spreng.

Gall No. 184 by unknown midge on leaf

Mani,M. S. 1935. *Rtc. Indian Mus.,* 37:444; 1948. *J. R. Asiatic SQC, Bengal* (Sci.) 14 (2) : 135.

Regular, elongate, cylindrical, vermiform, stout, fleshy, succulent, free swellings of the leaf-blade; 10 mm long, 1-2 mm thick, \isible on both sides of the blade; pale yellow or white, smooth or finely tubercled, but shiny, transversely, obscurely sulcate; with an elongate narrow slit-like ostiole, extending the whole length of the gall and leading to the elongate central narrow gall cavity, in which is found a single larva; when old the galls turn brown.

Distribution.—Coromandal Coast.

Fig. 14. Gall No. l>J4on leaf of *Murraya exotica* Spreng. by midge. On top left some leaflets wth galls, on right leaflet with a single gall magnified. Below two galls more highly magnified, one closed, another open to show the larval cavity.

[16] Trotter, A. I9lt>, *MarreUia,* 15:90, Hedges, F. J92J. *Phytopathology,* 1 : 63-65, pi. 1. Hedges, F. and Tenny, L. S. 1912. *U.S. Dept. Agric. Bur. Plant Industry, Bull.* 247 : 74, pis. 10, figs, 8.)

§

Kershaw[1]* has described a similar gall on *Xanihoxylttm nitidum* Guerin (by Poekillopteridae) from North Queensland.

Toddalia aculeata Pcrs.

Gall No. 185 by an unknown midge {*Asphondylia* ?)

Penzfe, O. 190*. *?Malpighia*, 18 (3-4) \ 188-190, pt. iv, fig. 1—7.

Trotter, A. 1904. *Marcellia*, 3, (1) (Bibliografia recension!) : xv.

Houard, C. 1922. Zoocecidics des Plantes d'Afriquc d'Asie et d'Occanic: 416, No. 1524.

Mani,M.S. 1918. *J.R. Asiatic Soc. Bengal* (Sci.), 14(2) : 135,

Regular, subglobose, almost solid, fleshy, asymmetrical, unilocular galls on flowers, of almost the same size and colour as the fruit of the plant, but rather deeply and longitudinally striated ; gall cavity small.

Distribution:—South India and Ceylon.

Natural Order BURSERACEAE

Commiphora caudata Engl.

Gall No. 409 by *Eriophyes* sp. on inflorescence

PI. V

Mani, M.S. 1953. *Agra Univ. J. Research {Sti.),%* (2) : 250 pi. viii ; *Marcellia,* 10:108 • 30:220.

Irregular, extensive, **diffuse,** superficial, solid, fleshy, tubercular, brownish-yellow; closely crowded emergences; simple or mostly irregularly lobed or branched, involving the entire inflorescence, which consequently becomes greatly stunted, contorted and deformed ; all the floral parts remain undeveloped and the flowers fail to open; pedicels and inflorescence axis somewhat swollen due to cortical hypertrophy; the affected floral axis usually more or less pronouncedly tumescent, curved or twisted) generally shortened and forming a bunch ; the fleshy emergences irregular, multicellular, wholly parenchymatous, lobed, branched, tuberculate, with greatly hypertrophied cells, some of which are remarkably similar to callus cells, especially on the periphery. The vascular bundles remain usually normal in the main floral axis, but in the pedicels and galled flower buds more or less extensive disorganization results from cambical cell proliferation. The mites occur superficially in the numerous interspaces between the fleshy lubeides.

Distribution.—South India.

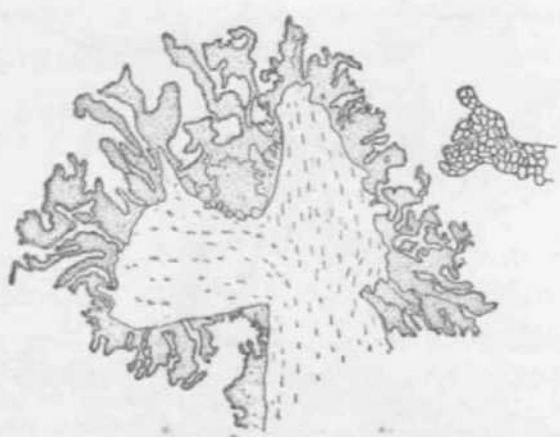


Fig. If). Gall No. 40^ *Commiphora caudata* Engl. by *Eriopkyes* sp., showing fleshy emergences on the swollen tips of inflorescence axis.

« Kenhaw, J.C. 1912. *J. Bombay Mat. Hist. Soc.,* 21 (2) :607-609, pi. A-B.

A gall on *Commiphora quadricincta* Schuf. from Eritrea, described by Trotter (1940, *Marcellia,* 33:220, No. 57, fig. 10) as possibly caused by a fungus, has a general superficial resemblance to the gall on *C caudata.*

Gall No. 410 by *Eriophyes* sp. on leaves

Mani, M. S. 1953. ***Agra Univ. J. Res. (Sci.)*** **2 (2): 251.**

Similar to gall No. 409, but involving whole terminal buds and tender leaflets, which are stunted, greatly irregularly swollen and also have irregular emergences. The transformation is frequently so profound that it is not quite easy to recognize the nature*of the part affected. The galled parts are usually conspicuous yellowish-brown. The main axis is also hypertrophied at the seat of gall formation.*

Distribution.—South India. Riibsaamen (1911. *Marcellia,* 10:108, No. 4221, fig. 12.) has described a gall on leaves, petioles and tender branches *of Commiphora campestris* Engl. from coastal regions of Mombasa (Africa), which is also undoubtedly produced by an eriophyid and shows certain similarities to the gall from India described here.

Garuga pinnata Roxb.

Gall No. 55 by *Phaeopteron lentiginosum* Buckton on leaf

PI. XXIV

Buckton, 1894. ***Indian Mus. Notes,*** **3 : 18.**

Crawford, 1912. ***Rec. Indian Mus.,*** **7 :420.**

Ramakrishnayyar, 1919 ***Rep. Proc. third ent. Meet.*** **Pusa,p. 1030.**

Mathur,R. N. 1935. ***Indian Forest Rec.*** **(N. S.), (Ent.) 1 (2) : 68.**

Mani, M. S. 1935. J. ***Asiatic Soc. Bengal*** **(Sci.) 1(2) : 102; 1948. J.** ***R. Asiatic Sot. Bengal*** **(Sci.) 14(2) : 75, 111.**

Epiphyllous, regular, simple; free and solitary or frequently densely clustered and bunched, subglobose, ovoid, or subcylindrical, unilocular, sometimes slightly compressed, sessile, hollow, coriaceous, dehiscent, beutel-galls, constricted basally into a short, neck-like stalk, inserted in a cup-like tumescence of the leaf blade near the midrib or one of the larger side veins, usually close to the base of the leaf blade. Young galls conspicuously yellow and smooth but with development, turning first yellowish-green and then tinted reddish, finally reddish-brown in patches; often longitudinally conspicuously veined or ribbed, sometimes with a reticulate surface, apically conspicuously mucronate, from which region radiate down numerous raised veins; ostiole completely obliterated; size of galls about 20 mm in length and 10 mm in diameter; a single leaf usually has 2-3 galls but sometimes as many as 6 and occasionally even a bunch of about dozen galls develop in a crowded cluster. Gall cavity spacious and contains 1-2 nymphs in each gall. When fully mature, the gall dehisces irregularly above and permits the escape of the adult psyllid, which has already emerged but remains still imprisoned within the gall.

Distribution.—Throughout India and tropical parts of Himalaya.

Natural Order AQUIFOLIACEAE

Ilex wightiana Wall.

Gall No. 56 by Psyllid on leaf

Sundar Raman, A. H. 1924. *J. Indian hot. Soc,* 4:13, No. 26.

Mani, M.S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14(2) : 111.

Hypophyllous beutelgalls, represented by yellowish and shallow epiphyllous pits.

Distribution.—Nilgiris

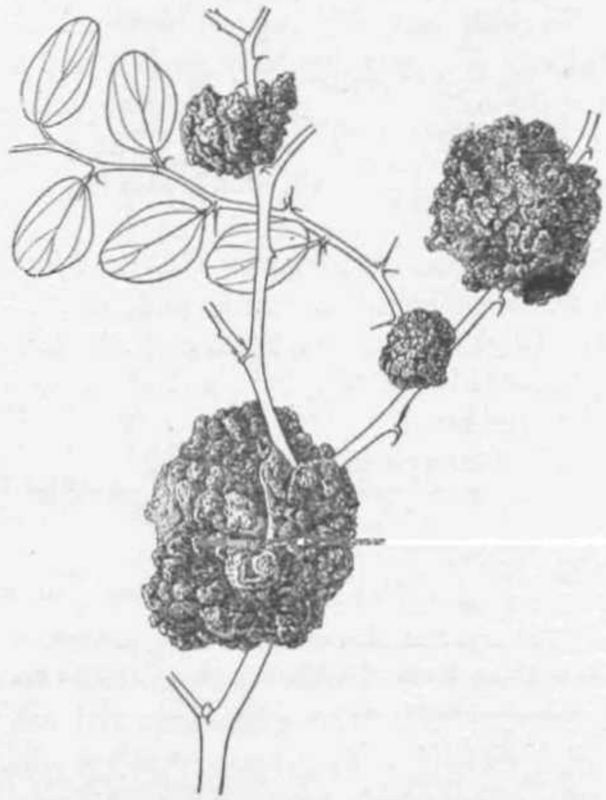


Fig. 16. Gall No. 11 on branches of #$£&!* *jujubn* L.imarck by *Eriopliyes cernuus* Masicc.

Natural Order RHAMNACEAE

Rhamnus virgata Roxb.

Gall No. 437 by *tiriophyes* sp. on leaf

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 (2) : 138.

Beutelgalls visible on both sides of the leaf blade, but more projecting on the lower side; hemispherical or subglobose above; obtusely conical below; about 1 mm high and 0.75 mm in diameter; ostiole circular, small hypophyllous; gall cavity with trichomcs; solitary, simple, yellow to greenish-yellow, sparsely pubescent above and somewhat more below; sometimes irregular and aggregate, agglomerate or compound.

Distribution.—Chakrata-Mussurie Hills, Garhwal Himalaya.

Gall No. 437 by *Eriophyes* sp. on stem

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 (2) : 138-139, fig. 1.

Irregular, subglobosc, solitary or crowded or often agglomerate, pale yellow to greenish-yellow, tubercular emergences, about 3-4 mm in diameter, from subepidermal layers of cortex of stem, side branches and petioles; with a minute ostiole on apex; surface finely pubescent. Gall cavity with fleshy emergences bearing sparse simple, long trichomes.

Distribution.—Chakrata Road, Mussurie Hills, Garhwal Himalaya, Gall No. 491 by *Ascomycetes* on branches and leaves

Mani, M. S. 1954. *Agra Univ.J. Res.* (Sci.) 3 (1) : 27.

Diffuse, local, solid, indehiscent tumescence of branches or leaf blade, about 15-20 mm long about 5-8 mm thick, with hypertrophy of cortex; the affected part usually curved or abruptly bent. On surface of mature galls bright orange-red spore tubes of the fungus.

Distribution.—Dhauladhar Himalaya.

Sageretia oppositifolia Brongn.

Gall No. 44:1 by an unknown midge on bud

Mani, M. &. 1953. *Agra Univ. J. Res.* (Sci.) 2 (2) : 139.

Globose terminal bud galls, multilocular ; tip of the main axis greatly swollen and bearing numerous irregularly crumpled, palmately lobed, reduced, greenish-yellow, fascicles of leafy outgrowths; gall cavities at the base of the fascicles of rosettes of leafy growths, pyriform, or irregular, spacious, often tortuous and with fleshy emergences, with a minute ostiole opening peripherally; 20-300 mm in diameter; single larva in each cavity; pupation in the gall.

Distribution.— Ghakrata Road, Mussurie Hills, Garhwal Himalaya.

Zizyphus jujuba Lamarck

Gall No. 11 by *Eriophyes cernuus* Massee on branch

PL XXIII

Mani, M.S. 1918. *J.R. Asiatic Soc. Bengal* (Sci.) 14:62, 98-99,"fig. 16.

Irregular, solitary or also often greatly crowded, globose, lobed, rugose or tuberculate, hard, reddish-brown galls on stem, representing axillary branches, growing continuously and frequently attaining diameters ranging from 25 mm to 50 mm (fig. 16). No true epidermis; gall surface with irregular, naked par-irregularly cells. Tne mass of the gall may consist wholly of parenchyma, with enchyma scattered vascular elements basally. When old, brittle and readily crumbling into black dust. Numerous individuals of the mites feed in between the crevice* of the tubercles externally on the gall. Compare : Houard, No. 1374 on *Z- orthacantha* Dc. by *Eriophyes* sp.[17]

Distribution.—This is one of the commonest galls on *gizyphus* occurring throughout India. Fresh galls are particularly abundant during the dry weather but in the south the gall may be found almost throughout the year. The galls develop equally readily on bud and young branches.

Gall No. 186 on leaf and branches by unknown midge

Mani, M.S. 1935. *Rec. Indian Mus.*, 37 (4) : 445, fig. 12 b : 1948. *J.R. Asiatic Soc. Bengal* (Sci.) 14:135, fig. 26.

Regular, simple, solitary, free, sessile, sometimes crowded, subglobose or pyriform, rarely shortly conical, hollow, unilocular, indehiscent, yellowish-green, glabrous or also sparsely or densely tomentose, often persistent galls, about 3-4 mm long and nearly the same in diameter, with ostiole on the

[17] Houard, G, 1922. Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 521 ; *Marcellia*, 3:191, No. 23 (1912), (Senegal French W. Africa). Massee, 1927. *Ann. Mag. Nat. Hist.*, (9) 20:373 (Blue Nile Province, Sudan (Africa). Cherian, M.G. 1933. *J. Asiatic Soc. Bengal*, (NS),27(1) : 141-147.

summit of a conspicuous curved or beaked, nipple-like, blunt process. The galls occur on tender branches, stipular thorns, petioles or on leaves ; when on leaves, visible on both sides but rather more on the lower side, with the ostiole usually hypohyllous. Occasionally a gall on the tender branch appears like a swollen curved stipular thorn. The galls on leaf usually tend to crowd on sides of ttie main neivures basally. A single leaf may have from 4-25 gails. Cells hypertrophied, undifferentiated into palisade; cells flattened and smaller than normal; no stomata on galls; beneath the gall epidermis 2-8 layers of flat cells, interior mass of large irregular closely packed parenchyma; vascular elements of veins scattered; trichomes fewer than on

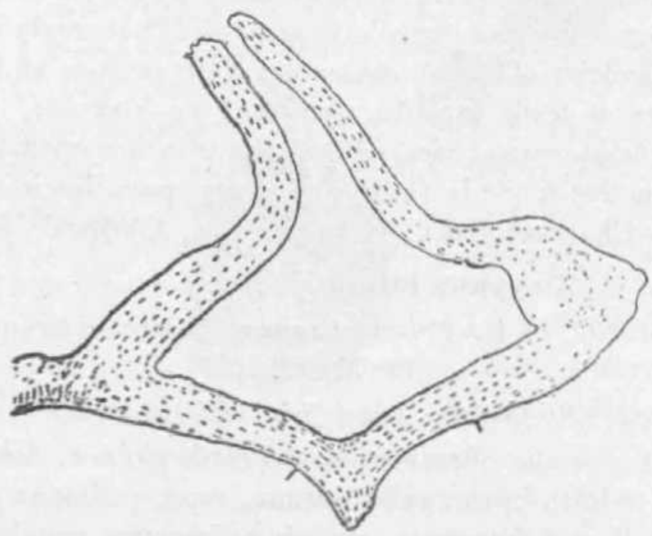


Fig. 17. Gross sagittal section through Gall No. 186 on Iraf of *Zizyphus jujuba* Lamarck by midge.

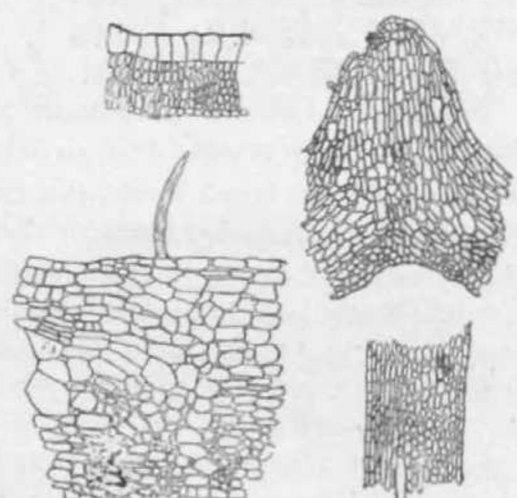


Fig. 18. Paris of sections gall No. 186 on *Zizyphus jujuba* Lamarck by midge (Highly magnified).

normal part of leaf blade, (fig. 17, 18).

Distribution.—Coromandal Coast.

Zizyphus sp.

Gall No. 300 by unknown midge on leaf

Mani, M.S. 1935. *Rec. Indian Mus.*, 37:446 ; 1948, *J.R. Asiatic Soc. Bengal,* 14:136, No. 187 a.

Regular, solitary, free, globose, unilocular, indehiscent, persistent, deep reddish-brown to rusty-brown, smooth pustule-like beutelgall, about 1-2 mm. in diameter, visible*on both sides of the leaf, about 6-12 per leaf.

Distribution.—South India.

Zizyphus xylopyra Willd.

• Gall No. 187 by unknown midge on fruit#

PI. XXI

Mani, M.S. 1935. *Rec. Indian Mus,*, 37:446, fig. 12 a ; 1948 *J.R. Asiatic Soc. Bengal* (Sci.) 14:136, fig. 26.

Similar to gall No. 186 on *Z-M^ba.* Regular, simple, solitary, free, sessile, but often crowded or rarely agglomerate, subglobose to pyriform or conical, unilocular, indehiscent, persistant, nearly glabrous, yellowish but turning brown and somewhat villous when old, nearly 4-5 mm in diameter, greatly resembling short, recurved blunt prickles with enormously swollen bases, ostiole on the short recurved nipple-like summit ; each fruit with about 1-10 galls ; fruit epidermis aud subepidermal cells involved in gall formation.

Distribution.—Goromandal Goast.

Natural Order VITAGEAE

Gayratis pedata Juss.

Gall No. 574 on leaf by unknown midge

New gall. Regular, mostly hypophyllous on midrib or more frequently also closely crowded on the petioles and occasionally on tender apical branches; subglobose, glabrous, indehiscent, solid, fleshy but hard, unilocular, beutelgalls, about the size of a black-pepper, never agglomerate. Larval cavity oval or subglobose, near the summit, surrounded by colourless thin-walled, small, spongy cells, with a single larva of the midge.

Distribution.—South India.

Leea sambucina Willd.

Gall No. 583 by unknown midge on leaf

New gall. Regular, pyriform, bluntly conical or subglobose, sessile beutelgalls visible on both sides of the leaf blade, but larger and more conspicuous on the under surface, on the opposite side presenting a truncated cbnical or obtusely pyramidal conspicuous solid projection ; solid, hard, uni- or bilocular, indehiscent, 2-3 agglomerate, free, up to about half a dozen galls on leaf; larval cavities irreglular, oval or elengate, lined by a thin zone of small, colourless cells. Surface smooth, without trichomes; in the dried herbratium material irregularly and reticulately rugose. Size 7-8 mm high and 4-5 mm thick. Emergence holes circular, irregular on the surface.

Distribution— Pathanapuram Reserve Forest (Travancore).

Leea sp. (venknobarawi Gamble?)

Gall No. 373 by unknown midge on stem

Nayar, K. K. 1948. *J. Bombay nat. Hist. Soc*, 47 (4) : 669.

Irregular, succulent, fleshy, frequently extensive, agglomerate, brownish-green, reddish-brown or green-tinted red, occasionally moniliform galls on young branches, petioles and midribs of leaves 4-23 mm long and 3-14 mm thick, each gall with about half a dozen larvae of the midge.

Distribution.—Tirvandrum.

Vitis semicodrata Wall.

Gall No. 432 by midge on branches and bud

PL XXXII

Mani, M. S. 1953. *Agra Univ. J. Res.*, (Sd.) 2 (1) : 139; ibid., 3 (1) : 28 (1954).

Irregular, pyriform or subglobose, solid, hard, multilocular, brown, smooth, indehiscent, persistent, shortly pedicellate swellings of axillary buds, branches or petioles, about 20-30 mm in diameter. Larval cavities narrow, elongate and irregularly scattered in the gall tissue. Pupation in gall.

Distribution.—From Mussurie to Dalhousie on the foot-hills of the Himalaya.

Gall No. 577 by *Eriophyes* sp. on leaf

New gall. Regular, epiphyllous, elongate, clavate, cylindrical, lop-sided beutelgalls frequently curved like a hook, free, narrowed basally, often irregularly rugose above, indehiscent, ostiole hypophyllous; reddish-brown or yellowish, smooth, glabrous; gall cavity spacious, with dense, curved or curled, long, colourless trichomes; mites numerous. Size of gall 8 mm long, 2-3 mm thick. A single leaflet has about a dozen galls.

Distribution.—Garhwal and Kumaon Himalaya.

Natural Order SAPINADCEAE

Aesculus indica Golebr.

Gall No. 504 by *Eriophyes* sp. on leaf

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 : 28.

Regular, local, free, epiphyllous, large, shallow, cup-like, smooth, yellowish-green beutelgalls on leaf blade, about 20 mm long and 10 mm wide, 5-8 mm high; upper surface of the gall with obscure fleshy tubercular elevations; gall cavity large, wide open hypophyllous ostium, with pit-like depressions covered by dense brown erineum.

Distribution.—Dalhousie Dhauladhar Himalaya. Also common in Chenab Valley : Ghamba State (North) in June.

Cardiospermum halicacabum Linn.

Gall No. 166 by Agromyzid fly on branch

Mani, M. S. 1918. *J. R. Asiatic Soc. Bengal* (Sci.) 14:132.

Irregular, terminal, contorted, semi-solid, indehiscent gall on apices of branches, with suppressed internodes, greatly crowded leaves and tendrils; gall cavity sinuous-elongate galleries in the middle, extending from below upward and lined by dead cells ; larva single in each gall; pupation in gall in the previously prepared larval gallery just beneath the emergence hole for the adult.

Distribution.—South India.

Gall No. 188 by unknown midge on flowers

Mani, M. S. 1935. *Rec. Indian Mus.*, 37:444; 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 : 136.

Irregular, subglobose, oval, discoid or spheroid, solid, lobed, free, vericose or somewhat tufc>ercled, indehiscent, deciduous, green or greenish-yellow, finely pubescent, spongy, soft gall on flowers, basally confluent to the enlarged and swollen but rather membranous smooth calyx, which partly also encloses the gall below; each gall about 5-8 him in diameter; the gall mass shows irregular large fissures and fleshy lobes, each lobe representing the floral envelopes; often the sterile anthers sessile on the surface of the gall; larval cavities numerous and disposed irregularly in the fleshy mass of the gall; pupation in gall.

Distribution.—South India.

Nephilium litchi Gambess

Gall No. 12 by *Eripphyes chinensis* O'Gara on leaf

O'Gara, 1916. *Science* (N. S.) 44 : 142.

Zacher, F. 1925. In Sorauer's Handbuch der Pflanzenkrankhciten, (4) 4 : 127.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc*, 4 : 5,8.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14:62,99.

Localised or extensive filzgalls on leaves, pale brown at first but later turning to deep chocolate-colour; very frequently accompanied by considerable curling, crinkling and swelling of the leaf blade; occasionally also with localised, large, irregular, blister-like epiphyllous beutelgall with wide open ostia below

Distribution.—China, Hawaii, India. Extremely common.

Spindus laurifolius Vahl.

Gall No. 13 by *Eriophyis* sp. on leaf

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14:99

Epiphyllous, regular, globose, ovoid, pale green, tubercular, pubescent or tomentose, uni-or multilocular, often agglomerated beutelgalls, about 5 mm in diameter, scattered in very large numbers on leaves, sometimes even 300-400 galls being found on a single leaflet. Practically every leaf on the tree bears galls; in such cases the leaves are generally badly curled and pale yellowish in colour, the under side being densely tomentose. Cavity large, full of erineum of brown, long, unicellular cylindrical hairs, cpiled and twisted together. Ostiole hypophyllous and more or less covered by hairs. Wall of the beutel distinctly thicker than normal blade; cells undifferentiated parenchyma; veins disorganised.

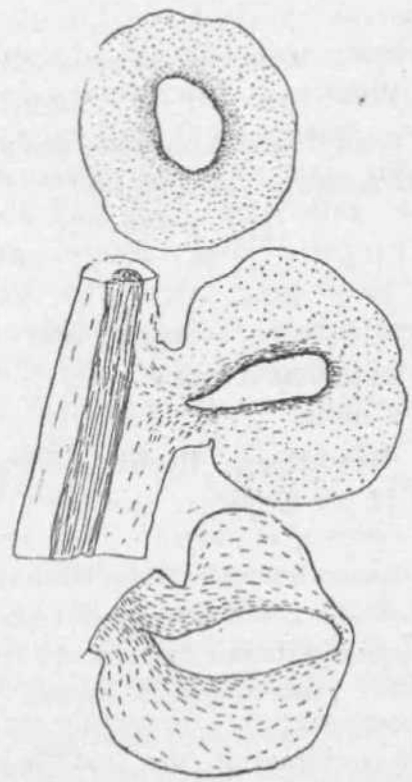
Distribution.—South India.

Schleicera trijuga Willd.

Gall No. 524 by unknown midge on leaf

New gall. Regular, subglobose or subconical, bilocular, thick-walled, tometose, brownish, indehiscent and persistent beutelgalls, developed nearly equally on both sides of the leaf blade, as many as 20 galls irregularly scattered on a single leaf; each gall about 3 mm in diameter; tomentum more conspicuous on the lower than upper side; a horizontal incomplete septum divides the gall cavity into an epiphyllous and a hypophylbus position.

Distribution.—Bihar : Chota-Nagpur.



Fig, 19. Gall No. 500 on stem *oTSabia campanula la* Wall, by *Acroectasis campamdala* Man Top figure transverse section of a single gall, middle figure longitudinal sect on of branch and gall in situ and bottom figure sagittal section of the single gall.

Natural Order SABIACEAE

Meliosma **rigida** S. Z.

Gall No. 485 by unknown midge on leaf

Mani, ML S. 1954. *Agra Univ.* J. *Ret.* (Sci.) 3 (2) : 28.

Regular, epi-or hypophyllous, local or diffuse, subglobosc or fusiform solid, indehiscent tumescence of the midrib and bases of the larger lateral veins, about 5 mm in diameter; smooch brown. Larval galleries irregular- Young galls arise as local lateral, obtusely conical, short cortical, emergences, but socn extend to deeper parts and become diffuse growths-

Distribution. —Kangra Valley.

Sabia campanulata Wall.

Gall No. 500 by *AcToectasis campanulata* Mani on branches

PI. XXV

Mani, M.S. 1954. *Agra Univ. J.* (Sci.) 3 (2) : 17-20,29, pi. vii.

Regular, free, globose, sessile, solid, indehiscent, fleshy, green, glabrous, persistent, epidermal, and subepidermal or cortical galls on stem and petioles, 5 mm in diameter, conspicuously crowded in very large numbers all round the branches and usually becoming partially fused basally with each other, curiously looking like a spike of pepper fruits; with a single vertical, narrow cylindrical axiate larval cavity, opening on the surface by a regular circular aperture about 0-5-1.0 mm in diameter and covered by a thin operculum of epidermal callus cells before emergence of the adult midge. The galls occur continuouly for several feet on the branch. Gall epidermis of rectangular flat, somewhat hypertrophied cells. The bulk of the gall is composed of largec losely packed, hypertrophied, multinucleftte parenchyma cells. The cells near the larval cavity with large conspicuous crystals. Larval cavity lined by callus cells, outside which is the^zone of the socalled nutritive cells (fig. 17). Secondary vascular elements develop from base of gall parenchyma and surround loosely the larval cavity and later connect up with the vascular ring of the stem.

Distribution.—Dhauladhar Himalaya.

Natural Order ANAGARDIACEAE

Holigrana arnotiana Hook

Gall No. 388 by unknown midge on leaf

Nayar, K. K. 1948. J. *Bombay nat. Hist Soc,* 47 (4) : 674, fig. 2.

Regular, hypophyllous, subglobose or oblate, depressed, sessile, indehiscent, solid, hard, free, rugose, dark brown or brownish-black, about 7 mm in diameter, with a single larva.

Distribution.—High Ranges : Travancore.

Mangifera indica Linn

KEY TO THE GALLS

1.	Galls by Psyllidae		12
	Galls by Itonididac		2
2.	Gall on branches		3
	Gall on leaves or flowers, not on branches		4
3.	Fusiform, unilateral swellings of iwigs caused by *Oligotrophus mangiferae* Kieff.	Gall No.	189
	Irregular, cortical, extensive swellings of twigs caused by *Rhabdophaga mangiferae* Mani ...	Gall No.	197
4.	Gall in flowers caused by *Dasyneura mangiferae* Felt ...	Gall No.	195
	Gall on leaves		5
5.	Gall visible on both sides of the leaf...		6
	Gall epiphyllous or hypophyllous, but not equally developed on both sides of leaf		7
6.	Depressed, circular, discoid pustules by *Procontarinia matteiana* Kieff. & Gecc.	Gall No.	192
	Biconvex pustules by unknown midge ...	Gall No.	194
7.	Obtuse-conical or subcylindrical, usually epiphyllous	Gall No.	191
	Hemispherical, epiphyllous green galls by unknown midge	Gall No.	406
	Globose or pill-shaped galls		8
8.	Large galls, with fleshy emergences, "resembling a miniature sea-urchin, caused by *Amradiplosis echinogalliperda* Mani ...	Gall No.	196
	Never with fleshy or other emergences, but smooth, at the most with the bark reticulated when mature ...		Q

9. Large, often over 3 mm in diameter, dark slate-coloured or very dark brown, usually epiphyllous, caused by *Alassomyia tenuispatha* (Kieff.) ... Gall No. 190
Medium-sized or small galls, never more than 2 mm in diameter 10
10. Small green galls by *Amradiplosis viridigallicola* (Rao) ... Gall No. 324
Small, pale yellow galls by *Amradiplosis keshopurensis* (Rao) ... . Gall No. 332
Medium-sized galls, not green when mature 11
11. Brown gall by *Amradiplosis brunneigallicola* (Rao) ... Gall No. 326
Slate-grey gall by *Amradiplosis amraemyia^fRao)* ... Gall No. 325
Gall not described *?Indodiplosis mangiferae* Felt ... Gall No. 193
12. Fire one-like terminal rosette gall by *Apsylla cistella* (Buckton) ... ... Gall No. 57

Gall No. 57 by *Apsylla cistella* (Buckton) on bud

Buckton, 1893.3,/iw/wn *Mus Notes,* 3:91. Crawford, 1912. *Rec. Indian Mus.,* 7:421. Sundar Raman, 1924. J. *Indian hot. Soc.,* 4:12, No. 25. Mathur, R.N. *1935:Indian Forest Rec,* (N. S.) 1 (2) : 38. Mani, M.S. 1948. *J.R. Asiatic'Soc. Bengal* (Sci.) 14:73, 111, fig. 25.

Regular, cone-shaped or oval, scaly, terminal, generally persistent bud-gall, about 20 mm long, 15 mm thick, green when young and brown when old, composed of the imbricated, thickened and dwarfed leaves, with the main axis somewhat moderately swollen, with the numerous nymphs of the Psyllid crowding in between them; in older galls the scaly leaves loosen and flare out apically. The gall has the general appearance of a pseudocone of fir or of the greatly enlarged and scaly buds of Rhododendrons. Oviposition occurs between the leaves of the unopened bud, in each of which 20-50 eggs being deposited. Hibernation as nymph during winter. Adults emerge in March-April. The syrphid *Bacca pulchrifrons* is parasitic on the nymphs.

Distribution.—This gall is very common throughout north India and is specially abundant in the Sub-Himalayan tracts.

Gall No. 189 by *Oligotrophus mangiferae* Kiefl. on branch

Kicffer, 1908. *Marcellia.* 7 : 150, No. 1, pi. Hi, fig. 1. Houard, C. 1922. Les Zoocecidics des Plantes d'Afriquc, d'Asie et d'Oceanie, 1 : 466, No. 1712. Sundar Raman, A. H. 1924. *J. Indian hot. Soc* 4 : 38, No. 63. Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14 : 126; 1952. *Agra Univ.* J. *Res.(Set.),* 1 : 48.

Regular, unilateral, oval, soild, indehiscent, tumescence of young branches, hard, extremely fragile, about 10-30 mm long, 5-10 mm thick; larval cavities numerous, oval or ellipsoidal, nearly 2 mm long, irregularly scattered beneath surface, metamoiphosis in gall; adults emerge about December. *Oligotrophus fnangiferae* was discribed by Kiffer from larvae only and adults have never been found so far

Distribution.—The gall appears to be fairly common in several parts of ihe plains of India.

Gall No. 190 by *Alassomyia tenuispatha* (Kieff.) on leaf

PI. XXI

Kicffer, 1908. *Marcellia,* 7 : 150, No. 2, pi. iii, fig. 6-7, pi. i_v, fig. 1. Houard, G. 1921. Less Zoocecides des Plantcs d'Afrique, d' Aiie ct d'Oceanie. 1 : 466, No, 1715. Sundar Raman,

A. N. 1924. *Jf. Indian bot. Soc.*, 4 : 39, No. 67. Nayar, K. K 194+. *Indian J.Ent.*, 6 : 71. Mani, M. S. 1948. *J. R. Asiatic Soc, Bengal,* 14 :91, 136; 1952; *Agra Univ.J. Res.* (Sci.), 1 : 48, pl. 1 fig. 4 and 6.

Regular, hypophyllous or also epiphyllous, globose, solid, unilocular, indehiscent, sessile, free, in groups of 3 or 4, rarely agglomerate, slaty-brown to black, glabrous or when old reticulate, about 2.5 mm in diameter, with a discolourised spot on" the upper surface of the leaf; larval cavity hard {fig. 20); metamorphosis in gall; this*is one of the largest and commonest galls on leaf of the plant, occurring nearly in all parts of India.

• Gall No. 191 by unknown midge on leaf

PI. XXI

Kieffer, 1908. *MarceUia,* 7 : 151, No; 4, pi. iii,ng.4—5. Docters van Leeuwen-Reijnvaan,J. &W. 1941. *Bull. Jardin Bot.* **Btatoneorg,** (2) **13;** 43, No. 462, fig. 214. Houard, C. 1921, Lcs Zoocccldics des Plantes d'Afrique, d[f] Asic et d'Occanic, 1 : 466—467, No. 1716. Sundar Raman, A. H. 1924. J. *Indian bot. Soc,* 4 : 39, No. 66. Docters van Lceuven-Reijnvaan, J.&W. 1926. Zoocecidia of Netherlands East Indies, p. 324, fig. 578. Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.), 14 : 136; 1952. *Agra Univ.J. Res.* (Sci.) 1 : 53.

. Tiny, cylindrical, epiphyllous, rarely hypophyllous, often obtusely conical, soild, glabrous, brown to dark reddish-brown, shiny, unilocular, indehiscent, sessile, solitary, free, simple, about 1mm thick basally and 1-2.5 mm high, apically with a cap-like black, red-rimmed operculum that falls off', leaving a circular large hole in old galls; on the opposite side of the leaf the site of the gall is marked by an obscure biconvex, brownish pustule; the gall implanted in a circular swelling of the leaf blade; gall cavity single, large, conical, with hard walls.

Distribution.—This gall was described by Kieffer from Ranchi, India, and is also known to occur in Java, Sumatra and Scbesi Islands. I have several examples from Guntur, Andhra State Coll. S. N. Rao.

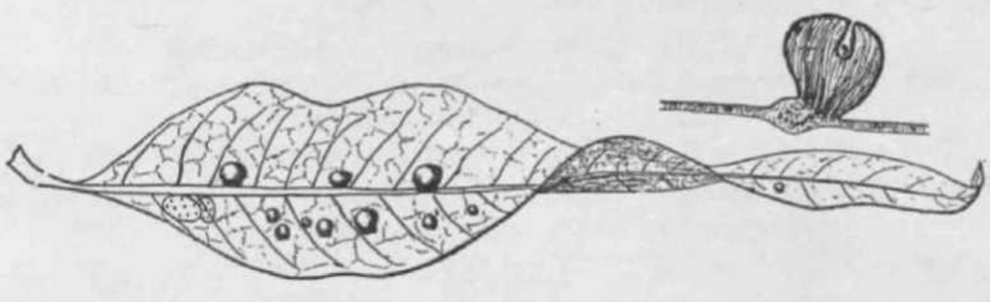


Fig. 20. Gall No. 190 on leaf of *Mang>fera indica* Linn, by *A^asssomyia tenuitpatha*

Gall No. 192 by *Proconlarinia m&tldana* Kieff. et Gecc. on leaf

Klcffcr & Cccconi, 1906. *MarcelUa,* 5 : 135-136, fig. 1-3. Stelam-Perez, 1906. *Marcetlia,* 5 : 1G5. Trotter & Cecconi. 1907. Cccidoltaeca Italica. 17, No. 412 ; Houard, C. 1921. Les Zoocccidies des Planics d'Afrique d'Asic et d'Oceanie. 1 : 467, No. 171 7. Sundar Raman, 1924. *J. Indian bot. Soc,* 4 : 38, No. 64. Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14-: 137; 1952. *Agra Univ. J. Res.* (Sd.), 1 : 52-52, pi. U, fig- 8.

Regular, circular, biconvex, depressed, solid, indehiscent, free, sessile disc-like galls, developed equally on both surfaces of the leaf blade; smooth, yellowish to brown; unilocular, with gall cavity central, horizontal, size 3-4 in diameter and about 2 mm thick; often over 300 galls crowded on a single leaf.

The gall midge was first described from specimens, which emerged from the galls on mango plants just imported into Sicily from India. The species also occurs in Java, Mauritius and South Africa.

The adults from the over-wintering larvae (in the gall) emerge about the middle of March and oviposit on the tender and newly forming leaves in early spring. Oviposition may continue to the end of May. The incubation period of the eggs extends from 3 to 4 days. The larval period ranges from 120 to 386 days. The pupal period lasts from 7 to 10 days during late February or early March and pupation takes place within the gall. The adult midges usually emerge in the morning.

There are possibly 3 or 4 annual generations that freely overlap; the first generation extends from March to July, the second from July to nearly the middle of October and the third from October to March. The adults of the first generation do not all emerge at one time in July, but continue to do so in 3 or 4 successive batches in July, October and next March along with the adults of the second and third generations. Tne adults of the second generation emerge likewise partly in October, a second batch in March and a third batch in July next. The third generation flies emerge largely in March but a small number in July next. The total life-cycle can be as short as two and a half months or as prolonged as one whole year. The larvae are frequently heavily parasitized by a platygasterid.

The proportion of males is relatively high in the adults emerging in March-April and comparatively low in the July and October families. Parthenogenesis is no doubt interposed in some of the families.

Distribution.—This is perhaps the commonest and most abundant of mango galls in India, where it occurs in all parts.

Gall No. 193 by *Indodiplosis mangiferae* Felt

Felt. 1916. *Canadian Ent.,* 48:403.Mani, M. S. 1943. J. *R. Asiatic Soc. Bengal,* (Sci.), 14: 137; 1952. *Agra Univ. J. Res.* (Sci.) 1:52.

The gall midge was described from specimens from "leaf galls" on mango at Pusa. The gall was never described and has not so far been recognized.

Gall No. 194 by unknown midge on leaf

PL XXI

Kiffer. 1906. *Marcellia,* 7:151; No. 3. Docters van Leeuwen-Rcijnvaan, J. & W. 1914. * *Bdl.Jardin Bot. Buitenzorg,* 2 (15) : 42-43, No. 461. Houard, C. 1921. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1:467, No. 1718. Sundar Raman. 1924, *J. Indian bot. Soc,* 4:39, No. 68. Mani, M. S. 1948. *J.R. Asiatic Soc. Bengal,* (Sci.) 14:137; 1952. *Agra Univ. J. Res. (Sci.)* 1:53.

Circular, biconvex, unilocular pustules, visible on both sides of the leaf, 1.5-3 mm. in diameter, grabrous, pink when old, with exit hole above or below, somewhat depressed or the summit.

Distribution.—This gall was originally described by Kieffer (loc. cit) from India and is likewise known to occur in Java.

Gall No. 195 by *Dasyeura mangiferae* Felt on flowers

Fell E. P. 1927. *Mm. Dept. Agric. India* (Ent. Scr), 10:1. Mani.M. S.I934. ***Roe.** Indian Mus.*, 36:404; 19*8. *J. R. Asiatic Soc. Bengal* (ScL) 14:91; 1952. *Agra Univ. jf. Res.* (Sci.), l;47-4£. Barnes, H.F. 1948. Gall midges of Economic Importance. Grossby Lock wood & Sons, London, p. 94.

The female of the midge lays a single egg in each flower bud, which develops into a small, jaointed, cone-shaped gall. Pupation also takes place within the gall.

This species causes the gall on the flower buds in South India. The species was originally described from female specimens reared from flower galls at Coimbatore. In 1939 I received specimens from Cochin, **where** it was reported to have galled over 70% of the mango flowers during 1938-1939. Barnes *(be. cit.*) refers to specimens in his collection labelled as heaving been reared from flower galls of mango in Malaya.

Gall No. 196 by *Amradiplosis echinogalliperda* Mani on leaf

PL XXI

Mani, M- S. 1935. *Ret. Indian Mus.*, 37 (4) : 446; 19+7. *Bull. ent. Res.*, 38(3) : 443; 1948, *J.R. Asiatic Soc. Bengal. {Sci.)* 14:92, 137: 1952; *Agra Univ.* • *J. Rei. (Sci.),* 1:49, 50, pi. ii, fig. 9.

Regular, cpiphyllous, free, solitary, sessile, sometimes agglomerate, indehiscent, solid, hard, imi-or bilocular, subglobose galls (fig. 21) with dense, elongate, stout, fleshy-spinous, nmhitellular emergences of simple parenchyma cells, giving the appearance of a miniature sea-urchin; the surface emergences arise from outside a close columnar epidermal layer and are already rubbed off when dry; green when young and dark reddish-brown to nearly reddish-black when old ; with circular exit holes on surface; 5-7 mm

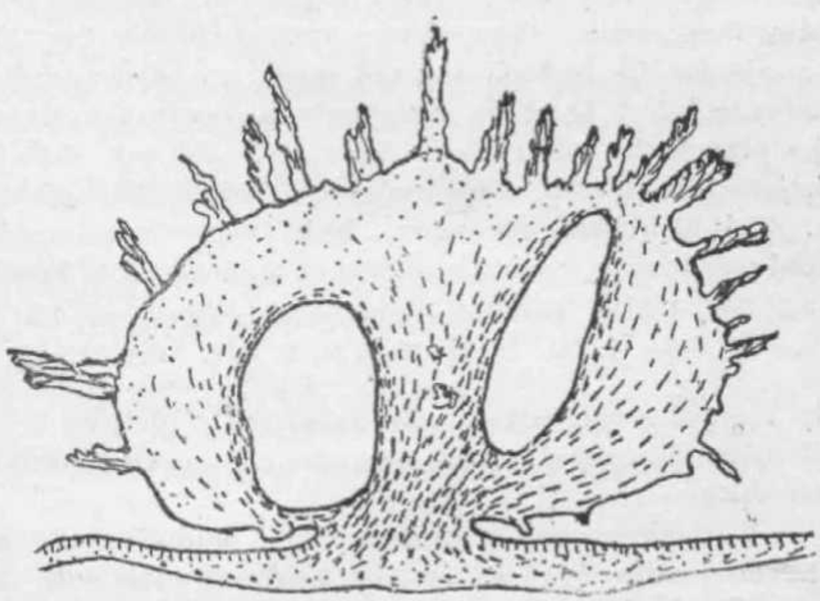


Fig.2,1. Gross sagittal section of Gall No. 196 on leaf of *Mangiftra indka* Linn, by *Amrfi>/o.ti't echinoglliperda* Mani-

>n diameter; each leaf with nearly a dozen galls. Larval cavities nearly

central, with a thick zone of small cells, surrounding an inner mass of collapsed cell.

It is widely distributed in Bengal, Bihar and Uttar Pradesh, especially in the northern parts. The gall of this species was first described by me in 1935 from specimens collected at Calcutta. The adult midges emerge once in February-March and again in October. Some of the progeny of the flies emerging in March complete the life-cycle in October, but the others over-winter in the gall as larvae to complete the development in February next. This species has not so far been found in South India.

Gall No. 197 by *Rhabdophaga mangiferae* Mani on branch

Pl. XIII

Mani, M. S. 1938. *Rec. Indian Mus.*, 40 (4) : 331; 1948. *J.R. Asiatic Soc. Bengal* (Sci.) 14:92, 137; 1952. *Agra Univ.* J. *Res.* (Sci.) 7:48-49, pi. 1, fig. 1-2.

Subglobose or subconical, cortical galls, rarely free and solitary but mostly developing in linear spiral series or into irregular, cortical, often extensive, agglomerate globose or fusiform, multilocular, solid, tuberculated, indehiscent, persistent swellings on tender branches, with numerous exit holes; covering the entire length of a tender branch and giving a warty or nodulated appearance. Single gall with a hard oval larval chamber in the middle orientated perpendicular to the axis of the branch; size 8 mm thick at base and 5 mm high; agglomerate galls often measuring 60 mm long and 20 mm thick. Surface brown and grey, with irregular cracks and rugosities. The entire mass of the gall is composed of simple pararchyma cells derived from the cortex of the branch.

The infestation is relatively very heavy in certain localities, especially during spring. Nearly every newly formed twig bears a dozen or more of the characteristic swrllings, while others closeby remain entirely free. The galls attain their maximum size in April and the emergence of the adult flies continues from May to July. There is apparently a single annual generation. Pupation takes place in the gall.

Distribution.—The species appears to be fairly widely distributed in South India. This is probobly the same which Docters van Leeuwen-Reijnvaan described as lenticular cortical swellings of branches from Java[18].

Gall No. 324 by *Amradiplosis viridigallicola* (Rao) on leaf

Rao, S. N. 1950. *Indian J. Ent.*, 10:34. Mani, M. S. 1952. *Agra Univ. J. Res. (Sci.),* 1:50, 51.

Usuajly the gall is epiphyllous, glabrous, solid, globose, sessile, free, solitary, unilocular, indehiscent, simple and about 1 mm in diameter, yellowish-green and shiny.

There is a single annual generation. The adults usually emerge in February-March or early April in certain localities. The galls mature by January next. The total pre-imaginal period is about 250 days, but the adult

!8 Docters van Leeuwen-Reijnvaan, J. & W. 1914. *Bull. JaXdin Bot. Buitenz.org*, (2) 15:43, No. 416. Houard, C.1922. Les Zoocccidies des Plantes d'Afrique d'Asic ct d'Oceanie, 1:466, No. 1713.

is relatively short-lived. The incubation period of the egg appears to be rather prolonged over 4 or 5 months.

Distribution.—The species appears to be extremely common in several parts of Madras, Bengal, Bihar and Uttar Pradesh.

Gall No. 325 by *Amradiplosis amraemyia* (Rao) on leaf

PI. **IX** & **XXII**

Rao, S. N. 1950. *Indian J. Ent.,* 10:37. Mani, M.S. 1952. *Agra. Univ. J. Res.,* (Sci.) 1:41.

The gall differs from that of the foregoing species in its larger size. Epiphyllous, solid, globose, solitary, sessile, simple, free unilocular, indehiscent and slaty-grey.. The emergence of the adult occurs about April and the galls mature in next February.

Distribution.—Uttar Pradesh.

Gall No. 326 by *Amradiplosis brunneigallicola* (Rao) on leaf

Rao, S. N. 1950. *Indian J. Ent.,* 10:39.

This gall differs Irom those of the other species in being small, brown, globose, epiphyllous, solitary, simple, free, solid, sessile, shiny, unilocular indehiscent and with a shiny-brown cap-like operculum over the future exit hole on the summit of the gall

The adult midge emerges in April and the galls mature in July, August next. The larvae however over-winter within the mature gall before pupating in March next. The total life-cycle is about one year and the pre-imaginal period extends to about 350 days.

Gall No. 332 by *Amradiplosis keshopurensis* (Rao) on leaf

Rao, S. N. 1952. *Proc. R. ent Soc. London,* (B) 21 (3/4) : 52.

The gall as yellow-coloured, globose, epiphyllous and hardly 1 mm in diameter. The midges emerge in November.

Gall No. 406 by unknown midge on leaf

PI. V & **VIII**

Doctcrs van Leeuwen-Reijnvann, J. & VV. 1910. *Marcellia,* 9:187, No. 189. Houard, G. !921. Lcs Zoocecidies des Plantes d'Afrique d'Asie et d'Oceanic, 1 :467, No. 1721. Mani, M. S. 1952. *Agra Univ. J. Res.,* Sci. 1:54. pi. iii, figs. 11—12.

Regular, epiphyllous, hemispherical or obtusely conical, sessile, free, rarely 2-3 agglomerate, smooth, greenish, indehiscent, unilocular, thick-walled, hard, beutelgalls; cavity large, central; about 2-3 mm high, 2 mm thick; on the lower surface the site of the gall is indicated by a short, obtuse cone, about 1.5 mm high.

Distribution.—South India, Java.

Odina wodier Roxb.

Gall No. 198 by *Odinadiplosis odinae* Mani on leaf

PI. **XIII**

Mani, M. S. 1935. *Rec. Indian Mus.,* 37:435-439; *ibid.,* 40:336 (1938). Sakscna, R. D. 1942. *J. R. Asiatic Soc. Bengal* (Sci.), 8:15, fig. 7. Mani, M. S. *Indian J. Ent.,* 5:160 (1943); J. *R. Asiatic Soc. Bengal* (Sci) 14:137 (1948); *Bull. ent. Res.,* 38 (3) : 441, % 9, (19i7); *Agra Univ. J. Res.* (Sci.) 2 : 140, pi. 1. fig. 1. (1953).

Regular, simple, free, local or also extensive, globose, oval, fusiform or moniliform, yellowish-brown, smooth, glabrous, solid, indehiscent, fleshy, succulent tumescence of the main rachis, petiole, midrib or the larger side veins of leaves, occasionally agglomerate; with an elongate, narrow, hard L-shaped larval chamber in each gall, one limb of the L opening to the outside on the surface of the gall. Size of a single gall 10-20 mm in diameter. Each leaf may have as many as 20 galls. A single larva usual in each gall; occasionally 2-3 may be found in agglomerate masses. In mature galls the surface is clothed with dry reddish-brown scaly pieces of thin bark. The emergence hole made by the larva before pupation stpps beneath the epidermis, which is pushed off as a circular lid by the wriggling movements of the pupa at the time of emergence of the adult midge.

The gall epidermis of large cells surrounds several layers of closely packed parenchyma cells. The larval gallery is composed of closely packed thicked-walled wood-like cells, with the innermost layer of cells lining the larval cavity wholly solid. Irregular groups of vascular bundles are scattered in the gall parenchyma. Seat of cell proliferation is cortex, medulla or both.

Golden-yellow, oval, smooth eggs, about 0.25 mm, deposited on tender leaf and opening leaf buds, hatch in about 2—3 days into colourless larvae, which penetrate the tissues. The fully grown larva is orange-yellow, 3.5 mm long. The larval period extends to about 5 weeks in South India. The larva gradually works its way outward from the centre of the mass of gall cells which have grown round it, with the hard cyst cells developing around it at the same time. About half way out the larva turns its course sharply at an angle and reaches the gall epidermis, which is however left intact and below which pupation occurs. The pupa is about 3 mm long and uses the cephalic horn in piercing and lifting up the thin epidermal opperculum which sticks out of the exit hole, facilitating the escape of the adult fly. Pupal period in South India extends to a maximum of 10 days. There are several overlapping generations in the year in South India, with aestivation as larvae in dried up galls in soil during the hot summer months, when the tree sheds its leaves. Parasitisation by Ghalcidoidea and Platygasteridae is common in late generations. The entire flesh of the gall is devoured by the caterpillars of unidentified Lepidoptera, leaving the gall epidermis as an empty bag for its pupation.

Distribution.—This gall is one of the commonest that can be collected during and after the rains throughout India and in the Sub-Himalayan regions.

Pistacea integrimma Stew.

Gall No. 105 by *Dasia aedificator* (Buckton) on leaf

Buckton, *Indian Mus. Notes,* 3 (1)£71-73 (1893). Das, B., *Mem. Indian Mus.*9 6 : 144, pi. xiii, fig*. 1—10, (1918); var **dcr** Goot, *ibid.*, 6:152 (1918). Sunder Raman, j \ . H., J. *Indian Bot. Soc*, 4 : 16, No. 43 (1924). Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.)., **14:83,** 121.

Elongate, horn-shaped, pod-like, twisted, curved or straight, hollow leaflet-roll gall, green or pinkish, leathery at first but soon becoming woody and hard when old, dehiscent, persisting on the branches for long periods after the escape of the aphids; size of the gall 130 mm to 400 mm long and about 25 mm thick; imperferate apically, the hole also serving for exit of the aplids.

The old, twisted horn-like galls have gained the popular name *kakkar-shingi.* The mature and old galls are also inhabited by Coccinellids, spiders and ants. The common squirrel eats away the galls.

Distribution.—Punjab and Afghanistan.

Pistacia khinjuk Slocks

Gall No. 106 by aphid on leaf

Figdor, W. *Gallen,* Leipzig, (2) 1:698/No. 2 (1900). Houard, C 1921. Lcs Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1:476, No. 1758. Mani, M. S. 1948. J. *R. Asiatic Soc. Bengnl* (Sci.), 14:122.

Irregular, simple fleshy galls, often with 2-4 appendages, compressed lite a pod 10-30 mm long, 10-15 mm. wide and 4-5 mm thick; gall cavity large.

Distribution.—North India.

Pistacia sp.

Gall No. 107 by *Ceratopemphigus zehntneri* Schout. on leaf

Schoutenden, *IL gpol.* #?/., 2:187-188, pi. iv, fig. 7-9 (1905). Houard, C. 1921. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1:476, No. 1762, fig. 1016. Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14:122.

Irregular, bag-like, leathery bunches of galls on leaf, about 44 mm long and nearly as thick.

Distribution.—Ceylon.

Rhus javanica Linn.

Gall No. 447 by *Eriophyes* sp. on leaf

Mani, M. S. 1953. *Agra Univ.J. Res.* (Sci.) 2 (1); 140.

Irregular, globose, hemispherical or tuberculated, solitary or often agglomerate, epiphyllous, hollow, fleshy, yellowish beutelgalls, with the ostiole wide open, pit-like, hypophyllous; densely crowded in very large numbers, often as many as 200 over the entire surface of the leaflet*; erineum moderately dense, white, simple, unbranched, sinuate, slender, unicellurlar, acute and rising irregularly from the lower epidermis, the cells of which are greatly hypertrophied; on the upper surface with scattered, short, recurved, erect trichomes; about2-3 mm in diameter and about 1.5 mm high; if agglomerate often measuring upto about 5 mm across. On the lower surface of the leaf the site of gall is indicated by an irregular wide pit.

Distribution.—Kumaon Himalaya.

Semecarpus anacardium Linn.

Gall No. 573 unknown Psyllid on leaf

New gall. Regular, hypophyllous, hemispherical, nearly solid, unilocular, hard, dehiscent, persistent, glabrous, reddish-brown beutelgalls, about 5 mm in diameter and nearly as high, with a short, obscure, blunt mucronate process on summit; on the upper surface of the leaf blade the site of the gall is indicated by a discoloured and somewhat shallowly depressed irregular spot, with a narrow, low rim and in the centre a small blunt elevation; gall-cavity large and irregular; often 2-3 galls agglomerate.

Distribution.—S. India

Spondias mangiferae Willd.

Gall No. 58 by *Pauropsylla spondiasae* Grawf on leaf

Crawford, 1915. *Philip. J. Sci.*, 10:260. Ramakrishnayyar, T.V. 1924. *Rec. Indian Mus.*, 26:622. Mani, M. S. 1935. *J. Asiatic Soc. Bengal* (Sci.) 1:102; 1948. *J. R. Asiatic. Soc.* (Sci.) 14:75,112.

Leaf scroll gall, reported to be common throughout South India; not seen by me.

Natural Order LEGUMINOSAE

Acacia catechu Willd.

Gall No. 209 by *Lobopteromyia bivalviae* (Rao) on leaflets

PI. I

Mani, M. S. 1935. *Rec. Indian Mus.*, 37 (4) : 447-448, fig. 13a; *J. Roy. Asiatic Soc. Bengal* (Sci.) 14:139 (1948). Rao, S. N. 1950. *Rec. Indian Mus.*, 48 (3-4) :35, fig. 4. Mani, M. S. 1953. *Agra Univ.J. Res.* (Sci.) 2:251,260-262, pi. vi.

Regular, globose, free, solitary or serially numerous, simple, hard, hollow, unilocular, dehiscent, persistent, bivalved galls, formed of unequally enlarged, swollen and cup-shaped bases of two adjacent leaflets on the same side of the pinna; the proximal valve smaller and terminal valve larger; the two valves fitting each other accurately by their broad brims to form a spherical pot and circular discoid lid; the apices of the leaflets thus affected remain normal; often the narrow margins of the leaflets also free. The colour of the galls varies from dark reddish-brown to violet. The surface smooth and glabrous. Each gall is attached by a very short petiole or is subsessile. The smaller valve projects partly into the lumen of the gall like a circular cork-like plug. Size varies from 3-3.5 mm in diameter. Rarely three leaflets from a single gall. Larvae 1-2 in each gall. Occurrence extremely abundant, each leaf bearing on an average about 50 galls and nearly every leaf on a plant being galled.

This gall was first collected by me from the Reserve Forest, Walayar, south of Coimbatore in 1926, but no midges were reared. In 1950 some specimens of the gall and one single example of a midge were received from Thana (Bombay) through the courtesy of the Forest Research Institute, Dehra Dun.

Distribution.—Walayar Reserve Forest, along railway line to the north of the Walayar Station and up to Bombay in the north.

Gall No. 582 by *Eriophyes* sp. on leaf

New gall. Subglobose, sessile or irregular and extensive densely pubescent hollow galls composed of the greatly enlarged, swollen leaflets in series on the upper side of the main rachis, which in consequence curves downward; frequently a whole axillary bud thus becomes converted into a composite mass of gall. A single gall nis about 2-5 mm in diameter and a serial composite mass may measure 10-15 mm long.

Fig. 22. Gall No. 38 (left) and No. 39 (right) on *Acacia Uucopklota* VVilld. by *Tkilakothrips babuli* Kamakr.

Distribution.—Ganeshkind : Poona.

This gall is somewhat similar to gall No. 14 by *Eriophyes acacxae* Nelpa on leaflets of *Acacia leucophloea* Willd *{vide infra).*

Acacia concinna Dc

Gall No. 270 by unknown Chalcid on fruits

Mani, M.S. 1948-7. *• *AsfatH Soc. Bengal* (Sri.) 14 ; 153-154.

Irregular, globose, agglomerate, multiloculuar, indehiscent, local or greatly extensive, persistent, rugose, hard, solid swellings of the pods, measuring about 30-45 mm in diameter.

Distribution.—South India.

Acacia leucophloea Willd.

Gall No. 14 by *Eriophyes acatiae* Nalcpa on leaf

PL XVIII & XXIII

Drs. van Leeuwen-Reijnvaan, W. & J. 1910. *Marcellia,* 8 : 37, No. 91. Nalepa 1914. *Marctllia.* 13 ; 70-71,86. Houard, C. 1921. Les Zoocecidies des Plantcs d'AFriqwr, dWsic et d' Oceanic, 1 : 346. No. 1260. Drs, van Leeuwen-Rfijnvaan, W. & J. 1926. The Zoocecidia or Netherlands Eait Indies, p. 226, figs. 360, 361. Mani M. S. 1948. J. *R. Astatic Soc. Bengal* **(Set)** 14 (2) : 61, 99.

Regular, simple, subglobose, hemispherical, elongate-oval or reniform, free, sessile, hollow, unilocular, utricular, moderately thick-walled galls formed by fleshy out-growths from secondary rachis and bases of at least 2 pairs

of serially adjacent opposing pairs of leaflets meeting together closely in a more or less regularly shaped slit on the upper surface of the pinna, with the short normal apices of the leaflets projecting above; yellow, yellowish-green, orange, brown or violet; smooth or rugulose, pubescent or densely villous, about 2-3 mm in diameter; very often not merely the leaflet-bases but entire leaflets and more frequently in series on the whole pinna become involved in the formation of an irregular extensive, elongate, multilocular, agglomerate gall, with the secondary and also the primary rachis swollen, conspicuously curved downwards and abbreviated; the gall cavity also with trichomes. The gall comprises parenchyma emergences from the cortex and epidermis of the rachides and from the leaflets. An irregular ostiole is situated at the point of meeting of the crossed slits near the summit. Hundreds of galls develop on a single leaf and nearly every leaf on the windward side of every tree may be covered by the galls. This is especially the case just before the outbreak of rains in South India.

***Distribution.*—India The gall has also been previously recorded from Java and Siam.**

Gall No. 38 by *Thilakothrips babuli* Ramakr. on flowers

Ramakrishna Ayyar, T. V. 1928. *Mem. DepU Agric India,* (ent.) 10 (7) : 275, fig. 24 a-d. Saksena,R. D. 1944. *J R. Asiatic Soc. Bengal* (Sci.), 10 : 121, pi. i. fig. 3. Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 68, 106.

Irregular, globose, agglomerate, fleshy, hollow, often lobed galls of flowers, in which the calyx, corolla and stamens are enlarged, deformed, greatly swollen, curled and crumpled; the flowers fail to open. The cortex of the floral axis, on which the gall forms, also shows hypertrophy and general swelling-up (fig. 22). The vascular bundle ring of the veins becomes separated irregularly. Gall parenchyma of greatly enlarged cells. More or less pronounced fusion of the floral parts occurs at base of the gall. Sterility of anthers and pistil.

***Distribution.*—North India, especially western parts, along the Aravalli Range.**

Gall No. 39 by *Thilakothrips babuli* Remark, on bud

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 : 106-107, fig. 2.

Subglobose cabbage or rosette-like galls in axillary and terminal buds (fig. 22), comprising the greatly enlarged, crumpled, swollen and rolled leaflets; coriaceous, glabrous, yellowish-green, green, brown, violet or reddish; measuring about 25-30 mm in diameter. The main axis bearing the gall is also more or less swollen. The galled leaves lack differentiation of palisade.

***Distribution.*—All over India from July to November.**

Gall No. 20225 described by Drs. Van Leeuwen-Reijnvaan W. & J., as produced by a Coccid from Java, is really this gall.[19]

[19] Dr. van Leeuwcn Reijnvaan, W. & J. 1926. Zoocecidia of the Netherlands East Indies, p. 2261, fig. 359.

Gall No. 131 by *Sphadasmus braminus* Pascoe on" stem

Pascoe, 1871 *Ann. Mag. Nat. Hist.,* (40) 7:203. Ramakrishna Ayyar, 1922. *Bull, ugric. Res. Inst. Pasa.,* 125:20. Mani, M, S. 1948. *J.R.Asiatic 3oc. Bengal,* (Sci.) 14 (2) : 88, 126.

Regular, subglobose, oval or fusiform, hollow, hard, woody, unilocular, indehiscent, persistent, local tumescencc of tender branches, 20-35 mm long and 15 mm thick, of same colour as the rest of the branch ; gall

Fig. 23. Gall No. 131 on *Acacia leucophloea* by *Sphadasmus braminus.*

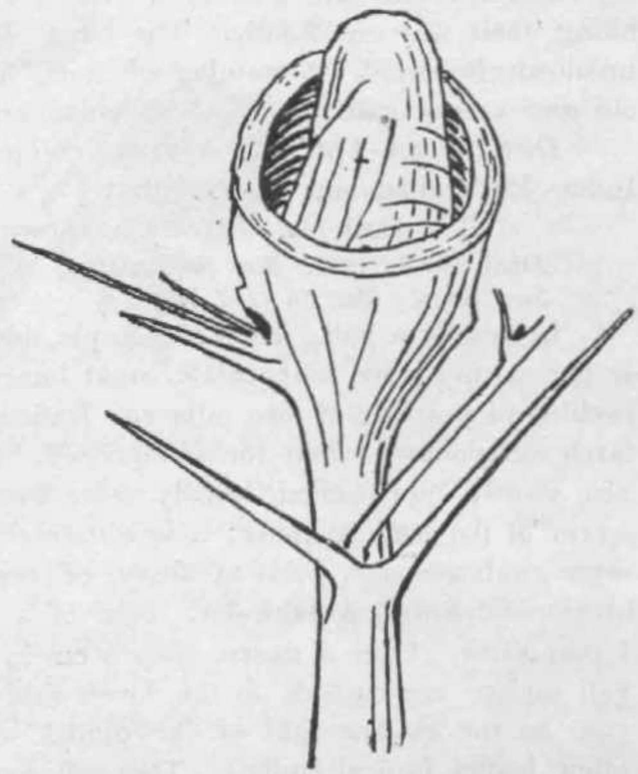


Fig. 24. Gall No. 131 on *Acacia Umopkloea* Willd., cut open to show the pupa of the weevil inside.

cavity large, oval or fusiform, central; exit holes circular, irregulaily placed on the side of the gall, single ; medulla absent ; cortex hypertrophied ;

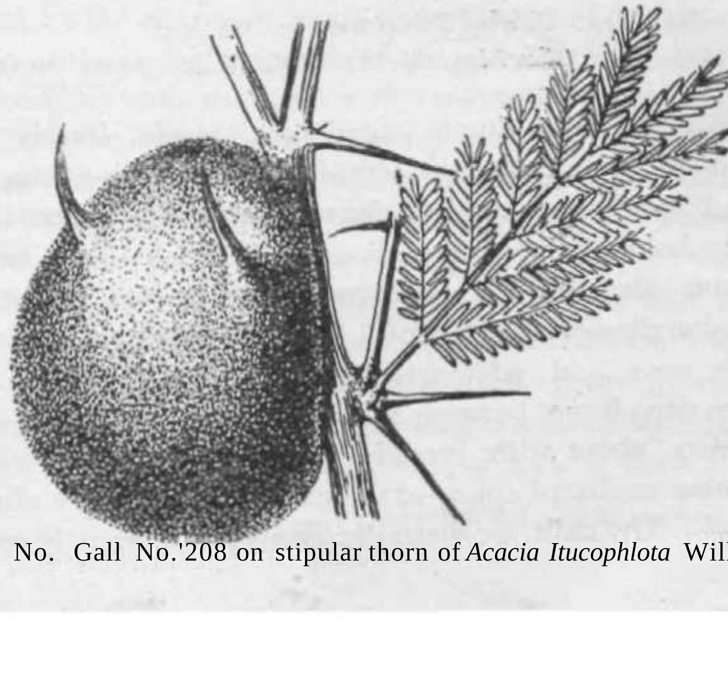


Fig. 25. No. Gall No.'208 on stipular thorn of *Acacia Itucophlota* Willd. by midge.

medullary rays widened, so that the vascular bundle ring is somewhat broken up. Eggs are deposited in June-July under the bark in tender apical part of branches in holes scooped out by the snout, incubate for about a week and hatch into grubs, which bore into the medulla. The grub remains in the larval cavity in a characteristic doubled-up posture. Larval period extends upto about 34 days. Pupation occurs inside the completely closed gall and lasts for over 40 50 days. The adults on emerging remain within the gall for a variable period of 10-15 days before biting their way out finally. The larva is frequently parasitized by an unknown Braconid. A number of ants, like *Cremastogaster subnuda,* occupy old and empty galls and make regular nests within them.

Distribution.—The gall is fairly common in isolated patches in South India, Hyderabad and Bombay State.

Gall No. 203 by unknown midge on leaf

Mani, M. S. 1935. *Rec. Indian Mus.*, 37:448, fig. 13b-c; 1948. *J. R. Asiatic Soc Bengal* (Sci) 14 (2) : 138.

Legumiform gall. Regular, simple, biconvex, ovoid, hour-glass-shaped or like a miniature biarticulate, stout lomentum, formed by the fusion and swelling of portions of two adjacent leaflets of the same side of the pinna, rarely subglobose, stout or compressed, generally sessile but sometimes also shortly bipedicelled basally, with two unequal, short wing-like normal apices of the leaflets above; a longitudinal conspicuous sulcus bordered by ridges indicates the joint of fusion of the leaflets; green, hispid, solid, brittle, thick-walled, bilocular. Size of a single gall 2-2.5 mm long and 1 mm thick. Over a dozen galls occur in series on a single pinna. The gall surface corresponds to the lower side of one of the leaflets involved, (i.e. on the cauline side of the pinna) and of the palisade side of the other leaflet (apical leaflet). The gall comprises simple parenchyma with larval cells large, oval and surrounded by a zone of sclerenchyma cells. No tissue differentiation in the galled part. A single maggot in each gall cavity. Gall indehiscent.

Distribution.—South India.

Gall No. 204 by *Schizomyia* sp. on leaf

Mani, M. S. 1935. *Rec. Indian Mus.*, 37:48; 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14(2) : 138.

Pubescent gall. Regular, simple, subglobose, sessile, (rarely with short stalk) solid, free, indehiscent, deciduous, semi-fleshy, yellowish-green, pale green or often yellowish-brown, more or less densely pubescent, externally bilobed swellings iromed by fusion of the basal portions, or of the middle of two adjacent leaflets on the same side of the secondary rachis on a pinna of the compound leaf; about4-5 mm in diameter; with 2 oval larval chambers surrounded by the socalled nutritive zone and sclerenchyma; on the surface the gall shows irregular and often deep fissure between fleshy carinae, representing the margins of the swollen leaflets; above with broadly sagitate green leafy wing-like expansions, representing unaltered apices of the galled leaflets; these often as much a fourth of the gall. The galls are generally arranged alternately on the pinna or also crowded irregularly upto about 15 on a single leaf; the secondary rachis curved donward at the site of the gall.

Distribution.—Coromandal Coast.

Fig. 26. Gall No. 271 on *Acacta Uucofrhloea* Willd. by *TrkkUogaster* sp.

Gall No. 205 by unknown midge on branches

Mani, M. S. 19+8. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 139.

Regular, globose, solid, indehiscent, persistent, hard, localised, swellings of young branches, especially of the inflorescence axis, brown, smooth, about 3-5 mm in diameter; with small oval larval chambers.

Distribution.—Coromandal Coast.

Gall No. 206 by *Asphandylia trichocecidarum* Mani on leaf

PI. XVIII

Mani, M. S. 1934. *Ree. Indian Mm.*, 3(5:413-414, fig. 145; 1948. *J. R. Asiatic Soc. Bengal (Sti.)* 14(2) :130.

Trichocecidium. Regular, globose or pyriform, sessile, deciduous, light brown, densely hairy, hard, solid, uni- or biloculate galls, nearly 3 mm in diameter, formed by the enormous swelling and fusion of two adjacent leaflets from the same side of the secondary rachis of the pinna closely applied to each other; each gall resembles miniature dense flower-heads. A single pinna may' have several galls in series, alternate or opposite, crowded but not agglomerate; as many as 20 galls develop on the complete compound leaf; apices of the galled leaflet persist as expanded wing-like vestiges on the gall- There is no differentiation of the palisade tissue. The epidermal cells derived from the palisade side of the distal leaflet and from the spongy parenchyma side of the proximal leaflet, with numerous hairy outgrowths; the hairs brownish, multicellular and tapering somewhat apically; basal hair cells with protoplasm, terminal cells dead and brown. Larval chambers with a moderately thick zone of proliferating small cells. Vascular bundles irregularly scattered in the gall parenchyma.

Distribution.—Coromandal Coast.

Gall No. 207 by *Schizomy'w acac'xae* Mani on leaf

Mani, M. S. *Res.* 1934. *Indian Mai.,* 36:405-407, pi. vii. Salcscna. R. D. *J. R. Asiatic Soc. Bengal* (Sci.) 8:18; 19, fig. 9 (1942). Mani, M. S. (1948). *J. R. Atktk Soc. Bengal* (Sci.) 14(2) :92, 139.

Fig. 27. Gall No. 273 on leaf axils of *Acacia leucophtoea* Willd. by Cynipid.

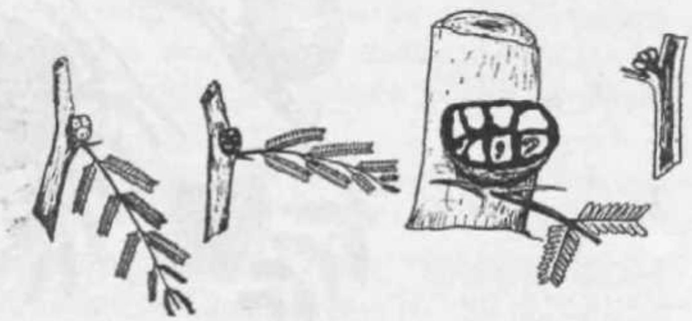


Fig. 28. Gall No. 2 73 on *Acacia Uurophlota* Willtl., cut open.

Tomciuose gall. Regular, globose, pyriform or shortly cylindrical, hourglass-shaped or lenticular, externally bilobed, solid, fleshy but hard, indc-hiscent, deciduous, yellowish-brown or reddish-brown, uni or bilocular, generally sessile galls, about 8 mm long and 5-6 mm thick, formed by enor-mously swollen and fused basal three-fourths of two adjacent leaflets on the same side of the secondary rachis in the pinna of the compound leaf; surface densely clothed with tomenturn and often with the expanded short apices of the leaflets projecting on the summit; as many as 30 galls are crowded in series, alternately or opposite each other on a single leaf. This is the largest of the leaflet galls on *Acacia leucnphleca* in India. The great bulk of the gall is composed of regular rounded or hexagonal, moderately large undifferentiated parenchyma cells containing chlorophyll and richly loaded with tannin. The epidermis of the gall, derived from the upper side of the distal and the lower side, made of hypertrophied cells with hairy outgrowths. The larval cavity is surrounded by a thick zone of colourless, small, closely packed cells. Vascular elements scattered.

The midge lays eggs in the tender buds, the larvae hatching in about 3 days, lie in "between two leaflets. The torn en turn appears on the outer surfaces of the affected leaflets after about 7 days. Larval period appears to extend to nearly two months. Pupation in gall. Pupal period 5 days- Before pupation the larva bores up to the surface of the gall and papates directly underneath the epidermis. These appear to *bt* two generations in the year.

Distribution.—Coromandal Coast.

Gall No. 208 by unknown midge on stipules

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2): 139, fig. 21.

Dilated stipular, basal, subglobose, solid, fleshy, parenchymatous, brownish or greenish-brown, very finely pubescent galls, about 5-12 mm in diameter. Old galls inhabited by *Cremastogasttr* sp., the workers of which bite off the pith and thus make a cavity suitable for themselves (fig. 25).

Distribution.—Coromandal Coast.

Houard[20] has described a very similar gall on the stipules of *Acacia fistula* from Egypt, Somaliland and Kilimandjaro.

Gall No. 271 by *Trichilagaster* on branches

PL XI & XIX

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 154, figf 12-14.

Subglobose, turbiniform, usually flattened at the top with a shallow cup-like depression in which project numerous (20—160) tubercular structures; these are later pushed away by the escaping adult; woody in the centre and with a narrow softer cortex, in the whole branch often turning into a gall; brownish, solid, often great many galls conglomerated, usually 7-8, sometimes even 12—14 galls becoming fused into large, irregularly globose, solid, woody mass, about 75-80 mm in diameter, with surface maiked out by sieve-like cupiilifom flat depressions of each gall, the gall is then facetted. Larval chamber (fig. 26) varying from 20-200 in a single gall, often as many as 500 in aconglomerale gall, small, flask-shaped, with a narrow long neck leading to the cupuliform facet and in the young gall closed by a corky, semiglobose, tubercular lid, acystiferous, 2 mm high, lid about 1 mm across. Often as many as 50-60 galls are found in a single twig and generally the entire tree is very badly galled.

The gall is really an axillary bud and branch gall, with sometimes the vestiges of the undeveloped leaves on the flattened summit of the gall. Old galls persist on the branches long, often over 1-2 years, after the emergence of the gall maker. Indehiscent. The great bulk of the gall is made of a large central contorted or stunted and truncated woody core, surrouded by a moderately soft, swollen cortex, in which the larval chambers are embedded; this latter surrounded by small, closely prcked, socalled nutritive cells but not sclerenchyma elements. The larval chambers are not irregularly sctattered, but are arranged within a circular zone, nearly all in about the same plane, just above the central woody core of the gall; there are several such patches of larval cells to a single gall. The eggs seem to be deposited in the axillary buds in the tender branches.

Distribution.—Coromandal Coast.

Gall No. 272 by unknown Chalcid on flower buds

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 154.

Globose, solid, hard, woody, sometimes agglomerated cystiferous brown, persistent, indehiscent swellings of flower buds, about 8 mm in diameter; larval

^ ^ Houard, G. 1909. Les Zoocecidies des Plantes d'Europe et du Basin de la Mediterrance, 2 : 575, Nos. 3323; *Ann. Soc. ent.* #«/**, 81. 104-105. No. 184, fig. 227 (1912); Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceame, 1 : 339. No. 1238, fig, 711-714 (1921).

cavities 3—4 in a gall; galls are often found as many 20 in a single inflorescence axis.

Distribution.—Goromandal Coast.

Gall No. 273 by unknown Cynipid on bud

Mani, M. S. **1918.** J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 154, fig. 66.

Globose, smooth, slaty grey, multilocular galls, hollo'v, about 8 mm in the axils of the compound leaves, with circular exit holes when old (fig. 27, 28).

Distribution:—Coromandal Coast.

Gall No. 360 by *Uromycladium* sp. *[notabile* (?)] on branches, fruits, etc.

PL VIII

Regular, subglobose or highly irregularly and variously shaped, hard, woody, indehiscent, wholly solid, persistent, often extensive, reddish-brown, smooth, sessile swellings of branches and fruits, often reaching up to 100-150 mm in diameter, solitary or greatly crowded or agglomerated, developing in enormous numbers on branches, which often completely bend under the weight of the galls, decaying when old and burrowed by ants and other insects.

Distribution.—Whole of South India, Hyderabad (Deccan).

Galls on various species of *Acacias* by the fungus *Uromycladium notabile* are common in Australasia and frequently grow to truly gigantic proportions of a foot in diameter, they start as poliferatious in phloem, the original cambium is lost.

Gall No. 365 by fungus on leaf rachis

New Gall. Regular, fusiform diffuse, solid hard localised swellings of the main rachis of leaflets, about 10 mm long and 4 mm thick, with numerous hollow fungal tubes, projecting on the surface. Compare gall No. 491 on *Rhamnus virgata.*

Distribution.—Coromandal Coast.

Acacia suma Buch.-Ham.

Gall No. 453 by unknown midge on leaf

PL I & II

Mani, M. S. 1953. *Agra Univ. J. Res.* (Science), 2 (2) : 252, pi. v.

Cylinder-piston gall. Regular, simple, hypoyhyllous, persistent, sessile, elongate, slender, cylindrical, solid, indehiscent, yellowish-green, reddish-brown of violet-coloured, smooth, glabrous, unilocular, interlocked series of galls on leaflets, consisting of a hollow cylinder formed as an hypophyllous local evagination from one leaflet, into which fits a solid, cylindrical, rod-shaped piston, formed as a solid parenchymatous local hypophyllous outgrowth from the next leaflet above (apically) on the pinna (fig. 29).

The solid piston fits close into the hollow cylinder, but does not extend right up to its tip; a short narrow, somewhat curved apical hollow part of the outer cylinder, above the truncated apex of the solid piston, forms the larval (gall) cavity and contains a single larva of the gall midge.

This part of the gall forms a short narrow nipple-like prolongation on the apex of the regular, basal, cylindrical longer portion. Each gall is thus formed from at least two adjacent leaflets from the same side. The cylinder is basally provided with a short, stout, fleshy, circular, hypophyllous rim, projecting conspicuously beneath and girdling the narrow solid piston. The site of the solid piston is indicated on the opposite side of the leaflet bearing it by a discolourised raised spot with a shallow central depression. The cylinder-piston galls arise in continuous interlocked series and succeed one another on the pinna; each leaflet providing the hollow cylinder for one gall basally and the solid piston for another apically. Size varies from 9 mm to 10 mm in length and 1-1.5 mm in diameter. Each gall is nearly 2-3 mm or more than the length of the leaflet on which it develops.

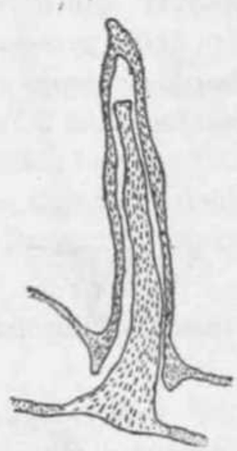


Fig. 29. Call No. 453 on leaflets of *Acacia sttma* Buch.-Ham. by unknown **midge.** Longitudinal section of a single gall, showing the outer hollow cylinder from one leatlet and the solid piston from **another** leaflet above, with the small larval cavity near the apex.

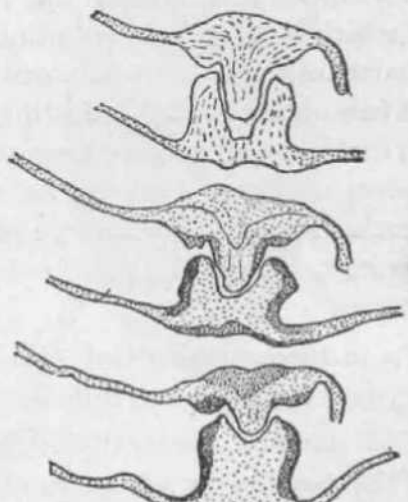


Fig. 30. Gall No. 456 on leaflets of *Acacia sutaa* Buch-Ham. by *Ijoboplaomyia ramachandrani* Mani. Longitudinal sections in different plant's, to show the larval cavity in the top section and the lid with solid plug from leaflet above and barrel-shaped body from leaflet below.

There is no fusion of the two leaflets, the piston fitting correctly into the perf ctly moulded-to-size cylinder.

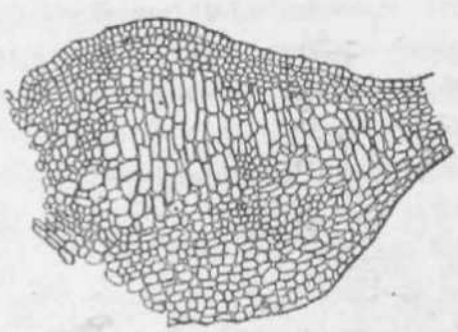


Fig. 31. Part of T. S. through Gall No. 456 *on* leaflets of *Acacia su,na* But h.-Ham. by *Lobopteromiya ramackandrctni* Mani

The piston of the gall is composed of closely packed, greatly elongate parenchyma cells lacking pigments. The cylinder is also composed of similar cells, but often with variable pigment.

Distribution.—Walayar Forest, Western Ghats.

Gall No. 456 by *Lobopteromyia ramachandrani* Mani on leaflets

PI. II & III

Mani, M. S. 1953. *Agfa Univ. J. Res.* (Sci.) 2 (2) :252, 262-265, pi. v.

Regular, agglomerate, serial, persistent, barrel shaped or also hourglass shaped and obliquely arranged on either side of the pinna of leaf; each gall formed of a barrei-shaped, stout, proximal, hollow, thick-walled growth from the upper surface of one leaflet, into which fits a short, stout, stumpy-cylindrical, pestle-like plug formed from the swollen disc-like lower side of the next leaf above, which in its turn bears a hollow barrel for the next gall in the series. Each barrel of the gall is prolonged into a long, curved, fleshy process, from the conical free end (fig. 30). Each gall is unilocular, hard, dehiscent, yellowish-brown, irregularly rugose and measures about 3.5-4 mm long and 2.5 mm thick. The apices and margins of the leaflets bearing the gall free and normal. The plug reaches nearly to the bottom of the gall cavity which contains a single larva of the midge. Every leaflet of every leaf galled so as to form leaf, curling in severe cases.

As in the foregoing Gall (No. 453), there is no fusion of the parts of the gall derived from the two different leaflets.

Gall parenchyma mostly of greatly hypertrophied cells elongate in the axis of the two halves, which together form the hourglass-shaped mass, with hexagonal or rounded parenchyma cells near the periphery. Epidermis made of closely-packed, subcolumnar, crenate thick-walled cells (fig. 31). Vascular bundle elements separated and scattered.

Distribution.—Reserve Forest near Walayar, Western Ghats.

Acacia species indeterminatae

Gall No. 404 by fungus on branches

PI. VIII

New gall. Irregular, subglobose, local, unilateral, dirty-white to pale yellow, rugose, lobulated, carnose, solid but moderately hard, indehiscent, persistent, sessile, subcortical swellings, often growing to over 50 mm in diameter; nvhen severe, involving deep-seated structures of the branches.

Distribution.—Marudamalai Hills near Coimbatore : South India.

Alhagi camelorum Fischer

Gall No. 343 by unknown curculionid on stem

New gall. Regular, diffuse, local oval or fusiform, somewhat compressed, hollow, thick-walled, indehiscent, persistent, often moniliform series of swellings of branches, with a single central, axial, large larval cavity, in which the grub of the weevil is found. Sometimes even the thorns become galled basally. Yellowish-green, green, brown or tinted violet, about 10 mm long and 4 mm thick. Pupation in gall.

Distribution.—Common in November-December in and around Agra.

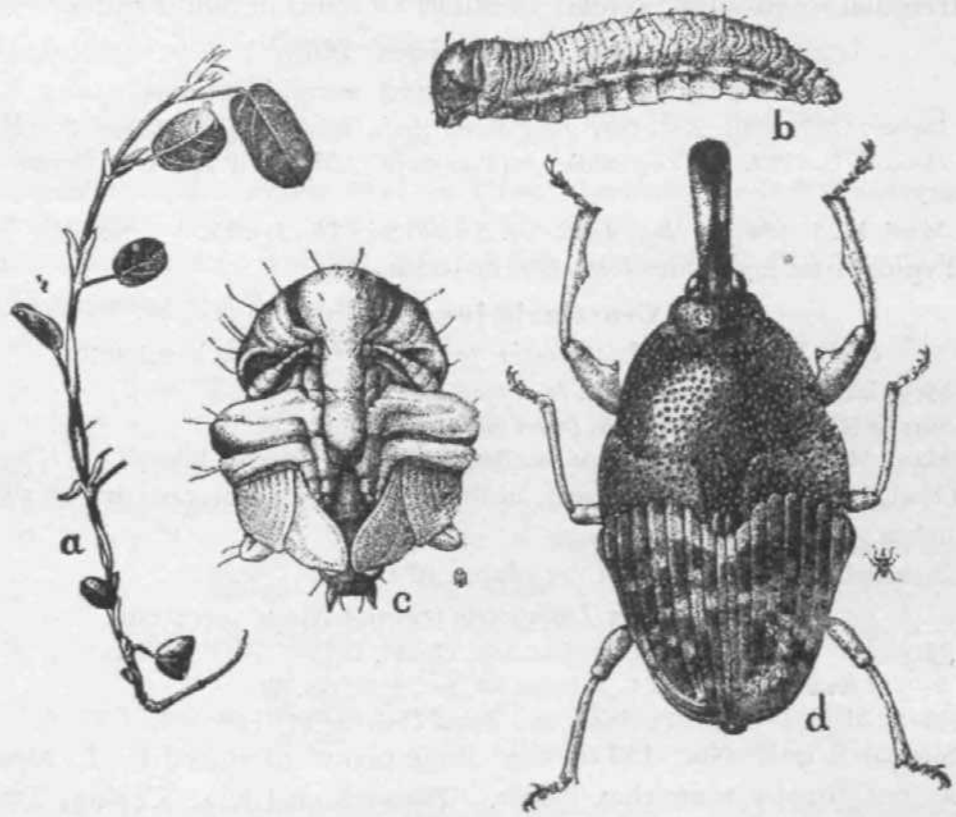


Fig. 32. Gall No. 132 on stem of *Atyskarpus moniliftr* DC by curculionid a. branch with gall, b. larva, c. pupa. d. adult weevil.

Aiysicarpus monififer DC.

Gall No. 132 by unknown curculionid on stem

Mani, M.S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 126.

Diffuse fusiform, semi-solid, hard, indchiscent, swellings of tender branches, **with** the laivae in the axial tunnel. Yellow or tinted violet. 3 mm thick. Pupation in gall.

Distribution.—-South India.

Butea frondosa Keen.

Gall No. 133 by *Pachyonyx quadndens* Chevr. on branches

Chevcr. 1880. *Ann. Soc. eni. FT.,* (5) 10 (Bull : cxvii).

Mani, M. S. 1948. *J. Raj. Asiatic Soc. Bengal* (Sci.) 1+ (2) : 88, 126, figs. 50-52.

Regular, oval or fusiform, rarely subglobose and local, persistent, indehiscent, solid, woody, sometimes moniliform series of swellings of Ihe tender branches, about 30 mm long and 20 mm thick, of the same colour as the rest of the branch, with irregular central larval gallery containing a single'larva in the characteristic doubled-up altitude. Pupation in gall.

Distribution.—Hyderabad (Deccan), Nagpur and neighbouring parts °f Central India.

Cajanus cajan

Gall No. 666 by *Alcidodes collaris* on stem

Fletcher, T. B. 1913. Some Indian Insects, p. 337.

Irregular, semi-solid, nodular swellings of stems in South India.

Cassia mimosoides Linn.

Gall No. 390 by *Heterodera marioni* on roots

Barber, G. A. 1901. *Bull. Dept. Land Record Agric. Madras, Agric. Baanch,* 2 (45) : 231.

Houard, C. 1922. Lcs Zoocecidies des Plantes de' Afrique, d* Asie et d' Oceanie, 1:367. No. 1334.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2; : 95.

Typical root nodosities from South India.

Grotalaria juncea Linn.

Gall No. 153 by *Laspeyresia pseudonectis* Meyerick on stem

Meyerick. 1907. *J.* *Bombay nal. Hist. Soc.,* 18:146.

Sundar Raman, A. H. 1924. J. *Indian hot. Soc,* 4:43, No. 88.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 88, 129.

Oval, or fusiform, large, hard, unilocular indehiscent, persisteut swellings of branches, often 25-30 mm long.

Distribution.—Throughout the plains of India.

Gall No. 154 by *Laspeyresia tricentra* Meyr. on stem

Meyerick. 1907. *J. Bombvy not. Hist. Soc,* 17:734.

Sundar Raman, A. H. 1924. *J. Indian hot. Soc.,* 4:43, No. 89.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 89, 129.

Similar to gall No. 153 on the same plant produced by *L. pseudonectis* Meyer, but usually somewhat larger. Throughout India, Ceylon, Transvaal (S. Africa).

Crotalaria saltiana Andr.

Gall No. 155 by *Grapholitha subrufillana* Snel on stem

Drs. van Leeu* en-Reijnvaan, W. & J. 1909. *Marcel Ilia*, 8:24, No. 3, fig. 3. *Rec. Trav.* ***bot. Neerl., Groningen,*** **8 : 16-23, fig. 5,6, pi. I, 7—11 (1911). Houard, G. 1922. Les Zoocecidies des Plantes d*Afrique, d'Asie et d'Oceanie, 1:373, No. 1355. Drs. v. L. Reijnvaan, 1925. Zoocecidia of the Netherlands. East Indies, 233, No. 540, fig. 375 *(Crot. striata).* Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2) 130.**

Subfusiform, subglobose, hollow, terminal, lateral, smooth, greenish, indehiscent, stem tumescence, about 10-15 mm long and 3-5 mm in diameter; larval cavity longitudinal, with irregular fleshy excrescences; with callus tissue formation inside. The colour changes to brownish with age.

Distribution.—Coromandal Coast. Also from Siam.

Gall No. 662 by unknown midge on stem.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 138.

LargS, globose, irregular, solid, tubercular, cortical swellings of the shoot, about 25 mm in diameter.

Distribution.—Bengal.

Grotalaria semperflorens Vent.

Gall No. 156 by unknown Lepidoptera on stem

Drs. van Leeuwen-Reijnvaan, W. & R. 1912. *Marcellia,* 11:67, No. 272. Houard, C. 1922. Les. Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1:373. No. 1357.

Matji, M. S. 1918, *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2):130.

Diffuse, subglobose, fusiform, hollow, terminal or sub-terminal stem tumescence, similar to No. 155.

Distribution.—Coromandal Coast. Also from Java.

Crotalaria verruosa Linn.

Gall No. 157 by unknown Lepidoptera on stem

Drs. van Lecuwccn-Rcijnvaan, W- & J. 1914. *Bull Jardin bot. Buitinzorg,* (2) 15:15, No. 385, **fig.** 174.

Houard, C 1922. Les Zooceidies des Plantcs d'Afnque, d'Asic ct d'Oceanx, 1:374, No. 1358. Mani, M. S. 1948, *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):130.

Regular fusiform, hollow, indehiscentj angulated sweUlngs of branches, nearly 15 mm long and 8 mm thick.

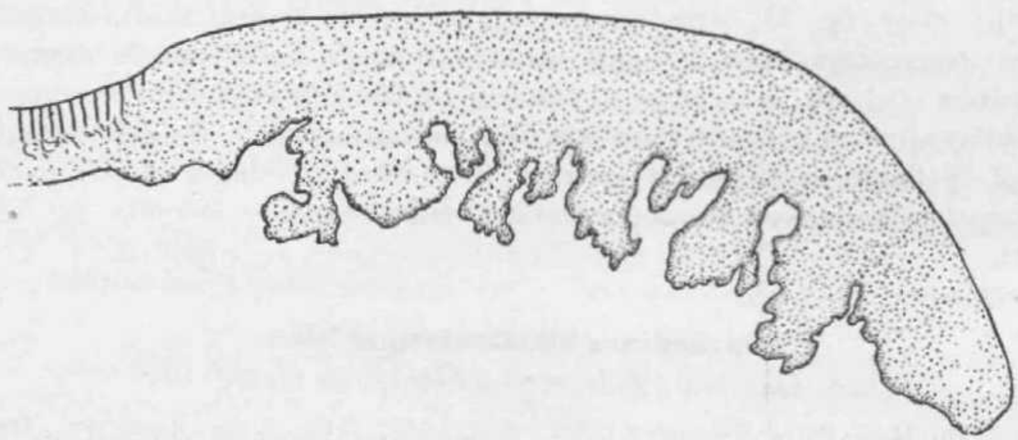


Fig. 33. T. S. through part of Gall No. 345 on leaf of *Dalbergia sissoo* Roxb. by *Eriophses sp*.

Distribution.—South India.

Crotalaria willdenoviana DC.

Gall No. 158 by unknown.Lepidoptera on stem

Mani,M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2): 130.

Similar to gall No. 160 on *Tepkrosia purpurea (vide infra).*

Distribution.—South India.

Cyamopsis tetragonoloba Tanb, **(=psoralioides** De.}

Gall No. 350 by *Asphondylia* sp. on flowers

Ramchandra Rao, Y. 1917. *Proc. Indent. Mm. Pusa,* 60-61.

Irregular, oval, ellipsoid or fusiform, solid, fleshy, deciduous, indehiscent swellings of the ovary, smooth, green, often reacting upto 10,mm long and 4 mm thick, without formation of seeds; sepals and petals not affected by gall formation, often only a part of the ovary is galled, with the remaining portion growing nearly normal.

Distribution.—South India.

Gall No. 667 by *Alcidodes bubo* (Fabr.) on stem

Fletcher, T. B. 1913. Some S. Indian Ins., p. 337.

Stem nodular swellings of irregular shape and size.

Distribution.—South India.

Dalbergia sissoo Roxb.

Gall No. 15 by *Eriophyes cheriani* Massee (?) on leaf

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2): 100.

Regular, epiphyllous, unilocular, clavate, somewhat lop-sided beutelgalls, Similar to Gall No. 17 on leaf of *Pongamia glabra* Vent, *{vide infra),* but smaller and pale yellow-green; with ostiole hypophyllous; gall cavity with simple unilocular, cylindrical, curled and sstaight hairs; pointed mostly downward.

Distiibution.—Scarce on themaidan in Calcutta.

Gall No. 345 by *Eriophyes* sp. on leaf

New gall. Irregular, epiphyllous, circular, hard, pustute-like evaginated beutelgalls, with spacious wide-open hypophyllous cavity; brown or reddish, smooth; cavity (fig. 33) with dense, rugulose, rusty-brown, short, irregular, fleshy, emergences. Size of gall variable from 5 to 20 mm in diameter. Sometimes the gall is merely a swollen patch of hypophyllous emergences, hardly invaginatcd and with but slight discolourisation above. No differentiation two of palisade; considerable increase in number of simple closely packed moderately large parenchyma cells. 2-3 galls generally develop on each leaflet.

Dislribu tion. —Agra.

Desmodium biarticulatum Benth.

Gall No. 199 by *Asphondylia* sp. on flower

Mani, M. S. 1935. *Rec. Indian Mm.,* 37:446-447; 1948. *J.Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):137.

Regular, simple, subglobose, sometimes pyriform, solid, fleshy, indebiscent, deciduous galls, nenrly 3-5 mm in diameter and enclosed in the somewhat inflated calyx, with corolla and stamens wholly swollen and undifferentiated, with a single larva or pupa in the gall.

Distribution—Coromandal Coast.

Gall No. 663 by unknown midge on stem

Mani, M. S. 1948 *J. Roy Asiatic Soc. Bengal,* (Sci. 14 (2) 137 No. 199a

Regular, oval or fusiform, local or subextensive, solid, hard, woody, indehiscent, persistent swellings of tender branches, about 10-15 mm long and 5 mm thick.

Distribution.—Coromandal Coast.

Desmodium pulcbellum Benth.

Gall No. 159 by unknown Lepidoptera on stem

Dw. van Leeuwcn-Reijnvaan, W. & J. 1909. *Marcellia* 8:94, No. 35, Houard, G. 1922. Lcs Zoocccidies des Plantcs d'Afrique, d' Asie et d* Oceanie 1391, No- .1432. Drs. van Lceuwen-Rcijnvaan, W. & J. 1926. Zoocecidia **of** Netherlands **East** Indies, p. 237, No. 550,fig. 381. Mani, M. S. 1948. *J.Roy. Asiatic Soc. Bengal,* (Sci.) 14(2) : 130.

Irregular cortical swellings of branches about 5-8 mm thick, witn spiral larval gallery, a narrow tube situated wholly in the cortex and just outside the stelle, which is not altered by gall formation.

Distribution.—South India and Java.

Desmodium sp. (?)

Gall No. 488 by unknown weevil on branch

Mani, M. S. 1954. *Agra Univ. J. Res. (Sci.)* 3:29.

Regular local, diffuse, fusiform or oval, indehiscent, persistent, solid, smooth, coi tical tumescence of branches, about 10-20 mm long and 5 mm thick, with one large, cylindrical, oblique larval cavity, containing a single prepua of the weevil. •

Distribution.—Dhauladhar Himalaya near Kangra

Gall No. 341 by *Heterodera marioni* on root ,

Barber, G. A.. 1901. *Bull. Dept. LandRec. Argic. Madras Agric. Branch,* 2 (45) 229.

Houard,C. 1922. Les, Zoocecidies dcs Plantes d'Afrique, d'Asie et d'Oceane, 391, No. 1434.

Mani, M. S. 1948, *J. Roy Asiatic Soc. Bengal, {Sci.)* 95.

Characteristically ii regular root nodositries. South India.

Gall No. 385 by unknown Lepidoptera on stem

Nayar, K. K. 1948. *J. Bombay nal. Hist. Soc* , 17 (4) : 673.

Regular, subglobose, or oval, indehiscent, smooth, succulent, green, unilpcular swellings of branches, 4-16 mm long and 4-10 mm thick, somewhat rugose when old.

Distribution.—Gape Coomarin '

Dichrostachys cinerea. W. & A.

Gall No. 16 by *Eriophyes dichrostachia* Tuck, on leaf

PL XXIII

Tucker, 1931. *Ent.Mem. Dept. Agric. Pretoria,* 5 : 8.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci) 13(2) : 68, 100, fig. J.

Regular, lenticular, often globose, smooth or finely tubercular, yellowish, pinkish, violet or reddish-brown, almost solid, unilocular, spongy, solitary or agglomerated, local, basal or apical swellings, 2 or 3 between the two adjacent leaflets on the same side of the pinna, binding the affected leaflets together. Galls entirely parenchymatous, with the veins of the leaflets completely disorganised.

The crowding of hundreds of these minute conspicuously coloured galls, gives a characteristic appearance to the tree.

Distribution.—Widely distributed in South, Central & Western India.

Gall No. 210 by *Asphondylia utriculae* Mani on ovary

Mani, M.S. 1934 *Rec. Indian Mus.,* 36 : 410-411, pi. vii, fig. 3; J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 139, 1948.

Regular, globose or pyriform, sessile or subsessile, utricular, hollow, indehiscent, deciduous, free swellings of the ovary, crowded in large numbers apically on the inflorescence axis; green, villous, with the calyx expanded into a basal cup; the style projecting terminally like an awn; the wall coriaceous and moderately thick, size nearly 5-10 mm long and 3-5 mm thick. Each gall contains a single larva. Larval period probably 15-20 days. Pupation in gall; pupal period 5-6 days. Braconid parasites frequent.

Distribution.—Coromandal Coast.

Dolichos lablab Linn.

Gall No. 134 by *Sagra nigrita* Oliv. on stem

Fletcher, T. B. 1919. *Bull. Agric. Res. Inst. Pusa,* 81 : 81-22, fig. 12. Sorauer. Handuch der Pflanzenkrankheiten 4te Auflagc, 5 (2) : 180.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 85-86, 126.

Diffuse, fusiform, sometimes unilateral, solid, hard, rough, greenish-brown, longitudinally striated, acystiferous, indehiscent, persistent, stem tumescence about 25-30 mm long and 10 mm thick; medulla more or less completely, destroyed, cortex the seat of cell proliferation, vascular bundles rather in an irregular ring. Epidermis more or less normal.

Distribution.—Ceylon, South India and Poona.

Gall No. 135 by *Alcidodes collaris* Pascoe on stem

Fletcher, T. B. 1914. Some South Indian Insects, Madras, p. 337. Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 86, 127.

Irregular tumescence of root and cauline stem.

The adult weevil scoops out a small hole in the plant by means of its sndut, deposits an egg in it and covers up the aperture with pieces of bark. The larvae bore up or down the cortex of the stem and cause irregular nodular swellings. Pupation in gall; pupal period 7-9 days. The adult on emerging remains within the gall for 2-3 days before biting their way out. At Tanjore (South India) the whole life cycle occupies about 35 days. Braconid parasites common.

***Distribution.*—South India.**

Gall No. 136 by *Desmidophorus* sp. (?) on stem

Ramkrishnayyar, T. V. 1922. *Bull, agric. Res. Inst. Pusa.* 125:21. Mani, M. S. 1948, *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 87, 127.

Irregular, subglobose or globose, hard, indehiscent, multilocular galls, often growing to the size of (he closed fist of man.

***Distribution.*—South India.**

Gall No. 668 by *Alcidodes collaris* on stem

Fletcher, T. B. 1913. Some South Indian Insects, p. 337; *Rep. Proc. Uent. Meet. Pusa.* pp. 79-81 (1920).

Irregular stem tumescence occasionally found in South India.

Indigofera aspalathoides Vahl

Gall No. 200 by unknown midge on ovary

Mani, M. S. 1935. *Rec. Indian Mus.* 37:447, 1948. *J.Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 138.

Sausage-shaped, hollow utricular gall, similar to gall No. 210 on *Dichrostachys cinerea* described above, but somewhat smaller.

***Distribution.*—South India.**

Indigofern dosua Ham.

Gall No. 429 by an unknown midge on leaf

PI. XV

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 (1): 141-142, pi. ii, fig. 2; *ibid.* 3:30 (1954).

Regular, globose, solitary, fleshy, hollow, unilocular, indehiscent, pinkish-red, smooth, sparsely pubecent or moderately villous, sessile, thin-walled galls on rachis of leaves. The seat of gall formation is cortex. Gall cavity large, spherical, 3 mm in diameter. Larva single. Pupation in gall. Size of gall 5-7 mm in diameter.

Distribution.—Kumaon, Garhwal and Dhauladhar Himalaya.

Gall No. 430 by an unknown midge on bud

Mani,M. S, 1953. *Agra Univ. J. Res.* fSci), 2 (1) *;ibid.*, **142,** pi. ii, fig. 1.

Irregular, globose, or pyriform, solid, indehiscent, solitary, hard, woody or fleshy, brown, smooth or often tuberculate swellings of axillary buds and branches, about 5-7 mm in diameter. Larval canals numerous, irregular. Seat of cell proliferation medulla of the branch. On the gall are often found crowded stunted leafy processes.

Distribution.—Kumaon and Garhwal Himalaya.

Gall No. 431 by *Eriophyes indigoferae* Nalepa an leaflets

PI. XXXII

Nalepa, A. 1914. *Marcellia*, **13:14 j 1928; *& id.*, 25:102.** ManiM.S,, 1953. *Agra Univ. J. Res.* (Sci.) 2 (!) :140, fig. 2, pi. I, figs. 2-3; *ibid.,* 3 :30 (1954).

Epiphyllous, subglobose or irregular, solitary or agglomerate, smooth or irregularly lobed, finely pubescent, reddish-brown, indeluscent, hollow beutelgalls, with hypophyllous minute ostiole; about **1-2** mm in diameter; crowded in very large numbers on almost every leaflet, with the result that the leaf as whole is greatly deformed, curled or twisted.

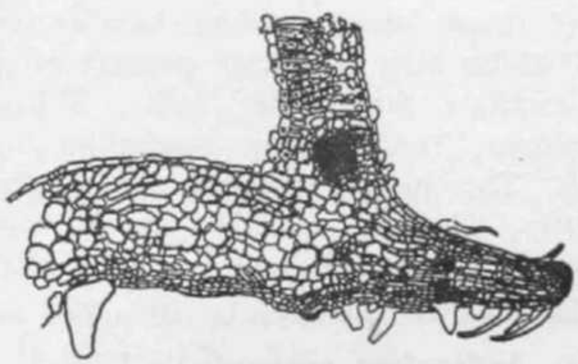


Fig. 34. Sagittal section through part of the gall near the osliolc of Gall No. 431 on leaflet of *Indigo/era dosuP* Ham. by *Eriophyes* sp.

Outer epidermis of gall of hypertrophied, giant, flattened, oblong cells, produced into long, unicellular, acutely pointed trichomes; continuous with the upper epidermis of the normal part of the leaflet. Beneath this lies the undiffcrentiated irregular parenchyma of giant cells. Chlorophyll present in the subepidermal cells. Gall cavity large, lined by irregular, greatly hypertrophied, undiffercntiated cells, often growing into the lumen as giant, blunt, unbranched, unicellular emergences, with giant, nuclei. Near the hypophyllous ostiole the **outer** epidermis of the gall is composed of dedififerentiated cells, loaded with stellate crystals; the cells in the rim of the ostiole developed into long, unicellular simple inwardly directed trichomes. Vascular bundles of the veins irregularly scattered in the gall parenchyma.

Distribution.—Kumaon, Garhwal and Punjab Himalaya.

Eriophyes indigoferae Nal. was previously known to give rise to clavate gall on leaflets of *Indigofera galegoides* DC. in Java (Drs. VLR. 1911. *Marcellia,* 10:78, 228, fig. 90} and also shorter galls on /. *suffruticosa* Mill in Java.

Gall No. 483 by *Oxasphondylia dosua* Mani on branch

Mani, M. S. 1954. *Agra Uuiv. J. Res.* (Sci.) 3:22-25, figs. 30.

Regular, simple, free, sessile or 2-3-agglomerate, hollow, indehiscent, persistent, unilocular, globose, or subcordate, greenish, almost glabrous, but often also with scaly tips of leafy vestiges, thin-walled branch galls, similar gall No. 429 on the *(vide supra)* same plant; single galls about 6-7 mm in diameter, agglomerate galls 7-10 mm in diameter; exit holes terminal and circular.

Distribution.—Dhauladhar Himalaya near Kangra.

Gall No. 484 by unknown midge on branch

Mani, M.S. 1954. *Agra Uhiv. J. Res.* (Sci.) 3:30, pi. vii.

Regular, subepidermal, oval, pyriform or oval, hollow, unilocular, sessile, cortical galls, initially wholly developing concealed underneath the bark from the cortical cells, with gall cavity oval, large, axial ; the wall of the gall fleshy, thick, green, parenchymatous, glabrous ; nearly 5 mm long and 3 mm in thickness. Very large numbers of these bodies develop close together and the branch becomes conspicuously swollen into a fusiform or elongate-globose swelling, bursting the bark in irregular patches above and at the sides due to the pressure of the galls developing beneath and exposing the nodular galls. This also permits the emergence of the midges. The galls thus develop on branches for nearly 150-200 mm length. The old galls generally persist after the bark has fallen off completely. This gall resembles in development gall No. 457 on *Indigofera pulchella* Roxb., described below but lacks trichomes.

Distribution.—Dhauladhar Himalaya.

Indigofera enneaphylla Linn

Gall No. 337 by *Eriophyes trichocnemum* Nal. on leaflets

PL VII

Nalepa, A. 1914. *Marcellia,* 13:75; 1928. *Ibid.,* 25:102
(ex *Indigofera trifoliata* DC.) Drs. van Leeuwen-Reijnvaan, 1911. *Marcellia,* 10:79, No. 229 (Semarang: ex /. *trifoliata).*

The leaflet is rolled up longitudinally from either side of the midrib and the whole somewhat curved downward.

Irregujar, epiphyllous, swollen, pod-like, elongate, densely white-hairy, leaf-roll gall, with the margins of the leaflets rolled upwards towards the midrib and somewhat curved downward. Dense, Silvery-white bairs both on the outside and inside of the gall. Nearly every leaflet of allmost all leaves of a plant galled. The galled leaflet is also greatly elongated and enlarged.

***Distribution.*—Agra**

A similar gall is formed by the same mite on *Indigofera trifoliata* DC. in Semarang.

Indigofera gerardiana Wall.

Gall No. 486 by *Oxasphondylia echinata* Mani on axillary bud

PL XX

Mani, M. S. 1954. *Agra Univ.J. Res. (Set.) 3 (I)* : 20, 31, pi. vii, figs. 5.

Regular, free, sessile, simple 2-3-agglomerate, indehiscent, persistent, globose, thick-walled, uniloculer, fleshy galls on axillary buds, about 15-20 mm in diameter, pale green to greenish white or also sometimes cottony-white: covered by dense, elongate, slender, fleshy, cylindrical or somewhat flattened pubescent, scaly or leafy vestiges and outgrowths and also with dense white, simple villous hairs, giving a curious appearance of the bedegaur on rose. Gall cavity central, globose, with a single larva or pupa of the gall midge. The emergence hole covered by thin scaly skin that is pushed off by the adult fly. The gall is extremely abundant and single branch often bears as many 50 galls. The wall of the gall is composed oF large, simple, close parenchyma cells, with vascular elements scattered irregularly. The larval cavity is surrounded by a thin zone of thick-walled mechanical cells.

Distribution.— Dhauladhar Himalaya (Punjab).

Gall No. 487 by an an unknown midge on inflorescence axis

PI. XX

Mani, M. S. 1954. *Agra Univ. J. Res. (Sci.)* 3 *(I)* : 32.

Regular, elongate-oval or fusiform, hollow, simple, indehiscent, petiolate, persistent, utricular, thin-walled, unilocular galls on the main inflorescence axis, which becomes stunted. Each gall bears externally a number of elongate, thin, needle-shaped, yellowish-green outgrowths. Gall cavity with a single pupa of the midge, Emergence hole apical. Each gall measures about 8 mm long and 4 mm thick.

Distribution.—Dhauladhar Himalaya (Punjab).

Gall No. 490 by *Oxasphondylia floricola* Mani on flower

PI. XX

Mani, M. S. 1954. *Agra Univ. J. Res. {Sci.),* 3 (1) : 25-27, 32, pi. vii, figs.

Regular, simple, free, solitary, petiolate, cordate to subglobose, solid, indehiscent fleshy, smooth or finely pubescent, pale red to yellowish-green or also white swellings of flowers, about 10-12 mm in diameter, formed of the greatly deformed, swollen and unopened calyx, corolla, stamens and pistils. The patals represented by scaly envelopes on the apically surface. Numerous larvae of the midge in galleries in between the fused floral leaves, which are wholly parenchymatous and are also covered by fine short dense, white pubescence. The galls are extremely abundant and widely distributed.

Distribution.—Dhauladhar Himalaya (Punjab).

Gall No. 491 by *Eriophyes {indigoferae* Nalepa. ?) on leaflet

Mani, M. S. 1954. *Agra Univ.J. Res. {Sci.)* 3 (1) : 32.

Epiphyllous, subglobose beutelgalls on leaflets, similar to gall No. 431 on *Indigofera dosua* and rather scarce during May-June in Dharmsala and Dalhousie.

Gall No. 503 by unknow midge on rachis

Mani, M. 1954. ***Agra*** *Univ. J. Res. (Sei.),* 3 (1) : 32, pi. **vii.**

Globose, hollow, thin-walled, green or pinkish-red, indehiscent, often agglomerate galls on leaf rachides, similar to gall No.429 on *Indigo/era dosua,* and measuring about 6-10 mm in diameter, with a single pupa. Surface smooth.

Indigofera linifolia

Gall No. 669 by *Anataractis plumigera* on stem

Fletcher, 1920. *Repts. Proc. II ent Meet. Pusa,* p. 81.

Hollow indehiscent stem galls collected by Fletcher at Pusa.

Indigofera pulchella Roxb.

Gall No. 457 by an unknown midge on branches

PL XIII

Mani, M. S. 1953. *Agra Univ. J. Res. {Sci.)* 2 (2) : 142, **pi.** i. fig. 5.

Regular, subglobose, but usually extensive, densely deep-reddish or rusty-red, hair-like, fleshy, elongate, straight, simple, multicellular emergences from central core of spongy, solid, parenchymatous swollen mass, enclosing 1-2 larval cavities, which are indehiscent. The trichomes arise from subepidermal cortical cells and burst through the bark, which is then cracked and peeled off, exposing the persistent fluffy growth. Pupation in gall.

Distribution.—Chakrata-Mussurie, Mt. Abu.

Gall No. 513 by unknown midge on bud

PL XVI

New gall, Irregular, subglobose, oval, pyriform, lobed, solid, hard, woody, green, indehiscent, persistent, swelling of entire axillary or terminal buds, moderately densely clothed with short, soft silvery-white pubescence, especially in patches apically; often also bearing vestiges of the swollen, greatly expanded bases of leaves and stumps of branches; surface irregular but neither rugose or tubercled. Larval cavities irregular, elongate, compressed, 4-5 crowded axially in each gall and' surrounded by thick nutritive zone, outside of which is sclerenchyma. Size of galls (immature when collected) 20-25 mm in diameter.

Distribution.—Garhwal-Chakrata-Mussurie Himalaya.

Gall No. 517 by unknown midge on bud

New gall. Compare No. 430 on *Indigofera dasua* described above.

Distribution.—Ghakrata Range; Himalaya.

Medicago sativa Linn.

Gall No. 340 by *Heterodera marioni* on roots

Man^M. S. **1948.** ***J. R.*** *Asiatic Soc. Bengal, (Sci.),* **13** (2) : **95.**

Root nodosities. Sparsely found in Bengal.

Phaseolus radiatus Linn.

Gall No. 665 by *Alcidodes collaris* Pascoe on stem

Fletcher, T. B. 1913. *Some South Indian Ins.* **p.** 337.

Irregular nodular swellings of branches in South India.

Phaseolus sp.

Gall No. 386 by Agromyzid fly (*?)* on stem

Nayar, K. K. 1948. J *Bombay Nat. Hist. So.,* 47 (4}:673.

Fusiform swellings of branches, nearly 5-7 mm long and 1-2 mm thick, with axial larval gallery.

Distribution.—Travancore.

Pongamia glabra Vent.

Gall No. **17** by *Eriophyes cheriant* Massee on **leaf**

Pl. XXIII

Kieffer, J. J. 1908 *Marcetya,* 8:167, pi. iii, fig. 16-17. (under ihe vernacular name of the plant 'Karanch').

Drs. van Lccuwcn-Rcijnvaan, W. & J. 1911. *Marcellia,* 10:84, No. 239, fig. 97; 1916, *Bull, Jardin bot. Buintenzorg,* (2) 21:17-18, No. 44, fig. 44; 1916. ***ibid.,*** p. 41.,No. 56, fig. 56.

Houard, C. 1922-23. Les Zooceeidics des Planies d'Afiique, d'Asic el d'Oceanic, 1:394, No. 1444; 2:907, No. 3203.

Sundar Raman, A. H. 1924. *J. Indian bot, Soc.,* 4:8.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. Zoocecidia of Netherlands East Indies, p. 248, No. 585, fig. 410

Massee, A. H. 1933. *Ann. Mag. Nat. Hiit.,* (10) 11 =201-203, pi. L

Mani, M. S. 1933. *Proc. Asiatic Soc. Bengal,* March 6th Monday, p. 3.

Mani, M. S, 1934. *Rec. Indian Mus.,* 36:425.

, Sakscna, R. D. 1942. *J. R. Asiatic Sot. Bengal,* (Sci.), 8:78, figs. 1—2.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.), 14 (2);62, 100-101, fig. 1, A.

Regular, epiphyllous, rarely hypophyllous, cylindrical, clavately-cylindrical, obliquely obpyriform, unilocular, hard, pedicellate, indehiscent

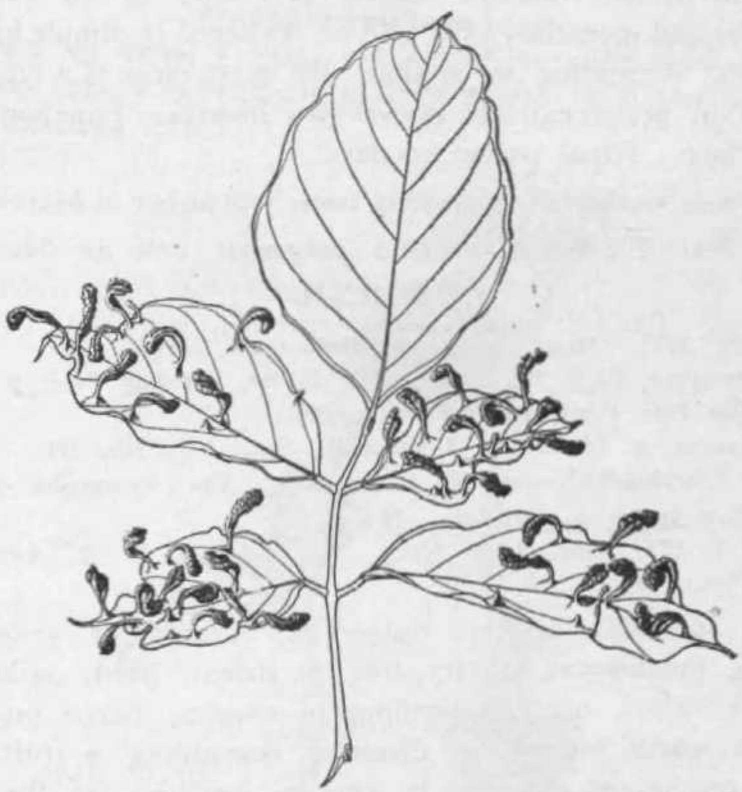


Fig. 35. Gall No. 17 on leaf of *Pongamia glabra* Vent, by *Enophyes ckeriani* Maasce.

cephalonean beutclgalls, more or less pronouncedly lop-sided, simple, rarely aggtomerate, glabrous, green, rarely pubescent or tomentose; nearly 10 mm high, 1-2 mm thick at base and 5 mm thick apically; ostiole minute, hypophyllous; cavity large, with irregular fleshy emergences, bearing long, stright cylindrical, simple, unicellular, pointed and downwardly directed hairs. The walls of simple, closely packed parenchyma. On some plants entire leaves are turned into dense clusters of pubescent and brown galls, without any free leaf blade.

Distribution.—Extremely widely distributed in India, but more abundant along the sea coast. It also extends to Java, Sumatra, Sebesi, Salajar, Celebes. The midge *Microdiplosis pongamiae* Mani is predaceous and the chalcid *Tetrastichus* sp. parasitic on the mites in South India. The gall is specially abundant in the summer months.

Gall No. 201 by *Myricomyia pongamiae* Mani on stem and leaf

Mani, M. S. 1934. *Rec. Indian Mus.,* 36:420-422, fig. 18; 1948. *J. R. Asiatic Soc. Bengal,* (Sci.), I4(2):93, 138.

Saksena, R. D. 1912. *J. R. Asiatic Soc. Bengal,* (Sci.), 8:16, pi. i, fig. 3.

Irregular, local or extensive swellings of terminal branches, petioles or midribs; globose, pyriform or fusiform moniliform, smooth, greenish-yelJow; glabrous or tubercled and rugulose. solid, indehiscent, persistent, hard, woody; agglomerate galls, varying in diameter from 10 to 20 mm. Frequently the petiole, midrib and larger lateral veins are continuously galled. Larval cavities numerous, irregularly linear, with sclerenchyma; there is complete disintegration of tissues; vascular bundles separated by cell proliferation in cortex, medulla and medullary rays and lie scattered in simple hypertrophied parenchyma and presenting in sections the appearance of a typical monocot stem. The larval period extends to over two months. Pupation in gall, first beneath the surface. Pupal period 4-5 days.

Distribution.—South India; common from September to March.

Gall No. 202 by *Asphondylia pongamiat* Felt on flowers

PI. XXII

Felt, E. P. 1921. *Mem. Deptt.Agric. India (ent.)*, 7:24.

Remakrishnayyar, T. V. 1922. *Rep. Proc. IV ent., Meeting Pusa,* p. 37, fig; 1924. *Rep. Proc. V ent Meeting Pusa,* p. 266.

Sundar Raman, A. H. 1924. *J. Indian hot. Soc.,* 4:38, No. 60.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 248, No. 584.

Mani, M. S. 1934. *Rec. Indian Mus.*, 36 (4) : 415; *J. R. Asiatic Soc Bengal* (Sci.), 14 (2) :92, 138.

Regular, spherical, hollow, dull-white, brown or yellowish-brown, corky, smdbth, indehiscent, solitary, free, persistent, hard, unilocular, rarely bilocular, thick-walled, nut-like swellings of ovaries, borne on the pedicels of the flowers; about 5-8 mm in diameter, resembling a fruit and formed in thousands on almost all trees in certain localities, so that it is frequently not possible to find many specimens of the normal flat, elongate, leathery legumes of this tree. Young galls somewhat compressed, greenish, with vestiges of style or of the enlarged and fused bases of the petals. The sepals enlarge, swell and persist, fused at base of the gall. Gall cavity large, irregular, with rugose suiface.

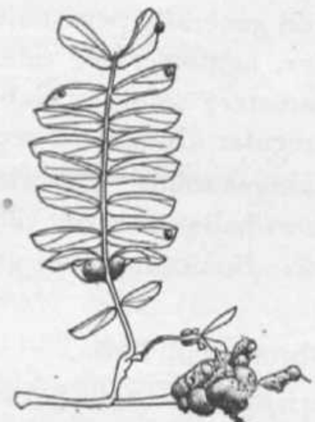


Fig. 36. Gall No. 18 on leaflets of *Prosopis juliflora* Ljnn. by *Eriopkyes prosopidis* Saksena.

Distribution.—Widely distributed in India, Java and Salajar.

Gall No. 411 by unknown Agromyzid on stem

. New gall. Regular, diffuse, localised fusiform, solid, persistent, indehiscent, hard, woody swellings of branches, nearly 10 mm long and 5 mm thick, with 4-5 oval larval cavities in the medulla of the affected stem.

Distribution.—Coimbatore, South India.

Prosopis juliflora Linn.

Gall No. 18 by *Eriophyes prosopidis* Saksena on leaflets

Saksena, R.D. 1942. *Indian j.Enl.* (4) 2:215. Man!. M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sri.) H(2) : 65,101, fig. K, 15.

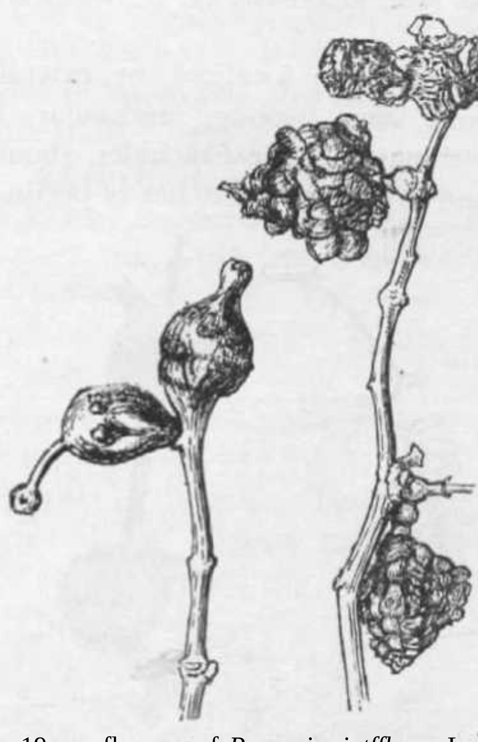


Fig- 37. Gall No, 19 on flowers of *Prosopis jutfflera* Lrnn. by *Eriophyex prosopidis* Saksena.

PI, XXIII & XXIX

Regular, globose, (fig. 36) free, solitary, sessile, solid, hard unilocular, epi- or hypophyllous, indehiscent and generally persistent beutelgalls, about 2-5 mm in diameter or greatly irregular, agglomerate, tubercled, multilocular masses, often reaching to 10 mm diameter; smooth, glabrous, bright yellow. Gall cavity nearly obliterated by irregular, thick hard septa and emergences growing from the wall and older galls almost solid. The whole mass of the gall is made of parenchyma cells. Fine short hairs grow out of the emergences and septa. Ostiole minute, above or below. Sometimes the galls from on the secondary leaf rachides also.

Distribution,—Common throughout India.

Gall No. 19 by *Eriophyes prosopidis* Saksena on flowers

PL XXIX

Mani, M. S. 1958. *J. R. AsiaticSoc. Bengal,* (Sci.), 14 (2) :!01, figs.. 67,68.

Irregularly oval, pyriform or globose, lobed or branched, agglomerate, solid, hard, enormously swollen masses of single flowers or of entire inflorescences, varying in size from 5-30 mm diameter (fig. 37); yellow or reddish-brown, smooth. When young with irregular cavities, which soon become nearly obliterated by ingrowths of emergences and irregular septa from the wall. All the parts of the affected flowers wholly disorganised and fused up.

Distribution.—Western Uttar Pradesh, Delhi, Rajasthan and parts of the Punjab,

Gall No. 211 by *Lobopteromyia prosopidis* Mani on leaf

Mani, M. S. 1938. *Rec. Indian Mas.,* 49:334-336, fig. 2; 1941. *J. R. Asiatic Soe. Bengal* (Sci.) 14 (2) :92, 139.

Regular, fusiform or globose, localised or extensive and moniliform, solid, indehiscent, persistent, hard, woody, unilocular, brownish, often agglomerate, multilocular swellings of the leaf-rachides, about 5-8 mm in diameter, with circular exit holes and brown scaly patches of peeling bark when mature;

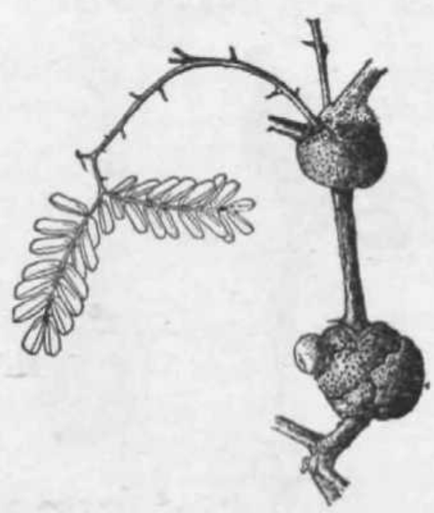


Fig. 38. Gall No. 274 on stem of *Prosopii j«lij!ora* Linn, by Chalcid.

forming in large numbers daring the rains and maturing immediately afterwards, the galls appear about June and the adult midges emerge about August-September. Each gall may have 1-2 midge larvae.

Distribution.—Common all over India.

Gall No. 274 by nnknown Chalcid on stem

PI. XI

Mani, M.S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 154-155, fig. 19.

Regular, globose (fig. 3°8), often irregularly globose and agglomerated, solid, hard, woody, brown, smooth swellings of branches, varying from 25-75 mm in diameter; with 200-500 small, oval, closely-set, peripheral larval chambers imbedded in the woody core and opening when mature just beneath the bark. The adults remain imprisoned in the cavities for a time, but soon the bark cracks irregularly and peels off in patches, exposing the exit holes and thus permits also the escape of the metallic green adults. Old galls persist for several years and show numerous close circular or oval exit holes. The gall chalcid is itself parasitized by another chalcid *Eurytoma* sp.

Distribution.—Common in many parts of North India during the summer and trains.

Prosopis spicigera Linn.

Gall No. 212 by *Lobopteromyia prosopidis* Mani on leaf

Mani, M. S. 1935. *Rec. Indian Mus.,* 33:449; 1948. *J.R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 139.

Similar to gall No. 211 by *L. prosopidis* Mani on *Prosopis juliflora* described above.

Distribution.—South India.

Gall No. 664 by *Eriophyes prosopidis* Saksena on leaflets

Mani, M. S. 1935. *Rec. Indian Mus.,* 33:449.

Similar to gall No. 18 by *E. prosopidis* Saks, on leaflets of *P. juliflora.*

Distribution—South India.

Rhynchosia minima Dc.

Gall No. 333 by *Pachyonyx menoni* M. Bose on stem

Bosc, M. 1946. *Indian J. Ent.*9 7 (1-2) : 85-88 figs. 1-6.

Regular, oval or fusiform, hollow, unilocular, indehiscent, presistent, soft, smooth swellings of the tender branches, 8 mm long and 4 mm thick, with a single larva in each; solitary, free, never crowded or agglomerate. Pupation in gall. Pupal period about a week. Adult on emerging bites irs way out of the central larval cavity by means of a large, nearly circular aperture on the terminal part of the gall. Total life-cycle occupies nearly one month. Two annual generations. Mature galls in field at Delhi during May-June. The larva is parasitised by the Braconid *Gastrotheca* sp. A chalcidoid hyperparasite has also been rared from the gall.

Distribution.—Western Uttar Pradesh and Delhi

Sesbania aculeata Poir.

Gall No. 139 by *Alcidodes bubo* (Fabr.) on stem

Fletcher, T. **B.** 1913. Some South **Indian Insects, pp.** 337—338, fig. 196.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.), 14 (2) 86, 127.

Irregularly globose, fusiform or moniliform nodosities of branches, especially near the base, often unilateral and rugose, rough, solid, hard, woody, hollow, indehiscent and of variable size.

Distribution.—Common in several parts of South India.

Sesbania aegyptiaca Pers.

Gall No. 137 by *Alcidodes bubo* (Fabr.) on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) '14 (2):86, 127.

Irregularly globose, fusiform or moniliform, often unilateral, solid, hard, woody, indehiscent swellings basally on stems, of variable size. The adult female weevil scoops out by its snout a small cavity under the bark, lays an egg and covers up the spot with chewed up pieces of vegetable matter. The number of eggs laid by each female varies from 40-85 and the young larvae hatch in about 5 days. Larvae burrow inside the medulla; larval period extends up to 6-7 weeks in South India.

Distribution.—Common in several parts of South India.

Sesbania grandiflora Pers.

Gall No. 138 by *Alsidodes bubo* (Fabr.) on stem

Ramakrishna, 1922. *Bull. Agic. Res. lnst. Pusa,* 125:14-15, pi. xii, xiii, fig. 1; 16.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):86, 127.

Compare gall No. 137 and 139 described above. Galls on older part not so conspicuous as those forming on the relatively younger ones.

Distribution.—Common in several parts of South India.

Tephrosia Candida

Gall No. 301 by *Asphondilia tephrosiae* Mani on flowers

Mani, M. S, **1943.** *IndianJ. Ent., 5:152,* figs; 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2)02, 152.

Barnes, H. F. 1949. Gall midges of Economic Importance, 6:135.

Irregular utricular, hollow, inflated pyriform or oval, coriaceous, indehiscent, deciduous, free, green or pale-green, glabrous, unilocular, thin-walled galls developing from the ovary, nearly 8 mm long and 4 mm thick, without trace of the ovules, but with persistent vestiges of the atrophied style and usually also of the calyx; single larva in each gall. Pupation in the gall. Adults emerge about September-November

Distribution.—Common in several parts of North India during the rains.

Gall No. 670 by *Stictodiplosis tephrosiae* Mani on flowers

Mani, M. S. 1943. *Indian* J. *Ent.,* 5:157—159.

Barnes, H. F. 1949. Gall midges of Economic Importance, p. 135.

Irregular flower bud galls, with the petals crumpled and somewhat swollen, the flower failling to open, but falling off prematurely; 3-4 larvae in each galled flower; pupation in soil. Pupal period 5 days.

Distribution.—Common in several parts of North India during September-October.

Tephrosia hirta Ham.

Gall No. 161 by unknown Lepidoptera on stem

Mani, M. S. 1948. J. *Roy. Asiatic* **See.** *Bfttgal* (Sci.) 14 **(2):131.**

Compare with gall No. 160 on *T. purpurea* by *Dactylethra Candida,* described below.

Distribution. —Coromandal Coast.

Tephrosia purpurea Pers.

Gall No. 102 by *dleitromirginalus tephrosiae* Corbet on leaf

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* **(ScL)** 14 (2) :121.

Regular, epiphyllous, smooth, yellow or yellowish-green, hemispherical beutelgalls, with wide open cavity below, in which lies the larva of aleuroidid. Tissue differentiation absent.

Distribution.—Common in most parts of India during November-December.

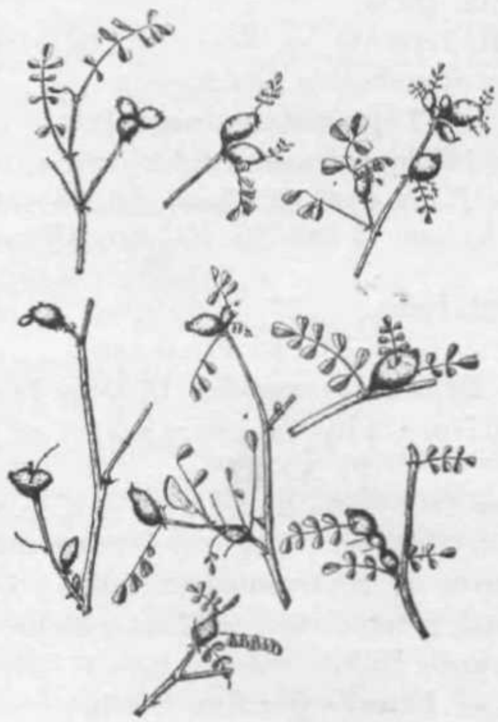


Fig. 39. Gall No. 160 on stem of *Tephmia purpnna* p<;rs. by *DactyUtkra Candida* (Staint.)

Gall No. 160 by *Daclylethra Candida* (Staint.) on stem

PI. XXX

Slainton, 1859. *Trans.cut. Soc. London* (NS), 5:114—115.

Meycrick, 1913. *J. Bombay nat. Hist. Soc,* 22:167.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* {Sci.) 14(2): 89, 130—131, fig.ll,

Regular, oval, pyriform, fusiform, or flask-shaped, hollow, greenish, villous or glabrous, hard, thick-walled, terminal, subterminal, indehiscent, nodal, persistent swellings often of an entire branch, sometimes several beaded together one above the other in regular rows or occasionally one rising on another laterally; but never agglomerate, with persistent slumps of vetigal 'eaves and branches on the surface; about 20 mm long and 8 mm in diameter; larval cavity large, oval, with callus tissue formation; medulla completely destoryed, cortex and medullary rays undergoing cell proliferation; epidermis of somewhat relatively larger cells; regular, circular exit holes made by the larva just before pupation, usually at a somewhat minute globose apex, occasionally lateral, nearly 1 mm in diameter. Gallfauna: parasites, spiders pseudoscorpions, ants and small beetles. Extremely common at Tanjore from May to December and also throughout South India.

The eggs are deposited about July in the tender parts of branches and the larvae hatch in about 3 days. Larval period extends to about 25 days. Pupation in galls and occupies 14-16 days. A single larva in each gall. Gall cavity contnins faecal pellets. The larva is parasitzed by *Eurytoma* sp., *Elasmus* sp., *Brachymeria* sp. and by *Microbracon incarnatus* Ramakr[21]. In addition to the parasites, the persistent old gall after escape of gall-maker is inhabited by small spiders, pseudoscorpions, ants and by small beetles.

Distribution.—South India.

Compare gall on *Tephrosia* sp. described by Houard[22] from Senegal-Nigeria as produced by an unknown Lepidoptera.

Tephrosia spinosa Pers.

Gall No. 162 by unknown Lepidoptera on stem

Mani, M. S. 1948. *J. Roy. Asiatic. Soc. Bengal,* (Sci.) 14 (2):131.

Stem swellings similar to gall No. 160 on *Tephrosia pur purea* described above.

Distribution.— South India.

Natural Order ROSACEAE

Prunus cerasoides D. Don.

Gall No. 422 by *Schizoneura* sp. (?) on leaf

PL XXXI

Mani, M. S. 1953. *Agra Univ. J. Res. (Sci.),* 2 : 143, pi. ii, fig. 3.

Irregular, extensive, crinkling, crumpling, twisting and swelling of the entire leaf, often of several leaves of the terminal or axillary buds, to give rise to a yellow or violet coloured, tuberculated, lobulated, fleshy, hollow mass.

Distribution.—Mussurie Hills.

Prunus ptersica Benth.

Gall No. 471 by Aphid on leaf

New gall. Irregular, epiphyllous or hypophyllous, reddish-brown, rugose, rough, open beutelgalls, localised or often also extensive, with an entire leaf-blade converted into the gall.

Distribution.—Nilgiris.

Pyrus communis Linn.

^ Gall No. 108 by *Toxoptero punjabipyri* Das on leaf

Das, B. 1918. *Mem. Indian Mus.,* 6 198.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal,* (Sci.), 14 (2) : 82- 122.

Regular pod-shaped, hollow, utricular leaf galls, open at ends and fused leaf blade margins; oviposition in February, followed by apterous female

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[21] **Ramakrishna Ayyar, T. V. 1928. *Mem. Dept.Agric. India (ent.),* 10 (3):48.**

2» **Houardo, 1913. *Mar cell ia,* 12:86-87, No. 16, fig 37-40; 1922. Lcs Zoocecidics dcs Plantcs d'Afrique, d'Asic ct d'Oceanie, 1:384, No. 1403,fig. 849-851.**

generations in March-April. Last female generation in May alate, not breeding on this plant. Early December the migrants of large females reappear on pear or plum to develop into oviparous females. Old galls inhabited by spiders.

Distribution.—Punjab.

Pyrus malus Linn

Gall No. 109 by *Eriosoma lanigera* Hausm. on roots

Fletcher, T. B. 1914. *Some South Indian Insects,* p. 500: fig. 382.

Börner & Schilder in Sorauer's Handbuch der Pflanzenkrankheiten, 5: (2) 663-669. (1931).

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 84, 122-

Irregular, solid root and cauline branch nodosities

Distribution.—Nilgiris, Kashmir, Punjab.

Gall No. 130 by *Alcidodes mali* Marshall on stem

Marshall, G. A. K. 1919. *Bull. ent. Res.* 9 (4) : 276-277, fig. 2.

Fletcher, T. B. 1919. *Ann. Rep. Imp. Ent.,* p. 92.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 87, 126.

The adult weevil is reported to scoop a small cavity in tender branches and deposit eggs. The larvae on hatching bore into the shoot and give rise to galls, which are not however described.

Distribution.—Shillong (Assam).

Pyrus pashia Ham.

Gall No. 113 by unknown midge (?) on leaf

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 85. 123, fig. 39.

Regular, epiphyllous, cylindrical, hollow, unilocular, dehiscent, persistent beutelgalls; 10-15 galls arranged on the circumference of circle or in irregular series on sides of mid rib; bursting apically when mature into out-spreading corona surounding ostiole and resembling very much a miniature sea-anemone; 3 mm long and 1 mm thick; hypohyllous subglobose or lenticular swelling; the circle of galls rising from a conspicuous swelling of the leafblade; gall cavity narrow, vertical, axial, cylindrical, smooth. In an earlier paper *(loc. cit.)* this gall was erroneously described as caused by the aphid *Moritziclia* sp, on leaf of *Careya* sp.

Distribution.—Kumaon Himalaya.

Gall No. 213 by unknown midge on stem.*

PL XXII

Mani, M. S. 1942. *Indian J. Ent.*, 4 (1): 47-48, fig. 16: 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 140.

Irregular, subglobose, rugose, tuberculate, rough, agglomerated, solid, woody, moderatley hard, multilocular, lateral, cortical, dark brown, indehiscent, persistent swellings of cortex of branches, about 15-25 mm in diameter; over a dozen galls agglomerate in series on a branch hardly 250 mm long; larval

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•In two earlier papers *(loc. cit.)* this gall was erroneously referred to under *Pyrus ffialus.*

cavities elongate-oval and irregularly scattered in the parenchyma of the galls; gall formation does not affect the stem of the branch, the entire gall originating from the superficial cortical cells.

Distribution.—Ramgarh : Kumaon Himalaya.

Rosa macrophylla Lindl.

Gall No. 497 by unknown cynipid on bud

PI. XXV

Mani, M.S. 1954. ***Agra Univ. J. Ris.,* *(Set.)*** **3 (1) ; 33, pi. viii.**

Nearly regular, free, axillary or terminal, subglobose, solid, hard, woody, indehiscent, peLsistent, greenish to deep pinkish, or pinkish-brown, smooth but with irregular, numerous fleshy spines, and leafy vestiges, with a large number of circular, small exit holes scattered irregularly on the surface of mature galls. The gall is formed on the entire axillary bud or terminal bud and measures from 15 to 35 mm in diameter when mature. Larvae numerous in small oval chambers scattered throughout the interior.

This gall greatly resembles the gall *Rhodites mayri* Schl. on *Rosa sicula* Trott. from Algeria (Houard, G. 1913. *Bull. Soc. Nat. Hist. Afric. No.,* 5 : 145 No. 37, fig. 13, 14; *ibid.,* 6 : 183, No. 25 (1914) ; Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1 : 320. No. 1164; fig. 665 667 (1922).

Distribution.—Dhauladhar and Pir Panjal Himalaya in Punjab and Kashmir,

Gall No. 499 by unkonwn cynipid on leaf

PI. XXV

Mani, M. S. 1954. ***Agra Univ. J. Res., {Sd.)*** **3(7) : 33- pi. viii.**

Regular, hypohyllous, simple, sessile, free, solitary, globose, smooth, yellowish or pinkish, solid, fleshy to hard, unilocular, indehiscent gall, about 5 mm in diameter, with a single larva of the cynipid, 3-4 galls on each leaflet. The thick wall of the is composed of simple, closely packed parenchyma cells.

Distribution.—Dhauladhar Himalaya in Punjab.

Gall No. 607 by unknown midge on leaf

PL XVI

New gall. Irregular, diffuse, oval, convex, pod-like, moderately stout folding of the leaf blade along the midrib, with the upper surface inside; 8 mm long and 3-4 mm thick; surface of the gall with irregular depressions or rugosities, tinged pinkish, the leaf blade at the galled part moderately swollen, Cavity large, with 1-2 larvae, open to the outside; there is no fusion of the two halves of* the blade and the margins of the affected leaf remain normal.

Distribution.—Great Himalaya : Upper Chenab Valley

Gal} No. 690 by *Phragmidium subcorticium* Schrk. on shoot

Irregular, extensive diffuse, sublcyindrical solid, indehiscent, hard swellings of the young shoot, with the surface coverd by the orange-red coloured spore masses of the fungus in the mature gall.

Distribution.—Upper Beas Valley (Kulu Valley). The gall is also widely known from Germany and other parts of Europe[23].

[23] Ross, H. und H. Hedicke. 1927. Die Pflanzcngallcn Mittel- und Nordeuropas, p. 248, No. 2300.

Rubus assamensis Focke

Gall No. 214 by *Schizomyia assamensis* Felt on leaf

Felt, E. P. 1920. *Mem. Dept. Agric. India (ent.),* 7:3-4.

Houard, O. 1922. Les Zoocecidies dcs Plantes d'Afrique, d'Asie et d'Oceanie, 1:316, No. 1144.

Sundar Raman. A. H. 1924. J. *Indian hot. Soc,* 4:37, No. 59.

Mani, M. S. 1934. *Rec Indian Mus.,* 36 (4) : 406.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 92, 140.

Regular, epiphyllousj subglobose, free, sessile, indehiscent, echinate galls, often greatly crowded togather. Not fully described.

Rubus micropetalus Gardn.

Gall No. 215 by unknown midge on leaf

Mani, M. S. J. *Roy. Asiatic Soc. BedgaL* (Sci.) 14 (2) : 140.

Regular, hypophyllous, globo e, tomentose, unilocular, yellowish-brown, operculate, thick-walled galls, 5 mm in diameter, with dense yellowish-brown operculum of tomentum on the lower side of the gall, i. e. on the upper surface of the leaf blade ; 1-2 or sometimes upto 15 galls on a single leaf.

Distribution.—Walayar Forests : South India.

Natural Order SAXIFRAGACEACE

Deutzia staminea R. Br.

Gall No. 496 by unknown midge on leaf

Mani. M. S. 1954. *Agra Univ. J. Res.* (Sci.), 3 (1) : 33-34.

Regular, simple, free, sometimes 2 galls agglomerate, mostly epiphyllous, circular, biconvex-discoid, reddish-brown, hollow, unilocular, thin-walled, indehiscent, utricular beutelgalls, partly visible on the lower side of the leaf blade also. The epiphyllous part of the gall thicker than the lower. Gall cavity large, with a single pupa of the gall midge or its parasite. Gall size varies from 3-4 mm in diameter to 2-3 mm height. The discolouration of the gall extends somewhat outside the limits of proliferated part right round in the neighbouring healthy leaf surface also.

Distribution.—Dhauladhar Himalaya, Punjab.

Natural Order COMBRETAGEAE

Anogeissus latifolia Wall.

Gall No. 320 by an unknown psyllid on leaf

Mani, M. S. 1953. *Agra Univ. J. Res. {Sci.)$_t$* 2(2):253.

Epiphyllous, regular, pyriform or globose, free, solitary, agglomerate, fleshy, thick-walled, yellowish-green or brown, glabrous beutelgalls, with minute hypophyllous ostiole on a small, subconical, fleshy prominance.

Distribution.—Jhabua, Central India.

Galycopteryx floribunda Lamarck

Gall No. 40 by *Austrothrips cochinchinensis* Karny on buds

PL XXVI

Salem, V. 1908. *Marcellia,* 7 : 105, Karny, 1923. *J. Siam Soc,* 21:113 Houard, G. 1923. Les Zoocecides des Plantes d'Afrique, d'Asie et d'Oceanie, 2:668-669, No. 2399. Ramachandra Rao, Y. 1924. *Agric. J. India,* 19 (4) : 435-437. Ramakrishna Ayyar, T. V.

1928. *Mem. Dept. Agric. India* (ent.) 10 (7):239,297, fig. 130. Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):69, 107, fig. 37. Ramachandra Rao, Y. 1924. *Agric.* J. *India*, 19(4):437.

Irregular, globose, greatly convoluted, lobed, verrucose-rugose, hollow, multiloculate, dehiscent, green, glabrous, or slightly pubescent, coricceous galls on axillary buds, 30-40 mm in diameter, with the wall 2-3 mm thick and without differentiation of tissue; the interior of the gall with numerous irregular folds and septa, tortuous labyrinthine inter-spaces; enormous numbers of the gall thrips, and other thrips viz. *Androthrips ramarkrishnae* Kary.. predatory mites, *Megastimus* sp., *Eurytoma* sp. and 2 other chalcid parasites occur within the complex galleries of the gall. Ramachandra Rao and Ramakrishna Ayyar collected the gall from the Western Ghats and the latter referred the gall thrips to *Austrothrips cochinenchinsis* Kary, which also produces galls on leaf of another plant *Hymenodictyon parviflorum* in Siam. In 1948 I erroneously suggested that this may be the same gall, (No. 676) which was described by Kieffer as produced by *Cecidothrips bursarm* on leaf of an unknown plant.

According to Ramachandra Rao *(loc. cit.)* the larva of an unidentified Pyralid moth feeds on the gall.

Distribution.—Western Ghats in South India.

Gall No. 346 by unknown midge on stem

New gall. Regular, hemispherical or lenticular, wholly cortical, soft, fleshy, solid, indehiscent, deciduous, sessile swellings on branches, with the bark cracking under pressure of growth and cell proliferation in the subepidermal cortex; with a single midge larva in a small larva chamber; size about 8 mm in diameter and 4 mm high; several galls arising like obscure blisters on branches.

Distribution.—Travancore.

Gall No. 675 by unknown midge on gall No. 40

Ramachandra Rao, Y. 1924. *Agric. J. India, 19 (4)-A37.* Mani, M.S. 1948. *J. R.* ***Asiatic Soc. Bengal,*** **(Sci.) 14(2): 141.**

Small blister galls were recorded by Ramachandra Rao as being produced on the gall No. 40 by *Cecidothrips bursarum* (= *Austrothrips cochinchinensis)* at Mangalore. The gall itself is not adequately described.

Terminalia arjuna W. & A

Gall No. 59 by *Megatrioza hirsuta* ? on leaf

Salem, V. 1908. *Marcellia,* 7:106. Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Aaie et d'Oceanie, 2:665, No. 2387. Sundar Raman, A. H. 1924. *J. Indian bot. Soc,* 4. Mani, M. S. 19*8. *J. R. Asiatic Soc. Bengal,* (Sci.) 14(2) :112.

Epiphyllous, regular, subsperical, sessile, dehiscent, deciduous, smooth, brown, unilocular, beutelgalls, with a hypophyllous crateriform large depression with raised margins and leading in the centre to the gall cavity, which is smooth and about 2 mm in diameter.

Distribution.—Throughout the plains of India.

Gall No. 60 by *Trioza fletcheri minor* Crawf.

Crawford, 1912. ***Res. Indian Mus., 7'AU.*** **Mathur, R. N. 1935.** ***Indian Forest Rec.*** (N. S.), 1(2):64. **Mani,** M. S. 19*8. *J. R. Asiatic Soc. Bengal,* (Sci.), **14(2):80.112.**

Mostly epiphyllous, rarely also hypophyllous, subglobose or lenticular, minute pustular, free, often agglomerate, pale yellow or brownUh, unilocular, smooth dehiscent and deciduous beulelgalls, about the size of a pea-seed, with slit-like hypophyllous ostiole covered by dense white pubeseence; a single leaf often bears about 500 galls.

This is a common gall found in may parts of India. In South India on the east coast oviposition occurs in February, end of May and again in September. Nearly 480 eggs are laid by each female. The eggs incubate for about 3 days and there are 5 nymphal moults. The galls mature in a little over one month. At Dehra Dun, Malhur *(loc. cit.)* observed over 500 eggs being deposited by a single female, and the incubation period extending upto 6 days. The galls require about 46 days during summer and 166-167 days during winter to mature. There are several overlapping generations.

Fig. **39. Gall No, 61** on **leaf** of *Terminalia calappa* by *Phyiioplecta hirsute.*

Other insects associated with this gall are Chalcid parasites *Tetrasiichus* sp., *Eurytoma* sp., *Pachynenron* sp. and *Bacca* sp. According to Mathur *(loc. cit.)* three mantids *Crcoboter urbana* (Fabr.), *Deiphobe* sp. and *Hierodula westwoodi* Kirby are predaceous on the Psyllid which produces this gall. «

Gall No. 275 by unknown Cynipid on fruit

Sundar Raman, A. H. 1924. *J.Indian bat Soe.*, 4:45, No. 97- Mani, M. S. 1948. *J- R, Asiatic Soc. Btngal* (Set), H(2):155.

Regular, subglobose or elongate-oval, truncated, solid galls on fruits, with apices truncate and hairy; 9-10 mm long 6-8 mm thick.

Described by Sundar Raman from specimens on Herb. Sheet No. 20993 in Botanic Carden, Calcutta, collected Gudalur, Cheybassa, Lakshmipuram (Vazagapatam Distt.J and Godaveri South India.

Terminalia catappa Linn.

Gall No. 41 by undescribed Thrips on leaf

Saksena, R. D. 1944. J. *R. Asiatic Soc. Bengal* (Sci.) 10:122-123, pi. i, fig. 5-

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14(2) :107, fig. 4.

Leaf margin roll gall. Margins rolled upwards (fig. 40) and reach nearly the midrib; irregularly crumpled, thickened, twisted, tuberculated, verrucose, parenchyma undifferentiated, veins and midribs often swollen due to hypertrophy of cortex. Stomata almost completely absent on the surface of the gall (which corresponds to the lower surface of a normal leaf); margins much more swollen the than the middle part of the blade, often fused with part of the upper surface of the latter and enolosing partially open cavities. Sometimes even regions of the blade far from the seat of attack exhibit lack of tissue differentiation and partial hypertrophy of the spongy parenchyma. In the young galled leaf the midrib is normal. The outer surface of the gall, corresponding to the spongy parenchyma side of the leaf, is characterised by the development of a few palisade cells. Gall cells nearly round and isodiametric. Epidermal cells rather large. Sometimes a row of subepidermal cells have considerably thick walls.

Distribution.—Western Uttar Pradesh and Delhi.

Gall No. 61 by *Phylloplecta hirsuta* (Crawf.) on leaf

Mani, M. S. 1949. *J. R. Asiatic Soc. Bengal,* (Sci.), 14 (2) : 112.

This gall is very similar to the gall No. 60 on 7*. *arjuna,* except that it is somewhat larger and relatively less numerous on the leaves.

Distribution.—Throughout the plains of India.

Gall No. 700 by Psyllid on stem

New gall. Irregular, fusiform or diffuse, elongate, agglomerate swellings of the cortex of the tender stem, about 30-50 mm long 10-15 mm thick; dehiscent in irregular patches to lay open the gall cavities, which are many. Surface mostly smooth, sometimes rugose; gray or brownish; old galls often persist on the branches.

Distribution.—South Bengal and parts of Bihar.

Terminalia chebula Retz.

Gall No. 110 by aphid on leaf.

Guibourt, N. J. B. G. 1877. Histoire naturelle des rogues simples. 7 ed. by Planchon. Paris, p. 286, fig. 65.

Baillon, H. 1877. Histoire des Plantes, Paris, p. 274.

Beauvisage, G. £. C. 1883. Les Gales utiles Paris, pp. 85-86, 99.

Nabias, B. 1886. Les Galles et leurs habitants Paris, p. 102-103. No. 5.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 663 No. 2386.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14(2) :122.

Vasiform, simple or lobed, greenish-yellow, fleshy, truncated on leaf, nearly 25-35 mm long, smooth when immature, but conspicuously longitudinally striated or ridged when old, unilocular, dehiscent; the cavity brown and with tubercles. Popularly called in Tamil Kodukaipou.

Distribution.—South India.

Trerminalia crenulata Roth.

Gall. No. 276 by unknow Cynipid on stem

Salem, V. 1908. *Marcellia,* 7:106.

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 665, No. 2384.

Sundar Raman. 1924. *J. Indian hot. Soc,*

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) :155.

Regular, globose or subglobose, free and isolated in bunches on young branches, ferrugenous, hard,[0] woody, solid, unilocular, indehiscent, persistent; surface irregular or glabrous; gall cavity spherical, simple, large; size about that a grain. ,

Distribution.—"India", exact lacality not mentioned.

Terminalia glabra R. Br.

Gall No. 20 by *Eriophyes* sp. on leaf

Salem, V. 1908. *Marcellia,* 7:106.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 665. No. 2385.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2)-.101-102.

Hypophyllous cylindrical galls on leaves, with flat apex, in which the ostitfle opens and about the size of a grain of hemp. On the upper surface of the leaf a brownish discolouration marks the spot where the gall occurs below.

Distribution.—"India*', exact locality not mentioned.

Terminalia paniculata Roth.

Gall No. 62 by *Phylloplecta hirsuta* (Crawf.) on different parts

Crawford. 1912. *Rec. Indian Mus.*9 7:427; *Philip. J. Sci.,* 15:201 (1919): 1924. *Rec. Indian Mus.,* 26:621.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.*9 26:625.

Mani, M. S. 1935. J. /?. *Asiatic Soc. Bengal* (Sci.), 1(2) :106-l08, pi. i, fig. 2.

Mani, M, S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2):112.

Irregularly subglobose or lenticular, simple, free and isolated or more often greatly crowded, agglomerate; smooth or glabrous or verrucose, pubescent or villous; yellowish-green or reddish-brown, almost solid, fleshy, of variable size, 2 mm to 10 cm; forming in enormous numbers of leaf, petiloe, gland, tender branch, flower peduncle, flower or also on fruit.

Branch Gall: globose or fusiform extensive, solid, hard, reddish or yellowish-brown, unilateral, cortical outgrowths, about 5-8 cm. long and 2-3 cm. thick; very often the gall is branched and lobed in a complicated manner, involving the swelling up of more than one branch. The gall is pierced irregularly by resin ducts, larval cavities, vascular bundles etc.

Bud gall: solid globose, fleshy, yellowish-green, dehiscent, wilh imbricating fleshy lobes representing the suppressed leaves.

Leaf gall : irregular, solid, fleshy, yellowish-green, glabrous and often very extensive swellings of the whole leaf blade, its dorsal gland and even the petiole. Size 2-3 cm in diameter.

Flower gall: globose, simple, sessile, brownish-yellow, glabrous, unilocular, thick-walled, fleshy, 5 mm. in diameter; often agglomerate into irregularly verrucose larger masses, bearing vestiges of stámens.

Fruit gall: oval, solid, fibrous, agglomerate, multilocular, cortical swellings, with deep-seated larval cavities; the greatly swollen gall parenchyma srrounds a pentagonal central cavity representing the original ovary. Seed does not mature. Sometimes the fruit gall is cavate, simple localised blisters of epidermal and subepidermal cells, 5 mm in diameter, the fruit otherwise normal.

Distribution.—South India.

Gall No. 466 by an unknown midge on buds and branches

PI. XIX

Mani, M. S. 1953. *Agra Univ.J. Res. (Sci.),* 2 (2):253-254. pi. vii.

Regular, cordate, or pyriform, hard, woody, sold, indehiscent, solitary, aggregate or conglomerate irregular woody masses, with a solid dark browrj. callus-celled piston-like lid, slightly projecting from a circular ostiole on the summit of the gall and reaching nearly down to the bottom of a tight-fitting cylindrical gall cavity; single larva of the gall midge lies beneath the lower end of the solid piston. When the gall is mature and old, the piston-like lid becomes rather loose and is pushed off easily, leaving a neat circular exit hole. Each solitary gall measures about 10 mm long and 7 mm thick basally. Ostiole about 2 mm in diameter and leads into a straight, long, narrow, cylindrical axial tunnel. When immature and newly forming, the surface of the gall is brown and smooth, but when old grey and covered by pealing bark. The largest conglomerate gall may measure about 35 mm in diameter and may be composed of over 50 separate galls. A gall frequently grows on the side of another gall.

Distribution.—Walayar Forests, Western ghats South of Nilgiris.

Terminalia tomentosa W. & A.

Gall No. 66 by *Phylloplccta hirsuta* (Crawf.) on leaf

Crawford, R. N. 1912. *Rec. Indian Mus.,* 7:427; 1919. *Philip. J. Sci.,* 15:201; 1924. ***Rec. Indian Mus.,* 26:621.**

Mathur, R. N. 1935. *Indian Forest Rec,* (N. S.), 1 (2):53.

Mani, M. S. 1935. *J. Asiatic Soc. Bengal* (Sci.), 1 (2):106-107.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14(2) :78, 113.

Leaf roll gall, the margin rolling upwards towards the mid rib, irregularly swollen, twisted, glabrous, pale green, sometimes pinkish.

Distribution.—Throughout the plains and low hills of India

Gall No. 677 by *Triozafietcheri minor* Crawf. on leaf

Crawford, R. N. 1912. *Rec. Indian Mus.* 7:434.

Mathur, R. N. 1935. *Indian Forest Rec.* (N. S), 1(2):64.

Sakscna, R. D. 1944. *J. Roy. Asiatic Soc. Bengal,* (Sci.), 10:123, pi. i_v, fig. 6-7.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) I4(2):8O, 113.

Epiphyllous, rarely hypophyllous, pustuloid subglobose or hemispherical, unilocular, fleshy, sessile, dehiscent, deciduous, yellowish or brownish beutclgall very similar to No. 60 on leaf of *Terminalia arjuna* described above; sometimes agglomerate. Undifferentiated parenchyma, with the cells laiger than those of normal leaf. Tissue differentiation gradually disappears from the leaf to the gall, thus at the edges of the gall near the normal part of the blade palisade cells are found normally. These gradually elongate and become hypertrophied in the interior and finally divide into undifFerentiated large parenchyma cells towards the apex of the gall. Epidermis of smaller and almost isodiametric cells and without stomata. Some of the smaller veins which enter the gall completely disorganised and the vascular bundles scattered in the parenchyma of the gall.

The following species of Thysanoptera are generally met with in the half mature and old galls: *Rhynchothripspallipes* Hood., *Androthrips flavipes* Schmutz, and *Gynaikotkrips iuterlocalu?* Karny.

Distribution. —Throughout the plains and low hills of India.

Gall No. 277 by unknown Cynipid on ovary

Sundar Raman, A. H. 1934. *J. Indian bot. Soc,* 4:44, No. 95-

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) :155.

Irregular, solid, ovarian, agglomerate, about 0.3-0.4 inches.

Distribution—Singhbhoom, Abbalgiri (Shimoga), Majurkhola (Rajmahals), Ganjam, Malabar.

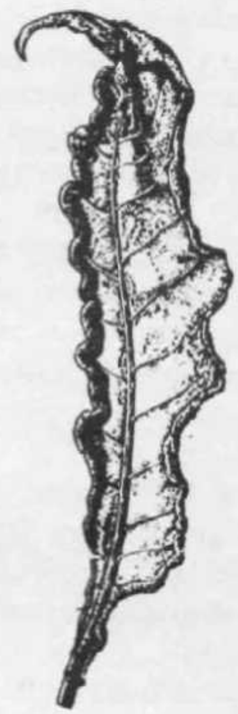

Fig. 40. Gall No. 41 on leaf of *Tsrminalia caiapfm* by thrips.

Gall No. 278 by unknown Cynipid on ovary

Sundar Raman, A. H. 1924. *J. Indian bot Soc,* 4;45, No. 96.

Mam, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* {Sci.), 14(2):i55.

Regular elliptic ovarian galls, somewhat beaked apically. •

Distribution.—South India.

Terminlia spp. incertae sedis

Gall No. 63 by unknown insect on stem.

Salem, V. 1908. *Marctllia,* 7:105.

Houard, C. 1923. L« Zoocccidiei des Planles d'Afriqur, d'Asic et d'Occanic, p. 667 No. 2393.

Mani, M, S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.), 14(2)1113.

Regular, cauline, fusiform, hard, umlocular, thick-walled galls on branches, nearly 10 mm long and 2 mm thick, with the larval cavity surrounded by sclerenchyma cells.

Distribution.—"India.".

Gall No. 64 by unknown insect on petiole

Salem; V. 1908. *Marcellia* 7:106.

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie. 2:668, No. 2396.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.), 14(2):113.

Regular, solitary, subglobose galls on petioles, about the size of a pea seed, with a single subspherical larval cavity at base and about 1 mm indiameter.

Distribution.—"India", exact locality not mentioned.

Gall No. 65 by unknown insect on leaf

Salem, V. 1908. *Marcellia,* 7:106.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie. p. 668 No. 2397.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2) :113.

Regular, epiphyllous, spherical and densely pubescent beutelgalls, with hypophyllous concavity covered by dense ferruginous erineum.

Distribution.—"India", exact locality not mentioned.

Terminalia sp.

Gall No. 327 by an unknown thrips on leaf

PL VII

Mani, M. S. 1953. *Agra Univ.J. Res* (&j.>2(2):254, pi. vi.

Regular, hollow, hypophyllous, leathery, utricular, dehiscent, pyriform or subglobose, often somewhat compressed, sessile, solitery, free or often irregularly agglomerate and large-lobed, yellowish-green or brown, smooth or rugose, deciduous, beutelgalls, with large irregular cavity. Ostiole hypophyllous. The gall is usually developed near the tip of the leaf blade. Size often reaching upto 25 mm long and 10-15 mm in diameter.

Distribution.—Dehra Dun and Western Ghats near Poona.

Gall Ne. 416 by *Trioza* sp. on leaf.

Epiphyllous, unilocular, fleshy, isolated, beutelgalls, somewhat similar to gall No. 60 an *Terminalia arjuna.*

Distribution.—Jhabua (Central India).

Natural Order MYRTACEAE

Eugenia corymbosa Lamarck

Gall No. 378 by Diptera on leaf

Nayar, K. K. 1947. *J. Bombay Nat. Hist. Soc.*% 47 (4):670.

Hypophyllous, irregular, globose, succulent, fleshy, solid galls generally free and solitery but often also agglomerate; 5-15 mm in diameter; reddish-brown in preserved specimens; larval chambers 2-6 in each gall.

Distribution.—Travancore.

Gall No. 379 by Lepidoptera on petiole

Nayar, K. K. 1947. *J. Bombay Nat. Hist. Soc,* 47 (4):671.

Regular fusiform, fleshy but hard, violet-brown swellings of leaf jpetioles; 20-27 mm long and 5-12 mm thick; larval gallery narrow and mature galls with exit holes and brownish-black.

Distribution.—High Ranges, Travancore.

Eugenia malaccensis Lamarck

Gall No- 67 *Megainoza vilims'ts* (Kirkaldy) on leaf

Zchntncr, L. 1900. *De Indischke Natuur Bijblad Archie Java Suiker., Soerabaya,* 5 (1):3-1I, %• 5.

Houard, C. 1906. *Marcellia,* 5:66-67, No. 2, fig. 3.

Drs. van Leeuwm-Rcijnvaan, W. & J- 1909. ***Marcellia,*** 8:95-96, No. 37, fig. 27; 1912. *ibid.* 11:53, No. 37; 66. *Bull. Jardin hot Buitenzorg,* (2)21:6-7,

Trotter, A. 97. Marcellia, 96:150.

Houard, C. 923. Les Zoocccidics dcs Plantes d'Afrique, d' Asic et d' Oceanic p. 594-595, No. 2142,

Kirkaldy, 1907. *Proc. Hawaiian eni. Soe.,* 1:103.

Crawford, 1915. *Philip. J.* ***ScL,*** 10:265; *ibid.* 15:195.

Ramakrishna Ayyar, 1924. *Rec. Indian Mus.,* 26:624.

Sundar Raman, A. H. 1924. J. *Indian boi. Soc,* 4:13.

Mani, M. S. 1935. J. ***Asiatic Soc.*** *Bengal (Set.),* 1:104-106, fig.

Irregularly globose, discoid, hemispherical, pustuloid, unilocular, epiphyllous, beutelgalls on leaves with a small conical projection below, at the apex of which the minute ostiole opens; yellowish or pinkish; brownish, hard and dehiscent when old; measuring about 3-6 mm in diameter; generally very similar to gall No. 68. The main anatomical features are as in gall No. 66. Dehiscence of the gall takes place partly by curling and splitting of the wall of the ostiolar duct and partly by the cracking of the conical projection beneath. This gall is very abundant, practically throughout the year at Tanjore.

Distribution.—Coromandal Coast, Java and Malaya.

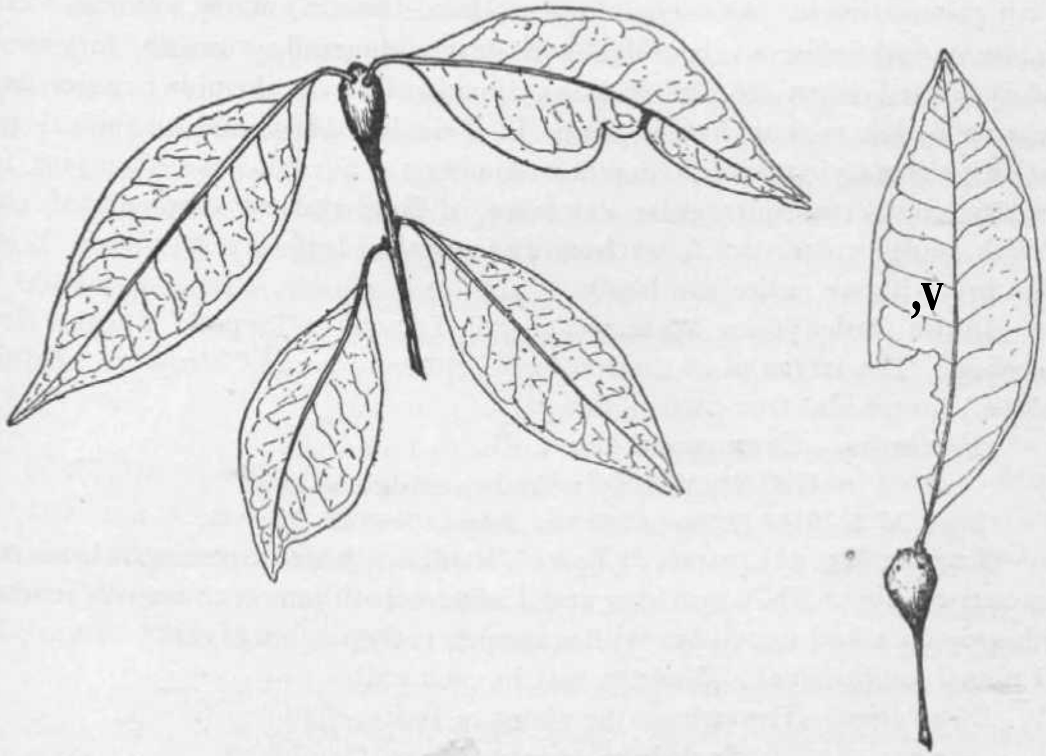

Fig.'41. Gall No. 216 on branch or *Syzigium jambcianum* by unknown midge.

Eugenia wightiana Wight.

Gall No, 678 by *Eriophyes cingulatus* Nalepa on bud

Nalepa, A. 1908. *Densk. Akad. Wits. Wien,* pp. 532-533, pi. iii, figs. 8, 4, 13.

Houard, C. 1923. Lcs Zoocecidies des Plantes d'Afrique, d'Asie ct d* Oceanic, p. 594, No. 2138.

Budgalls comprising stunted branches, not fully described.

Distribution.—Ceylon.

Syzigium jambolanum DC.

Gall No. 43 by *Eothrips jambuvasi* Ramakr. on leaf

Ramakrishna, 1928. *Mem. Dept. Agric. India (ent.),* 10 (7):300.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal, (Sci.),* **14** (2):70, 108.

Leaf margin roll, epiphyllous gall mostly similar to gall No. 41 described above.

Distribution.—South India.

Gall No. 68 by *Trioza jambolanae* Crawf. on leaf

Mathur, R. N. 1935. *Irdian Forest Rec.* (JVS), 1 (2) : 66.

Epiphyllous, hemispherical, isolated or conglomorate, smooth, hard, greenish, yellowish or brownish, often globose or somewhat oblong, unilocular, dehiscent beutelgalls on leaves about 7 mm long and 5 mm in diameter and more or less similar to gall No. 68a.

Distribution.—Throughout India.

Gall No. 679 by *Megatrioza vitiehsis* (Kirk.) on leaf

Mani, M. S. 1935. *J. Asiatic Soc. Bengal (Sci.)* 1 : 104-106 fig.; 1948. *ibid.* 14 (2): 114, No. 68a.

Regular, pustioloid, hemisherical, subpyriform, subovoid, rarely subglobose ; sessile, glabrous, greenish-yellow and often tinged with pinkish or brownish colouration in places, epiphyllous, hard, biittle, rarely soft and fleshy, deciduous and dehiscent beutelgalls on leaves, generally turning dark brown and very hard when old, moderatley thick-walled, unilocular ; cavity large irregular ostiole minute, hypophyllous in the middle of a minute conical projection ; size varying from 5-10 mm in diameter. Several galls often fuse into one large fleshy mass, irregular, extensive, diffuse, globose tuberculated often whitish, multilocular, solid, arched, and cracked into several pieces, below, often involving an entire leaf blade.

In the fleshy young agglomerate galls I found a Trypetid maggot freely breeding. The larvae of an unidentified Lepidoptera and Goleoptera *(Balanius c-album*) ? were also true pests of the gall.

Distribution.—Goromandal Coart.

Gall No. 216 by unknown midge on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2) : **140.**

Regular (fig. 41), ovoid, ellipsoid, hard, indehiscent, persistent local stem tumescence, ajpout 20-70 mm long and 15-20 mm in diameter ; smooth, covered with grey bark and sometimes with scattered scaly patches of corky tissue ; larval tunnel longitudinal and one to two in each gall.

Distribution.—Throughout the plains of India.

Syzigium operculatum Gamble

Gall No. 69 by unknown Psyllid on leaf

Drs. Van Lecuwcn-Rejnvaan, 1926- Zoocecidia of Netherlands East Indies, p. 412, No. 1078.

Mani, M. S. 1918. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 115.

Semiglobose, hypophyllous, unilocular, hard, beutelgall on leaves, with a minute conical process above, in which the very minute ostiole opens. Rare.

Distribution.—Coromandal Coast.

Gall No. 217 by midge on stem

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. Zoocecidia of Netherkands East Indies, p. 412, No. 1077, Fig 775 on p. 414.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 140.

Regular, fusiform or oval, solid, hard woody, indehiscent, persistent, light brown swellings of the branches, similar to gall No. 216 on *Syzigium jambolanum* but somewhat larger, measuring 50-70 mm long and 25 mm in diameter.

Distribution.—Coromandal Coast.

Natural order MELOSTOMACEAE

Memecylon amplexicaule Roxb.

Gall No. 337 by *Brachythrips* sp. on leaf

Nayar, K. K. 1947. *J. Bombay Mat. Hist. Soc,* 47 (4) : 670.

Hypophyllous, pustule-like, dark green, verrucose, open beutelgall, with concavity above, and generally appearing near and greatly distorting the amplexjcaul bases of the leaf and each gall measuring about 3 mm in diameter.

Distribution.—Travancore.

Memecylon edule Roxb.

Gall No. 316 by unknown midge on leaf

PI. IX

Nayar, K. K. 1947. *J. Bombay Nat. Hist. Soc,* 47 (4) : 670.

Hypophyllous, regular, globose, sessile, free, solitary, solid, fleshy, succulent, yellowish-green or brown, smooth, deciduous and often indehiscent galls, about 5 mm in diameter, generally 4-5 galls on each leaf ; mature galls with irregular patches of corky layers on the surface and also with irregular and more or less deep fissures, in which there is a general profuse growth of sooty-black fungus. Gall with a single central larval chamber.

Distribution.—Travancore.

Memecylon umbellatum Burm.

Gall No. 458 by thrips on leaf

PI. XIX

New gall. Irregularly globose, agglomerate beutelgalls involving whole leaf blade and producing complex large, globose, verrucose, rugose, yellowish-green semisolid mass, often measuring 40 mm in diameter, in which the individual galls are about 4 mm in diameter.

Distribution.—Mahabaleswar near Poona.

Gall No 579 by unknown midge on leaf

New Gall. Hypophyllous, regular, sessile, oblate, smooth, hollow gall, with 6-7 regular lobes and resembling a miniature capsular fruit, with an obtuse central summit; free, solitary, never agglomerate.

Distribution.—Mahabaleswar.

Memecylon sp.

Gall No. 42 by *Brachythrips dentahasta* Ramkr. on leaf

Ramakrishna Ayyar, T. V. 1928. *Mem. Dept. Agric. India* (cnt.) 10 (7): 294.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):69, 108.

Marginal epiphyllous roll gall, with the blade swollen, crumpled and tuberculated.

***Distribution.*—Mangalore.**

Natural Order ONAGRACEAE

Jussieua repens Linn.

Gall No. 140 by unknown Coleoptera on fruit

Fruits arrested in development and measuring only 15-18 mm long instead of normal 30 mm, but swollen very much, and measuring about 5-6 mm thick (instead of the normal 1.3-4 mm) with irregularly arranged, numerous larval cavities, curved, greenish or often reddish; seeds do not develop.

***Distribution.*—Coromandal Coast.**

Natural Order CUCURBITAGEAE

Bryonopsis laciniosa Naud.

Gall No. 218 by *Lasioptera bryoniae* Schiner on stem

Schiner, J. R. 1868. Diptera, in Reise Österrexhsischen Frcgatte Novara um die Erde in den Jahren 1857-1859 unter den Befehlen des Commodare B.von Wullerstorf-Urbair; Zoologischer Teil. 2(1) B:5-6, No. 2, pi. i, 2-3.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afriquc d'Asie et d'Oceanie, p. 856, No. 3072.

Sundar Raman, A. H. 1924. J. *Indian hot Sec,* 4:42, No. 84.

Mani, M.S. 1934. *Ric. Indian Mm.,* 36 (4) : 394; 1943 J. *R. Asiatic Soc. Bengal.* (Sci.), 14(2): 91, HI.

Irregularly elongate- fusiform, solid, tuberculated, fleshy, indehiscent tumescence of branches, with numerous irregular narrow larxal cavities in the middle.

***Distribution.*—Vellore : South India. Probably in other parts of India also.**

Coccinia indica Naud.

Gall No. 219 by *Neolasioplera cephalandrae* Mani on stem

Mani, M. S. 1934. *Rec. Indian Mus.,* 36 (4):397-399, fig. 9; *ibid.,* 38: 193 (1936); *ibid.,* 40:331 (1938).

Saksena, R. D. 1942. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 8:12, pi. ii, fig. 2.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2) : 91, 141.

Regular stoutly fusiform, oval or ellipsoidal, localised or also extensive moniliform, solid, hard, fleshy, smooth, greenish or yellowish-green, indehiscent, persistent swellings of the branches; size varying from 25-50 mm long and 15-30 mm in diameter; larval cavities irregular, elongate longitudinal, 3-4 in each swelling and with sclerenchyma walls; vascular bundles scattered; seat of cell proliferation chiefly the medulla, but often also the cortex, so that the stele is disrupted; gall tissue largely of simple, closely packed parenchyma cells. Old galls with numerous, small, circular exit holes on the surface. More or less cylindrical in section.

Oviposition on the surface of the tender growing branches is followed by the newly hatched larvae boring into the branch. The larvae of the galls reach maturity in about four weeks. Before pupation, the larvae tunnel up to the surface of the gall and pupate directly beneath the thin but intact epidermis. Before emergence of the adult the pupa wriggles up and pushes off the operculum and projects half way out. The larva is heavily parasitized by *Eurytoma* sp. and by *Inostema indica* Mani. The parasitisation is frequently so heavy that nothing but the,,parasites emerge from a gall, which does not show marked differences from unparasitized ones. The gall is common throughout India. In the South one may find galls maturing almost all the year round on the east coast, but in the north the gall appear during July-October. Larvae hibernate inside fallen dry galls in winter in north.

This gall usually forms only on the branches, but occasionally one may find a rather deformed gall on the petiole or basal part of a tendril.

Distribution.—Throughout the plains and low bills of India.

Gall No. 363 by fungus on stem

PL XVIII

« New gall. Irregular, subglobose or elongate oval, greatly lobed and knotted, solid, hard, verrucose or rugose indehiscent swellings of the older branches, tendrils, petioles or leaves, often 70 mm long and 30 mm thick; with crowded leaves, tendrils etc. on the surface.

Distribution.—Coromandal Coast.

Cucumis sp.

Gall No. 454 by *Dacus cucurbitae* Coq. on stem

Mani, M. S, 1953, *Agra Univ.J. Res.* (Sci.) 2:(2):143.

Irregular, extensive, fusiform, solid, fleshy, indehiscent tumescence of the branches, with irregular longtudinal larval galleries in the medulla Pupation in soil.

Distribution —Naini Tal District.

Gucurbita pepo DC.

Gall No. 367 by fungus on stem

New gall Irregularly globose, finely tuberculated, solid, fleshy, unilateral, cortical gall on the branches about 10 mm in diameter.

Distribution.—Bengal.

Gymnostemma **pedatum** Blume

Gall No. 220 by midge on stem

Drs. van Leeuwen-Reijnvaan W. & J. 1912. *Marcellia,* 11:75-76, No. 294.

Houard, G. 1923. Les Zoocecidies des Plantes d' Afrique, d' Asie, et d' Oceanic p. 847, No. 3082.

Drs. van Leeuwen Reijnvaan W. &.J. 1926. The Zoocecidia of Netherlands East Indies, p. 548, No. 1487, fig, 1055.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):141.

Irregular moniliform solid, fleshy, indehiscent swellings of branches, about 5-25 mm long and about half as thick.

Distribution.—South India,

Luffa aegyptiaca Mill

Gall No. 221 by midge on stem

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2): 141.

Irregular or regular fusiform, oval, somewhat elongated solid, fleshy, more or less ribbed, often curved, greenish, glabrous, cystiferous stem tumescence, resembling gall No. 224, measuring about 30-40 mm long and 10 mm in diameter.

Distribution.—Udaipur (Rajasthan).

Luffa acutangula Robx

Gall No. 576 by midge on stem

New gall. Fusiform, elongate or oval or sometimes also somewhat irrigularly carrot-shaped, slightly curved, sometimes also slightly twisted, solid, smooth, but obscurely ribbed, yellowish-green, fleshy but moderately hard, indehiscent, persistent swellings of the branches; occasionally somewhat unilateral; about 50 mm long and 10-15 mm thick; with 4-5 irregularly elongate, central larval chambers surrounded by sclerenchyma cells, more or less circular in section. Resembling gall No. 219 on *Coccinia indica*.

Distribution.—Western Uttar Pradesh and parts of Rajasthan.

Melothria amplexicaulis Gogn.

Gall No. 222 by *Prolasioptera javanica* (KiefF. et Drs. van Leeuwen) on stem

Kieffer, J. J. & Drs. van Leeuwen-Reijnvaan, 1909. *Marcellia,* 8:123, fig. 10.

Mani, M.S. 1935. *Rec. Indian Mus.,* 37:450-451, fig. 14; 1947. *Bull. ent. Res.,* 38 (3):439; 1948- J. *Roy. Asiatic Soc. Bengal (Sci.)* 14 (2):141.

Regular fusiform, simple, localised or somewhat extensive, occasionally subcylindrical, sometimes subcompressed, somewhat curved, solid, fleshy but moderately hard, indehiscent, persistent swellings of the branches, with obscure longitudinal ridges or sulci, but otherwise smooth, glabrous, very rarejy with indistinct tubercles; yellowish-green or yellowish-brown; 25-30 mm long and 10-15 mm thick; larval cavities longitudinal, narrow, cylindrical, superficial or also deep-seated and with thick sclerenchyma wall. The surface of galls may have stunted stumps of branches, vestigial tendrils or leaves. Occasionally the galling is continuous to give rise to a more or less distinct moniliform growth or are branched and articulated. Mature galls with minute circular exit holes. Seat of cell proliferation medula and cortex.

Distribution.— Coromandal Coast and Java.

Melothria heterophylla Cogn.

Gall No. 223 by *Prolasioptera javanica* on stem

Kieffer, J. J. & Drs. van Leeuwen-Reijnvaan. 1909. *Marcellia,* 8:123, fig. 10.

Drs. van Leeuwen. Reijnvaan, W ^& J. 1948. *Bull. Jardin hot. Buitenzorg,* (3) 1:57, No. 631, fig. 631.

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique,' d'Asie et d'Oceanie. p. 844, No. 3064.

Mani, M. S. 1935. *Rec. Indian Mus.,* 37:451; *Bull. ent. Res.,* 38(3):439(1947). *J. Roy. Asiatic Soc. Bengal* (Sci.), 14:(2): 142(1948).

Fusiform swellings of branches similar to gall No. 222 on *M. amplexicaulis* described above

Distribution.—Coromandal coast and Java.

Melothria madarapastana Cogn.

Gall No. 224 by midge on stem

PL XXII

Mani, M. S. 1935. *Rec. Indian Mus.*, 37:450 *(Mukia scabrella* Am.); 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14(2): 152. Saksena, R. D. 1942. *ibid.*, 8:11, fig.4 .

Regular, simple, globose, ovoid, ellipsoid, fusiform, cucumber-shaped, moniliform, localised or subextensive, terminal or basal, solid, fleshy, soft semi-succulent, indehiscent swellings of branches, 30-45 mm long and 10-15 mm thick; pentagonal in cross section; with the surface rough, scabiid, longitudinally ridged, often also sulcate; greenish or pale-greenish; hairs multicellular. Larval cavities elongate, irregular in section, longitudiual, superficial or deep-seated, 3-4 per gall, with moderate sclerenchyma walls. Seat of cell prolifera-tion cortex and medulla. A transverse section of the gall differs but little from that of a normal stem, except in the hypertrophied cortex and medulla.

Distribution,—Coromandal Coast.

Gall No. 682 by midge on stem

New gall. Regular, diffuse, subylindrical, greatly elongate, attenuate solid, fleshy, somewhat ribbed often also slightly twisted, indehiscent swellings of branches, over 100 mm thick, with axial, deep-seated, elongate larval cavity, extending nearly the whole length of the gall.

Distribution.—Near Coimbatore.

Melothria odorata Hooker

Gall No. 519 by midge on stem

New gall. Oval or fusifrom, short, solid, fleshy, stout, indehiscent, scabrid swellings of branches, 30 mm long and 10 mm thick.

Bistribution.—Garhwal Himalaya.

Melotbria perpusilla Cogn.

Gall No. 225 *byProlasiopterajavanica* Kieff. & Drs. Reijnvaan on stem

Kieffer, J. J. & van Leeuwcn-Reijnvaan. 1909. *Marcsllia,* 8:123, fig. 10.

Houard, C. 1923. Les Zocecidies des Plantes d'Afrique, d'Asie et d'Oceanie. p. 843, No. 3062.

Drs. van Leeuwen-Rcijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 550, 1497, fig. 1061.

Mani, M. S. 1947. *Bull. ent. Res.* 38(3) :439; *J. Roy. Asiatic Soc. Bengal* (Sci.) 14(2): 142, (1948).

Elongated, oval, fusiform, or irregular, ribbed, solid, parenchymatous tumescence of stem or leaf petiole, often also of tendrils; with the larval cavities numerous, longitudinal and with sclerenchyma wall; occasionally gall forms onmid rib of leaves also; larvae orange.

Distribution.—Coromandal Coast and Java.

Momordica charantia Linn.

Gall No. 226 by *Lasioptera falcata* Felt on stem

Drs. van Leeuwen-Reijnvaan, W. & J. 1909. *Marcellia*, 8 : 110, No. 71;/to. *Trav. hot. Merl.*, Gromingen, 8 : 24-27 (1911); *Bull. Jardin bot.* Buitenzorg, (2) 21 : 37, No. 44 (1916); Zoocecidia of Netherlands East Indies, p. 551, No. 1499, (1926).

Houard, C. 1923. Lea Zoocccidics des PJantes d'Afriquc, d'Asie et d'Oceanie, p. 844, No. 3068; p, 848, No. 3088.

Felt, E. P. 1919. *Philip. J. Sci.*, 14 : 288.

Ramakrishna Ayyar, T. V. 1919. *Rep. Proc. //lent. Meet. Pusa,* 1 : 324, pi. xviii, a, b.

Sundar Raman, A. H. 1924. *J. Indian bat Soc*, 4: 41.

Mani, M. S. 1934. *Rec. /ndian Mu£..,* 36: 394 \J. *Roy Asiatic Soc. Bengal* (Sci.), 14 (2) : 142 (1948).

Barnes, H. F. 1946. Gall midges of Ecnomic Importance, 1: 25.

Saksena, R. D. 1947. J. *Roy. Asiatic Soc. Bengal.* (Sci.) 8: 9-11, fi^. 3.

Nayar, K. K. 1947. *J. Bombay not. Hist. Soc.*} 47 (4): 668.

Regular, slender, attenuate fusifrom, solid, indehiscent, fleshy but moderately hard, somewhat curved swelling of the stem, often extending to more than 100 mm in length, but hardly 10 mm thick; angulated and ribbed, sometimes cylindrical; finely pubescent but otherwise smooth; occasionally somewhat also twisted. Larval cavities irregular, axial, elongate, deep-seated and extend the whole length of the gall. The cross section of the gall differs but little from the normal stem, except for the moderately hypertophied cortex; seat of cell proliferation medulla, but the cells of cortex and medullary rays undergo simple hypertrophy. Parasitisation of the larva of the midge but Proctotrypids and Chalcidoids moderate.

Distribution.—Common throughout India. Also recorded from Java, Celebes and Philippines.

Fig. 42. Gall No. 226 on stem of *Momordica charantia* by *Lasioptfrajalcata*, with the gall **cut** longitudinally open on the right,

Momordica dioica Roxb.

Gall No. 227 by *Lasiopterafalcata* Felt on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.), 14 (2) : 142.

Similar to gall No. 226.

Distribution.—Goromandal coast.

Gall No. 334 by *Heterodera marioni* on root

New gall. Irregularly globose, moniliform and frequently agglomerate, solid, indehiscent, fleshy and succulent, white coloured swellings of roots, about 10 mm thick.

Distribution.—Uttar Pradesh.

Trichosanthes palmata Roxb

Gall No. 681 by midge on stem

New gall. Regular, elongate-oval, elliposid or stout fusiform, solid, fleshy, succulent, indehiscent, contorted and warty, densely tomentose, pale greenish swellings, mostly terminally on branches, 50.-70 mm long and 15-25 mm thick; with irregular angulated outline in cross-section; larval cavities slender, irregularly elongate, superficial or deep-seated; extensive cell proliferation in medulla. The galls are not always confined to the main axis, but often also form on the leaf petiole or midrib, sometimes also on flowers and inflorescence axis and occasionally base of a tendril.

Distribuion.—Kalsi Gate on Dehra Dun Chakrata Road. Garhwal Himalaya.

PLANTAE INDET.

Gall No. 519 by Lasiopterini on stem

New gall. Irregular, often extensive, subfusiform, solid, fleshy, indehiscent, swellings of stem, with longitudinal and irregular larval galleries. Similar to the galls on *Melothria* spp.

Distribution.—Chakrata-Mussurie Hills.

Natural Order AIZOAGEAE

Mollugo pentaphyalla Linn.

Gall No. 399 by *Heterodera marioni* on root

Barber, C. A. 101. *Bull. Dept. LandRec. Agric. Madras Agric. Branch,* 2 (45) : 299.

Houard, G- 1922. Les Zoocccidies des Plantes d'Afrique, d'Asie et d* Oceanie, 1 : 244, No. 900.

Mani, M. S. 19*8. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):96.

Irregular, moniliform, solid, fleshy swellings of roots. Common in certain parts of South India.

Natural Order UMBELLIFERAE

Centella asiatica Urban

Gall No. 1 by *Heterodera marioni* on noot

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2):96.

Irregular, localised or extensive, branched, subglobose or moniliform, warty and clavate, solid fleshy swellings of roots about 5 mm. thick Rarely isolated, globose, unilateral outgrowths from cortex of roots, 2 mm indiameter. Gall tissue typical of nematode gall.

Distribution.—South India.

Heracleum canescens Lindl.

Gall No. 515 by *Kiefferia pimpinellae* (F. Löw) (?). on ovary

PI. XXVI

Löw, F. 1874. *Verh. zool.-bot. Ges. Wien*, 24:326.

Mik. 1895. *Wien. Ent. £.*, 14:96.

KiefferJ. J. 1913. *Gen. Ins.*, 152:89-90, pi. xii, fig. 20.

Ross, H. & H. Hedicke. 1927. Die Pflanzengallen Mittel- und Nordeuropas, p. 159. No. 1227.

Rübsaamen, E. H. & H. Hedicke, 1938. Die Gecidomyiiden und ihre Gecidien, p. 280, text fig. 68, pi. xxxi, fig. 11-13.

Regular, globose, sometimes slightly compressed, smooth, obscurely longitudinally lined, with well separated, long, straight, colourless, simple, cylinderical, stiff hairs, pale green or yellowish about 10 mm in diameter; solid, fleshy, succulent, with 1-2 central spacious larval chamber containing 1-2 reddish larvae.

Each gall is free, simple, never agglomerate, but clustered at the end of the umbel, on the apices the galls bear short, scale-like vestiges of the sepals and occasionally also the style. In course of gall formation the inferior ovary becomes enormously swollen.

Distribution.—Ghakrata Range, Garhwal Himalaya.

Pimpenella diversifolia DC.

Gall No. 585 by *Kiefferia pimpenellae* (F. Löw) on ovary

New gall. Irregularly subglobose or oval, compressed, finely rugose, tuberculate, rough, greenish, pubescent, usually ribbed, fleshy, succulent, unilocular galls, about 2-4 mm. in diameter. Compare gall No, 515 described above.

Distribution.—Narkanda, on Simla-Tibet Road, 2890 m. above mean sea level.

Natural Order ARALIACEAE

Hedera nepalensis

Gall No. 689 by midge on flower

New gall. Regular, globose, solid, fleshy but hard, smooth galls, about 5 mm in diameter, with a single central larval chamber.

Distribution.—Narkanda, 2895 m. Himalaya: Simla-Tibet Road.

Natural Order ALANGIACEAE

Alangium salvifolium Wang.

'Gall. No. 358 by *Eriophyes alangii* Nalepa on leaf

Drs. van Leeuwen-Reijnvaan, W. & J. 1914. *Bull. Jar din hot. Buitenzorg,* (2) 15:3, No. 354; *ibid.*, 21:23-|4, No. 3 (1916).

Nalepa, A. 1914. *Marcellia,* 13:61-62, fig. 85; 25:135.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 700, No. 2510.

Epiphyilous, irregularly ubglobose, verrucose, sessile, free or agglomerate, pale yellow or yellowish-green beutelgalls, size variable, 2-15 mm in diameter, with large, wide-open cavity on the lower side, clothed with fine, short, rusty-brown erineum, usually isolated patches of galls occur on the leaf blade.

Distridution.—Jeddi Goppa: Andhra State (East Coast). This gall is also known from Java and Celebes,

Natural Order CAPRIFOLIAGEAE

Lonicera parvif lora Edgew.

Gall No. 594 by midge on leaf

PL XVI

New gall. Regular, epiphyllous or also hypophyllous, sometimes also more or less irregular rolling-in of one or both the leaf margins towards the midrib into an elongate cylindrical, conical, cordate or even subglobose, hollow, thick, leathery swelling, with a large enclosed cavity, containing 3-4 larvae of of the gall midge and open to the outside by a narrow slit between the inroUed leaf margins, which are in contact with each other but not fused together. Length of the gall 10-15 mm, thickness 5-8 mm. Surface obsurely regulose or almost also smooth, green, yellowish-green, purple, blue or tinted violet.

Distribution.—Base of the Mt. Baihalijot: Chenab Valley, Namu Gorge, 3000 m.

Viburnum coriaceum Bl.

Gall No. 442 by midge on leaf bud

Mani, M. S. 1953. *Agra Univ. J. Res. (Sci.),2(\)* : 143.

Rosette-like gall similar to gall No. 441 on *Sageretia oppositifolia* described above, but 40 mm in diameter and with somewhat larger and more numerous leafy outgrowths.

Distribution.—Chakrata Mussoorie Hills,

Viburnum cotinifolium Don.

Gall No. 296 by *Eriophyes viberni* Nalepa on leaf

PL XII

Nalepa, A. 1889. *Sitzungb. A had. Wiss. Wien,* 981:38; 1896. *Denksch. Akad. Wien,* 61:389; 1925, *Marcellia,* 25:153.

Houard, G. 1929. *Marcellia,* 25 : 34, No. 236; *ibid.,* 26 : 62, No. 29.

Mani, M. S. 1948., J. *Roy. Asiatic Soc. Bengal (Sci.)* 14 (2) : 105 *{Ficus).*

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 (1) : 144, pi. ii, fig. 7.

Regular, epiphyllous, clavate or cephalonean, subcylindrical beutelgalls, somewhat curved on one side apically, yellowish-green or brown, thin-walled, about 5mm high and 1—2 mm thick, with moderately dense, short, stiff, errect, acute trichomeson the outer surface; ostiole hypophyllous and nearly obliterated by the dense white trichomes. Gall cavity spacious, irregular, with irregular fleshy emergences bearing stellate bundles of simple, straight or coiled, long, acute trichomes. The inner epidermis of the gall composed of giant cells. Outer epidermis moderately hypertrophied cells. Gall tissue largely of large, globose, undifferentiated closely packed parenchyma.

Distribution.—Nainital Distt.

Somewhat similar galls on *V. coriaceum* and *V. lantana glabrescens* are known respectively from Java and Morocco.

Natural Order RUBIACEAE

Adina stipulata

Gall No. 335 by *Erioplyes* sp. on leaf

Epiphyllous, convex, green or deep-violet-red beutelgalls along the outer margins of the larger veins and at the angle of the side veins, about **1-1.5** mm in diameter and 1 mm high. On the lower side with large ostiole filled by fleshy blunt, irregular, often multiccllular, tubercular, emergences of the lower epidermal cells from the adjomig veins, with the rells mostly undifferentiated globose parenchyma, lacking chlorophyll but with clear protoplast. The deeper layer of cells frequently with anthocyaninj which is also found in the surrounding zone of the unaltered leaf blade. A few of the epidermal cells grow out into elongate, straight, pointed hairs. The modification of epidermal cells occurs both on the upper and lower leaf surface of the strictly galled part as well as **a** narrow belt of the normal blade near the gall.

Distribution.—Western Uttar Pradesh.

Chomelia asiatica O. Kze

Gall No. 313 by Psyllid on leaf

Nayar, K. K. 1944. *Indian J. ent.*, 6:72.

Hypophyllous, subglobose, simple, sessile, soft, succulent, unilocular galls generally on the midrib, sometimes on the larger side veins, greenish-yellow, smooth, about 3-12 mm long and 5—10 mm wide; sometimes crowded but never agglomerated.

Distribution.—Pampadapara 2000 m Travancore.

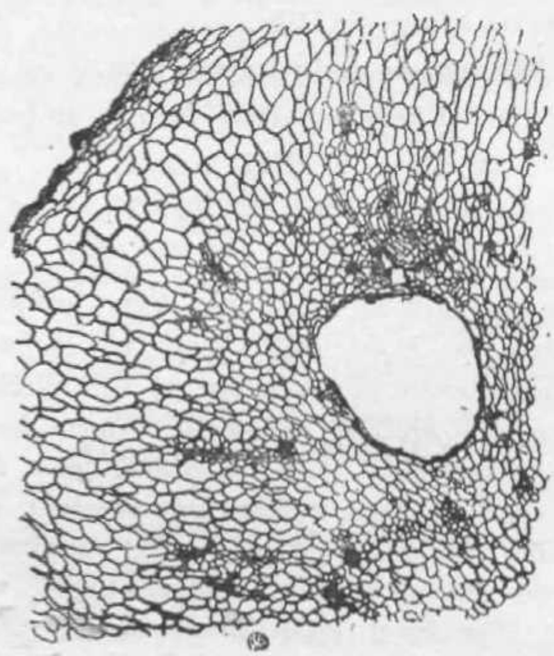

Fig. 43. T. S. through part of Gall No. 434 on *stem^ofGtilmm moKitgo* Linn, by midge showing the *%a.U* parenchyma and OIK: larval cavity.

Cinchona sp.

Gall No. 391 by *fleterodera marioni* on root

Barber, C. A. 1901. *Madras Dejil. Land. Rfc. Agrk. Branch, Bull.*, 2 (45): 230, pi. iii.

Houard G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Occanic, p. 117, Ne. 2959.

Irregular root nodosities from certain parts of India.

Galium mollugo Lnn. **(=asperifolium)**

Gall No. 434 by an unknown midge on stem

PL VII

Mani,M. S. 1953. *Agra Univ. J. Res. (Sei.)* 2 (1) : 144, pi. ii, fig. 4.

Regular, solitary, globose, smooth, brown, solid, fleshy, indehiscent swellings of branches, about 10mm in diameter. Larval cavities 4—5, oval, central. Surrounding the larval cavities are small sized, regular, closely packed proliferating cells in young galls (fig. 43). Outside lies a thick zone of large, closely packed parenchyma cells. The epidermis of the gall is composed of irregular flattened cells, subepidermal cells likewise flattend. Vascular bundles irregularly scattered in the gall parenchyma. Seat of cell proliferation medulla of the stem, medullary rays and part of cambium.

Distribution.—Garhwal and Kumaon Himalaya

Gall No. 435 by unknown midge on bud

Mani, M. S. 1953. *Agra Univ. J. Res. (Sei.)* 2 (1) : 145; *ibid.,* 1954. 3 (1):34.

. Irregularly globose, hollow, swollen leaf or flower buds, with whorls of atrophied, crumpled leafy outgrowths and enclosing several larvae. Pupation in soil.

Distribution.—Chakrata Road, Mussurie Hills, Dharmsala (Kangra Distt.)

Morinda tinctoria Roxb.

Gall No. 228 by *Asphondylia morindae* Mani on inflorescence

PI. XIV

Mani, M. S. 1934. *Ann. Mag. Nat. Hist. London,* (10) 13 : 134—137, figs. A—B; 1934 *Rec. Indian Mus.,* 36 : 409—410, pi. vii, figs. 2, text—fig 13—14; *ibid.,* 40 (4) : 19, (1938): ***J.Roy. Asiatic Soc. Bengal* (Sei.) 14(2) : 143 (1948).**

Regular or irregular, globose, agglomerate or compound, solid, fleshy, soft, indehiscent, deciduous, greenish, smooth galls, readily confused with and mistaken for the normal syncarpium, especially because of the presence of the usual more or less four-sided pyramidal sections of the enlarged, fleshy, persistent vestiges of calyx. The complete absence of seeds and the conspicuously hypertrophied flesh however serve to distinguish the gall. Occasional solitary simple free galls comprise perfectly globose or pyriform smooth swellings of the thalamus of **a** single flower in the inflorescence. This gall grows upto 20-30 mm in diameter when fully mature.

Usually however we come ocross greatly clustered or agglomerate, inrregularly globose fleshy masses, formed of the continuous swellings of the thalami of all the flowers in the inflorescence, but with limits of each flower indicated by subglobose fleshy emergences. This mass attains about 35-40 mm in diameter. In extreme cases we have a single large compound fleshy irregular mass, marked with characteristic green lines on the surface, indicating the limits of the thalamus of the constituent flowers, and presenting an astonishing resemblence to the normal fruit. Internally however there is nothing to distinguish the compound nature of the mass. This type reaches a diameter of 50 mm. On all the galls occasional vestiges of short, contorted, fleshy corolla may be found in the middle of the area, enclosed by the green lines. The mass of the gall is composed of close, small, simple, globose or hexagonal parenchyma cells, inbetween which the vascular bundles are scattered.

This gall is common throughout the cast coast of South India and has been collected up to the base of Western Ghat Ranges. Breeding continues throughout the year and the galls thus occur always, but are specially abundant and **mature** rather rapidly from September to November. **Pupation** takes place in the gall just beneath epidermis and extends to about a week. The larva is parasitized by Chalcids and Braconids. The gall is often damaged by the attack of an unidentified beetle.

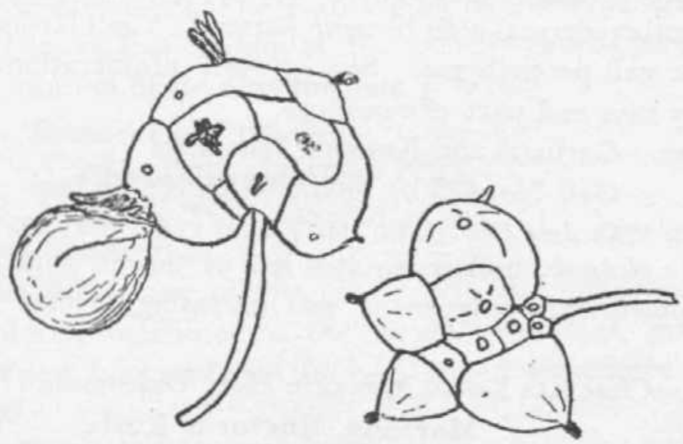

Fig. 44. Gall No, 228 on the flower-heads of *Morinda iincloria* by *Asphondylia morindae.*

Mussaenda **hirsutissima** Hutch.

Gall No, 21 by *Eriophyes* sp. on sepal

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* {Sci.) 14 (2) : 102.

Uniloculafj corniculate, pale yellow or yellowish-green beutelgalls on the upper surface of the enlarged sepal of flowers, about 5 mm long, 2 mm in diameter at base; cavity pilose, ostiole beneath. Similar galls were described by Houard[24] on the enlarged sepal of *Mussaenda temtiflora* Benth. from French Congo.

Distribution:—Walayar Forest

OJdenlandia sp.

Gall No. 392 by *Heierodcra marioni* on root

Barber, C. A. 1901. *Madras Dept. Land Rec. Agrk. Branchy Bull.*, 2 (45) : 229.

HouardpC. 1923. Lrs ZooCecidies des Plantes d'Afrique, d'Asic et d'Oceartie, P. 816, No. 2954.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 95.

Irregular solid root swellings. Common in seversal parts of South India.

Randia dumetornm Lamarck

Gall No. 22 by *Enophyes* sp. on leaf

PI. XXIX

Mani, M.S. 19-18. *J. Roy. Asiatic Soc. Bengal* (Sci.) H (2) : 102.

2* Houard, C. 1923. Lcs Zoocecidies des Plantes d'Airique, d'Asic et d'Oceanic, p. 820 No.2«>68, **fig. 1741,** 1742 and 1743.

Regular, globose, sessile, solitary or agglomerated, irregular, tubercular but smoth, sometimes pubescent, epiphyllous, histioid beutelgalls, scattered irregularly in large numbers on the leaves; sometimes hypohyllous also; 2—4 mm in diameter; pale green or yellowish in colour on the surface and whitish within; solid, spongy, multilocular; cavities densely closed with whitish, cylindrical, long, unicellular hairs from fleshy projections from the septae; minute ostiole below. Complete disorganisation of palisade and spongy tissues; veins are also more or less completely disorganised, with the vascular bundles irregularly scattered in the parenchyma of gall. Hairs sometimes found on the outer surface relatively shorter and more slender than those on the inner Surface.

Distrbution.—Throughout South India, extending as far as Poona along the Western Ghat.

Randia malabarica Lamarck

Gall No. 328 by midge on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 143.

Regular, globose, diffuse, fusiform, often unilateral solid, acystiferous, woody, hard, reddish-brown, frequently moniliform and extensive stem tumescence, about 15 mm long and 10 mm in diameter; with irregular bulges from the surface; very often with callus growth also; found in any part of a branch, generally 8-9 in a single branch; larval cavity elongate, oval but narrow and lined by spongy cells; a single pale whitish larva inside.

Distribution.—Slopes of Western Ghats near Coimbatore.

Rubia cordifolia Linn.

Gall No. 524 by midge on flower

New gall. Regular, subglobose, oval or fusiform, sometimes somewhat compressed, smooth, greenish or purplish, solid, soft, fleshy, indehiscent, deciduous swelling of a whole flower, with 6-8 larvae of the midge inside the irregular minute crevices in between the deformed and swollen inner parts. Only immature specimens of the gall were collected. Size 6-8 mm in diameter.

Distribution.—Garhwal Himalaya.

Natural Order COMPOSITAE

Achillea millefolium Linn.

Gall No. 505 by *Rhopalomyia* sp. (? *millefolii)* on bud

PL XXVI

Trotter. 1908. *Marcellia,* 7:89, No. 6, pi. 1, fig. 4. Houard 1923. Lcs Zoocecidies des Plantes d'Afrique, d'Asie ct d'Oceanie, 867, No 3153. Ross & Hcdicke, 1927. Die Pflanzcngallen Mittel- und Nordeuropas, Gustav Fischer: Jena, p. 75, No. 47. Mani, M. IS. 1954. *Agra Univ. J. Res.* (Sci.), (3) (1) : 34, pi. vii.

Irregular, subglobose, solid, fleshy, terminal-bud rosette gall, about 15-20 mm in diameter, pale green or yellowish-green, with numerous fleshy, bud-like tubercles and imbricating fleshy leafy vestiges.

Distribution.—Dhauladhar Range, Himalaya.

This gall has been originally described from China.

Gall No. 527 by *Rhopalomyia millefolii* (H. Law) on leaf and axillary bud

Frauenfeld, G. von. 1859. *Verh. zoolAot. Ges. Wien,* 9 : 328, pi. vii. fig. 22. Bergenstamm, J. E. von & P. Low. 1876. *Ibid.* 27 (Abh.) : 89, No. 513. Darboux, G. & G. Houard, 1901. *Bull. Sci. France Belgique,,* Paris, 34 : 20, No. 134, fig. 39, 40. Houard, G. 1909. Les Zoocecddies des Plantes d' Europe et du Bassin de la Mediterranee, p. 986, No. 5720, fig. 1295, 1296; *Ann. Sec. ent. Paris,* 81 : 175-176, No. 306, fig. 357-358. Ross, H. & Hcdicke, 1927. Die Pflanzengallen Mittel- und Nordeuropas, Gustav Fisher: Jena. p. 77, No. 66, pi. 1, fig. 10, 11. Rubsaamen & Hedicke, 1938. Die Gedidomyiiden und ihre Cecidien, pp. 288-289, pi. xxiii. fig. 8-11. Mani, M. S. 1954. *Agra Univ.J. Res. (Sci.)* 3 (1) : 35.

Regular, subcylindrical or vase-shaped, epiphyllous, fleshy, unilocular, solid, indehiscent, sessile, free and solitary, frequently crowded together or also agglometrate galls on rachides, petioles, axillary buds, branches, etc., about 3 mm long and. 1-1-5 mm thick, smooth with bent leafy process apically. surrounding the emergence hole. Each gall with a single pupa in the basal larval cavity, leading above by a narrow tube to the emergence hole.

Distribution.—Dhauladhar Range, Himalayas.

This gall is previously known from Egypt and Europe.

Ageratum conyzoides Linn.

Gall No. 396 by *Heterodera marioni* on root

Barber, C. A. 1901. *Madras Dept. Land Rec. Agric. Branch Bull.* 2 (45) : 299.

Houard, C. 1923. Les Zoocecidides des Plantes d'Afrique, d'Asie et d'Oceanie, p. 853, No. 3100.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. BengaL(Sci).,* 14 (2) : 96

Irregular often moniliform solid swellings of roots.

Distribution.—South India.

Ainsliaea aptera DC

Gall No. 521 by *Eriophyes* sp. on leaf

New Gall. Epi- or hypophyllous, irregular, verrucose, hemispherical, fleshy, pubescent, thin-walled, beutelgalls, with large wide open cavity, surface and cavity clothed with dense brown erineum; usually galls agglomerate along the part of leaf blade near the midrib, causing more or less pronounced curling and crinkling of the blade, size 5-8 mm.

Distribution.—Garhwal Himalayas

Artemisia (herba-alba Asso.)

Gall No. 229 by *Clinodiplosis artemisiarum* Kieff. on stem

Kieffer, J.J. 1905. *Ann. Soc. Sci. Rruxelles,* 29(2) : 153-155 No. 6. fig. 2; 1908. *Marcellia,* 7 : 156T

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie p. 882, No. 3195.

Sunder Raman, A. H. 1924. *J. Indian hot. Soc,* 4 : 42, No. 82.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2): 143.

Globose ovoid or also somewhat elongated, solid, fleshy, semi-succulent, indehiscent swellings of branches, nearly 15-40 mm long, with numerous larvae of the gall midge inside obscure cavities scattered in the flesh of the gall. Pupation in gall, which matures about September-October.

Distribution.—Kurseong : Eastern Himalayas.

Gall No. 230 by *Rhopalomyia sp.* on leaf

Kieffer, *J.J.* 1905. *Ann. Soc. Sci. Bruxelles,* 29 (2) : 153, No. 5.

Houard, C. 1923. Lcs Zoocecidies dcs Plantcs d'AMquc, d'Asic ct d'Occanie, p. 882, No. 3196.

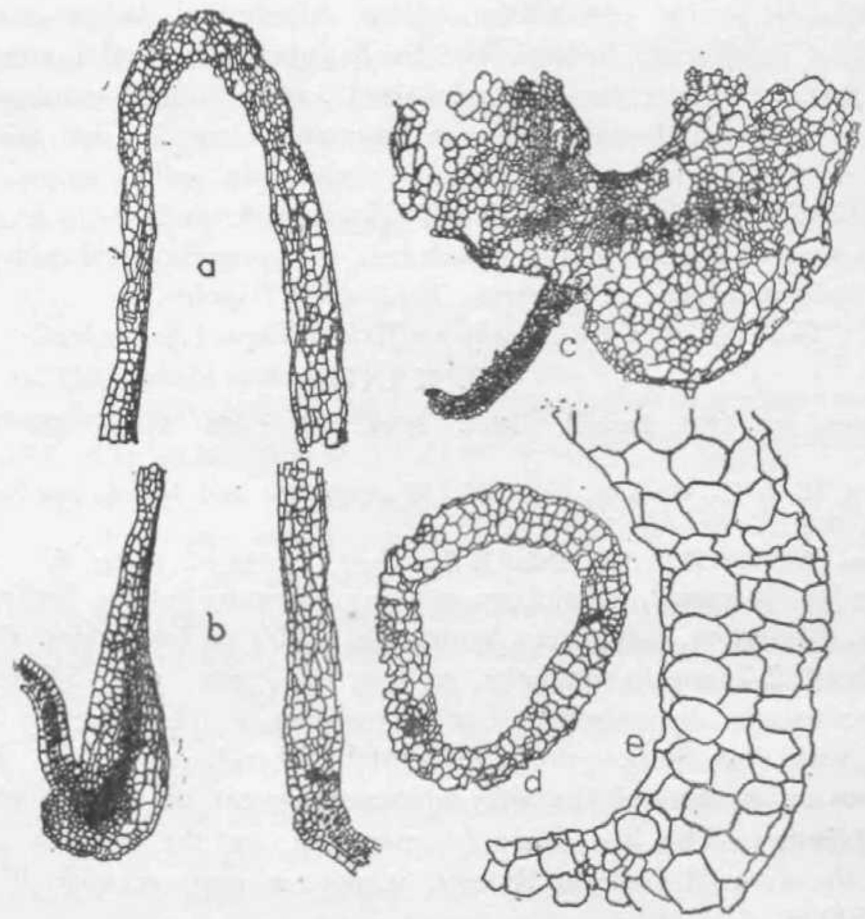

Fig. 45 *(a)* Sagittal section of Gal! No.-127 on **leaf <rf** *Ltcantlms wightU* Wcdd. 1> Psyllid, near ihc apex; {£) the same near the base, showing the normal portion of the leaf toward the left; (rf) T. S. of the same gall in the middle; (*} T. S. of the wall of the same gall in the middle, more highly magnified; *[c)* A part of the T.S. of Gall No. 445 on leaf of *Artemisia toiigans* Linn, by midge, showing the normal part of the leaf bt-low anp the larvil chamber above.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal {Sci.)* 14 (2) : 143.

Regular, subglobose or ovoid, solid, sublignose, indehiscent, sessile galls, about 5 mm in diameter, with dense white hail's on surface, larval cavity single, oval, containing a single larva, which pupates in the gall.

Distribution.—Kurseong : Eastern Himalayas.

Gall No. 231 by *Panteliola haasi* (Kieff.) on bud

Kicffer, J. J. (905. *Bull, Soc. Sci. BruxelUs,* 29 (2) : **151-153, No. 4.**

Houard, C. 1923. Lea Zooeecidica dcs Plantes d'Afriqtie, d'Asic et d'Oceanii-, p. 881-882, No. 3194.

Mani, *M.* S. 19*8. *J,Roy. Asiatic Soc. (Sci.)* 14 (2) : 143.

Irregularly globose, solid, spongy, densely tomentose, deciduous swelling;;, about **the** size of a pea seed, with 2-4 larval cells, each cell with one midge larva, pupation in gall.

Distribution:—'India'. Exact locality not specified.

Artemisia vulgaris Linn.

Gall No. 407 by Lepidoptera on stem

PI. V

Mani, M.S. 1953. *Agra Univ. J. Res. (Sci.),* 3:148, pi. iii, fig. 1

Subglobose, ovate or fusiform, often subterminal, hollow, unilocular, hard, woody, indehiscent, smooth but finely pubescent, local tumescence of the branches, bearing clusters of under-sized leaves; often terminally continued into a normal branch; 30 mm long and about 20 mm thick when full grown. Larval cavity in medulla. Pupation in gall.

Distribution.—Naini Tal District of Himalaya.

A somewhat similar gall is produced by an unknown Lepidoptera on *Artemisia herbaalba* Asso. in Algeria, Tunis and Tripoli[25].

Gall No. 443 by *Eriophyes affinis* Nalepa (?) on leaf

PL XXXII

Nalepa, A. 1904 *Denksch. A had. Wien,* 77 : 135 142; 1928. *Marcellia,* 23 : 157

Ross, H. & H. Hedicke, 1927. Die Pflanzengallen and Mittel- und Nordeuropas, p. 94, No. 308.

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.), 2 : 145, pi. ii, fig. 6.

Regular, biconvex, subglobose, oval or elongate, hollow, fleshy, densely pubescent, silky-white, indehiscent beutelgalls, visible on both sides of the leaf blade, about 2-3 mm in diameter, as long as 7 mm and 5-6 mm wide; unilocular; ostiole hypophyllous or sometimes epiphyllous; gall cavity spacious, with fine pubescence; moderately abundant on the leaf and conspicuous on account of the silky-whiteness against the foliage green.

Distribution.—This is a fairly common gall on the warmer southern slopes of the outer Himalayan Ranges, where it may occasionally ascend up to 2500 m.

Gall No. 444 by an aphid on bracts and leaves

PI. VI

Mani, M.S. 1953. *Agra Univ.J. Res. (Sci),* 14 (2) : 147, pi. ii, fig. 5.

Irregular, hollow, open, reddish-brown, fleshy, swellings of leaves or of bract; the affected part curled or rolled up into the hollow gall and enclosing the aphids; gall cavity communicating to the outside by numerous tortuous passages; usually the apices of the affected parts remain more or less normal. The gall forms in extremely very large numbers, especially on the flowering shoots, which consequently become curved and greatly contorted and stunted. Each gall measures about 7 mm in diameter.

Compare gall by the aphid *Macrosiphontella artemisiae* Boyer and Fonsc. on the same plant in Europe. Also compare galls by *Cryptosiplum artemisiae* Passerini on *Artemisia campestris, A. vulgaris and A. absinthium* in Europe.[26]

25 Honard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et .d'Oceanie, p. 877, No. 3172, fig. 1853-1856.

[2]«Drs.van Leeuwen W. M., *Marcellia,* 29(4) : 74, No. 5 (1934-35); Ross, H. & H. Hedicke, Die Pflanzengallen Mittel-und Nordeuropas, p. 93, No. 299, Fig. 26. (1927).

Gall No. 445 by *Rhopalomyia baijali* Mani on leaf

PL V & XXVI

Mani, M. S. 1953. *Agra Univ.J. Res. (Sci.),* 2 (1) : 147, pi. iii. fig. 2; *ibid.,* 3 (1): 35 (1954); *ibid.,* 4 (2) : **(1955).**

Regular, globose, sessile, solitary or agglomerate, smooth, silky-white or with cottony appearance, fleshy, sparsely pubescent, unilocular, indehiscent, spongy galls on leaf petioles, midribs or even tender branches; 5-6 mm in diameter; agglomerate galls, often as much as 10 mm in diameter (Fig. 45). The bulk of the gall tissue is composed of giant parenchyma cells, with considerable intercellular air spaces and irregularly scattered vascular bundles. The gall epidermis rather incomplete; there is no differentiation of palisade or other tissues. The central larval cavity surrounded by a thin layer of smaller proliferating cells.

A somewhat similar gall is caused by the midge *Misospatha giraldii* Kief. & Trott. on the buds of same plant in China.

Distribution.—Kumaon, Garhwal and Dhauladhar Himalaya in Punjab.

Gall No. 455 by *Eriophyes artemisiae horridus.* Nalepa on inflorescence

PI. XXXII

Nalepa, A. 1917. *Anz. Akad Wiss. Wien,* 54: 151; 1928. *Marcellia,* 25: 157.

Mani, M. S. 1953, *Agra Univ.J. Res.* (Sci.), 3 (1) : 14b. pi. ii, fig. 8.

Subglobose, solid, fleshy, indehiscent, brown or reddish, irregularly lobcd and tuberculated swellings of the entire inflorescence, about 10 mm in diameter; with short scaly or leafy processes representing the reduced and malformed apices of the florets;all the florets sterile, greatly swollen basally and remaining unopened; the main inflorescence axis also greatly swollen, with large, spongy parenchyma. The mites occur in large numbers in between the fleshy swollen folds of the florets. The bracts also swollen and adnate to the galled inflorescences.

Distribution.—Kumaon Himalaya.

Centrantherum reticulatum Benth & Hook.

Gall No. 397 by *Heterodera marioni* on root

Barber, C. A. 1901. *Madras Dept. Land Rec. Agric. Branch, Bull.* 2 (45) : 229.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 850, No. 3087.

Mani, M. S. 1948, *J. Roy. Asiatic Soc. Bengal (Sci.)* 14 (2): 96.

Root nodosities not fully described.

Gerbera kunena Braun & Asch.

Gall No. 684 by midge on bud

New gall. Solid subglobose, fleshy but hard, terminal swellings, with rosette of vestigial leaves on the summit, densely clothed with silvery-white cottonose hairs, indehiscent, free, never agglomerate, about 4 mm in diameter and scarcely distinguished from an ordinary terminal bud; with 1-2 small larvae imbedded in the middle of the flesh.

Distribution.—Lakka Pass, about 4267 m, near glacier on southern aspect on Dhauladhar Himalaya: Kangra Distt.

Erigeron (alpinus Linn. ?)

Gall No. 514 by midge on leaf and bud

PL XV

New gall. Regular, subglobose or pyriform, indehiscent, deciduous, solitary, sessile, but frequently clustered or agglomerated, solid, fleshy, succulent, sparsely pubescent, pale greenish, swellings of the leaves and leaf-buds, lying close to the ground at the bases of the cluster of leaves; somewhat apically beaked; with 4-6 larval chambers, deep inside «the flesh, irregular and with sclerenchyma wall and usually longitudinal, reaching and converging below into the stem; with a single reddish larva in each chamber or the pupa of a Hymenopterous parasite; a single gall about 10 ram in diameter and a cluster or the agglomerate mass may reach upto 20 mm in diameter, with as many as 6-8 galls clustered or more or less completely fused togather; pubescence thin, simole, short.

Distribution.—Garhwal Himalaya.

Inula cappa DC.

Gall No. 476 by midge on stem

Mani, M. S. 1953. *Agra Univ. J. Res. {ScL)* 2 **(1)** : **148.**

Regular, oval or fusiform, solid, indehiscent, hard, woody, smooth, finely pubescent, multilocular, diffuse swellings of terminal branches, about 10 mm in diameter and 15 mm long; larval cavities longitudinal.

Distribution.—Naini Tal District of Himalaya.

Senecio zeylanicus DC.

Gall No. 398 by *Heterodera marioni* on root

Barber, A.C. 1901. ***Madras Dept. Land Rec. Agric. Branch Bull.,*** **2 (45) : 229.**

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p.885, No. 3212.

Mani, M.S. 1948. ***J. Roy.*** *Asiatic Soc. Bengal* (Sci.) **14** (2) : 96.

Irregular solid, unilateral or moniliform swellings of roots.

Distribution.—South India.

Zinnia sp.

Gall No. 290 by *Heterodera marioni* on root

Barber, A. C. 1901. ***Madras Dept. Land Rec. Agric. Branch, Bull.,*** **2 (45) : 229.**

Mani, M. S. 1948. J. *Asiatic Soc. Bengal* (Sci.), **14** (2) : 96.

Irregular subglobose solid, unilateral or moniliform swellings of the roots.

Distribution.—Most parts on plains.

Gall No. 359 by crowngall bacterium on branch

PL VIII

Irregularly globose, verrucose or tuberculate, often also rugose, lobed, solid, flesby, succulent, greenish swellings on branches, varying in size from 4 mm to over 15-20 mm in diameter, sometimes occurring in large series on a branch and crowded.

Distribution.—Agra.

Natural Order VACCINIACEAE

Vaccinium leschenaultii Wt.

Gall No. 354- by an unknown aphid on bud

PI. X

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.), 2 (2) : 254, pi. vii.

Irregular, lobed, globose, hollow, utricular, leathery, thin-walled, dehiscent, brownish to reddish, glabrous swellings from the terminal buds and terminal leaves, measuring upto about 80-90 mm in diameter, with numerous irregularly bursting ostioles on the irregular lobes. Gall cavity large, irregular, tortuous, covered by a fine powdery wax secreted by the numerous aphid nymphs.

Distribution.—Kodai Kanal Hills,

Natural Order ERICACEAE

Rhododendron arboream Sm.

Gall No. 421 by *Exobasidium rhododendrt* Crow, on leaf

PI. VI

Mani, M.S. 1953. *Agra Univ. J. Res.* (Sci.), 2 (2):148-149, pi. iii, fig. 3-5.

Regular, globose or oblate, strongly constricted basally and broadly and shortly peditnclcd; hypophyllouSj solid, spongy, indehiscent, sometimes lobed but otherwise smooth and pale cottony in appearance when young, and cracked and rugose, somewhat brown when old; occasionally agglomerate; usually solitary but frequently as many as a dozen on a single leaf and varying in size from that of a pea to fleshy masses over 30 mm across and 20 mm high. On the upper surface of the leaf the site of the gall is indicated by an irregular shallow discoloured concavity. The great bulk of the gall tissue is derived from the epidermis and subepidermal cells of the lower surface of the leaf and is composed of spongy, irregular giant cells, with large intercellular air-spaces; when the gall is extremely large, the palisade cells of the region are also affected* and undergo both hypertrophy and cell proliferation. In the gall the periferal zone comprises 3-4 small actively proliferating cells just beneath

Fig. 46. Sagittal section through the leaf and the basal part of Gall No. 428 on *Rhododendron arboreum* Sm. by *Exobasidium rhododendri* Cam.

the outer surface, with numerous fungal hyphae (stroma) and often also on the vessels that enter the gall parenchyma from a vein at the base.

The growth of the gall is confined to the extreme peripheral zone of cells only, so that it continues to increase in size enormously.

Galls on leaves of *Rhododendron indicum* Sweet by *Exobasidium discoideum* Ellis has been described from South America by Raposo[27]. *Exobasidium rhododendri* Cram, is known to give rise to leaf galls on *Rh. myrtifolium* Sch. & Kotsch. in Rumania.[28] A somewhat similar gall is caused by *Exobasidium vaccini* Worm on *Rh. ferruginum* Linn, and *Rh. hirsutum* in several parts of the world[29],[30] *

Distribution.—Kumaon and Garhwal Himalaya.

Xolisma ovalifolium (Wall.) Rehd.

Gall No. 502 by *Eriophyes* sp. on leaf

Mani, M. S. 1954. *Agra Univ. J. Res.* (S«\), 3(1):35.

Irregular, extensive, reddish-brown growth of epidermal cells on leaf blade, veins and midrib into dense petiolate, compound, clavate, irregularly globosely branched, greatly swollen erineal agglomerate emergences, leading to leaf-curling when severe. On superficial examination these emergences present a eurious resemblence to conidial spore of fungi. The mites occur on and in between the emergences.

Distribution. — Dalhousie.

Natural Order MYRSINAGEAE

Embelia ribes Burm.

Gall No. 232 by midge on ovary

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 444, No. 1174.

Mani, M. S. 1948. *J. Roy. Astatic Soc. Bengal* (Sci.), 14(2): 143-144.

Ovarian, globose, ovoid or subpyriform, solid, fleshy, uni- or multiJocular, cystifrrous; apically somewhat pointed, or with a blunt, short process; basally stalked; measuring about 10-12 mm in diuneter and 20 mm in fength.

Distribution.—Walayar.

Maesa perrottetiana A. DC.

Gall No. 126 by Psyllid cr aphid (?) on leaf

Kieffer, J. J. 1908. *Marcellia,* 7:162-163, fig. 3.

Houard, C, 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 704 705, No. 2526.

Mani, M.S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14(2) :125.

Clustered globular structures on leaves, resembling a bunch of flower huds, large beutelgalls, smooth, yellow, coriaceous, or irregularly lobed; spongy, hollow, gall cavity filled with exudation from the gall insect; the galls

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27 Raposo, H. 1943. A galha da azalea, *Rhododendron indicum* Sweet, provocado pelo fungo *Exobasidium discoideum* Ellis. *BoL Soc. Brasilerira Agron.,* 6 (1) : 61-70 fig. 3.

28 Borcea, I. 1912. Deformation provoquces per *Exobasidium rhododendri* Cram, sur *Rhododendron myrtifolium* such, and Kotch. *Ann. Sci. Univ.Jassy,* 7 : 209-210.

29 Zellner, J. 1913. Ueber die durch *Exobasidium vaccini* War. auf *Rhododendron ferruginum* Linn, erzeugte Gallen. *Oest. bot.* £., 63 : 45.

80 Ross, H & H. Hedicke. 1927. Die Pflanzengallen Mittel- und Nordcuropas, *Gustav Fischer, Jena,* p. 246, No. 2273, pi. viii, fig. 173.

occur on a large area of the leaf blade or rarely covering the entire leaf surface.

Distribution.—Ranchi: Bihar.

Gall No. 233 by unkown midge on fruit

Drs. van Leeuwen Reijnvaan, W. & J. 1912. *Marcellia,* 11:81 No. 305 fig. 132.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 704, No. 2534.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlancs East Indies, p. 444-445, No. 1176, fig. B40.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14(2) :144.

Fruit gall, globose, fleshy, sometimes pyriform, with a short, blunt nipple-like projection at apex, unilocular, solid, greenish, about 12 mm in diameter; placenta the seat of cell proliferation; ovules undeveloped; cavity of ovary filled up by cell proliferation of ovarian wall; a few larvae found in the cavity.

Distrbution.—South India.

Gall No. 234 by *Oligotrophus quadrilobatus* Kieff. on leaf

Kieffer, J. J. 1908. *Marcellia,* 7:151-152, pi. iii fig. 2-3, pi. iv., fig. 4.

Houard, G. 1923. Les. Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 704, No. 2525.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2) :144.

Hypophyllous on the midrib, conical, acute, unilocular, thick-walled beutelgalls, about 3 mm high, 15 mm thick basally, green; on the upper surface of the leaf the site of the gall is indicated by small hemispherical or convex swelling.

Distribution.—Bengal.

Natural Order SAPOTACEAE

Bassia latifolia Roxb.

Gall No. 317 by midge on leaf

Nayar, K.K. 1948. J. *Bombay not. Hist.* So<\, 47(4) :671.

Epiphyllous, circular, subconvcx, lenticular, disc-like or hemispherical, often depressed, sessile, free solitary, rarely aggolmerated, solid, fleshy, almost succulent, green or yellow galls, in large numbers on the leaf blade, about 3-6 mm in diameter; each gall with one yellowish larva of the gall midge; old galls with exit holes appevaring about the middle of November Agra.

Distribution.—This gall appears to be widely distributed and was reported by Nayar from Kallar Bridge Area in South Travancore. It is also common in a number of localities near Agra.

Gall No. 321 by an unknown chalcid on leaf ,

PI. XXII

Mani, M.S. 1953. *Agra Univ. J Res. (Sci.),* 2(2):255.

Regular, hypophyllous, simple, free, local or subextensive, solid, oval or fusiform, indehiscent, persistent, often moniliform swellings of every vein of nearly every leaf; brown, smooth, glabrous, unilocular; over 200 galls on each leaf; about 4 5 mm long and 1-2 mm in diameter. When mature irregular longitudinal cracks and fissures arise in the epidermis, exposing the dry brownish tissues beneath. Gall cavity spacious, oval, smooth, central and longitudinal.

The incidence of this gall was very heavy at Agra during 1949-58 but since then appears to show pronounced decline on the same trees in the same area when the galls were first collected.

The gall maker belongs to the Tetrastichidae and the adults emerge in very large numbers in spring and early summer and the eggs are deposited on the newly forming leaves. The galls grow rather slowly and reach maturity next spring.

Distnb ution.—Agra.

Gall No. 581 by midge on leai

Hypophyllous, regular, hemispherical of greatly convex, rarely subglobose, rugose, brown, solid, fleshy, hard, indehiscent, persistent, solid, unilocular gall on margins of the leaf blade, sometimes 1-2 agglomerate in a linear row but generally free and sessile, 1-5 mm in diameter. On the upper surface the seat of the gall is indicated by an abrupt depression of the leaf margin. Gall cavity central, oval. Cells of the lower epidermis and of the spongy parenchyma proliferate, leaving the paisade almost unaffected in the gall.

Distrib ution.—Poona.

Bassia longifolia Linn.

Gall No. 352 by an unknown midge on midrib

PI. X

Mani, M. S. 1953. *Agra Univ.J. Res. (Scu)*, 2(2):255.

Regular, simple, fusiform, solid, indehiscent, presistent local swellings of the midrib, more conspicous on the lower surface than on the upper, about 10 mm long and 3 mm thick; larval cavity irregular, longitudinal. The bark cracks longitudinally and exposes the cortical growth beneath.

Unlike the gall No. 321 on *B. latifolia,* this gall always appears in isolated patches, generally never more than 1-2 galls on a single leaf; it is also restricted to the midrib.

Distribution.—Coromandal Coast.

Gall No. 353 by an unknown midge on leaf blade

Mani, M. S. 1953. *Agra Univ. J. Res {Sci.)* 2 (2) : 255.

Regular, simple, free, solitary, solid, hard, indehiscent, discoid, greenish swellings of the leaf blade, equally visible on both sides of the blade, with small circular exit holes irregularly scattered mostly on the lower surface. Size of the gall 3-5 mm in diameter. Surface rugulose. Gall cavity irregular.

*Distribution^*—Goromandal Coast.

Gall No. 362 by an unknown midge on branches

PI. VIII

Mani M. S. *T953. Agra Univ.J. Res. (Set.)* 2 (2) : 256.

Irregular, solid, indehiscent, local cortical outgrowths from the tender branches, which become exposed by the bursting of the bark due to stretching.

Distribution.—Coromandal Coast.

Gall No. 685 by midge on leaf

Houard, G. 1921. *Marcellia,* 17: 146, fig. 32—33; 1923. Les Zooceddies des Plantes d'Afrique d'Asie ct d'Oceanie, p. 710, No. 2540.

Circular pustules equally developed on both sides of the leaf blade, smooth, with a single minute exit hole on the lower surface of the leaf blade, larval cavity irregular but fleshy; the gall varies from 3—5 mm in diameter. The gall develops generally on one of the secondary veins or midrib, rarely elsewhere, but not on parts towards the leaf borders. Large number of the gall develop on a single leaf blade.

Distribution.—Malabar, Konkan.

Mimusops elengi Linn.

Gall No. 44 by *Arrhenothrips ramakrishnai* Hood on leaf

Hood, 1919. *Insec Inscit. Menstr.,* 7:99. Ramakrishna Ayyar, T. V. 1928. *Mem. Dep. Agric. India* (Ent.) (10) 7:282, fig 139.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal (Sci.)* 14 (2) 68,108.

Ananthakrishnan, T. N. 1954. *Agra Univ. J. Res.* (Sci.) 3(2):463-473, fig. 1-14.

Leaf folded on the upper side, crumpled, twisted and thickened irregularly; tissue differentiation absent.

In the same gall *Rhynchothrips vichitravarna* Ramkr. and *A.flavipes* are also found in association with *A. ramkrishnai* Hood and it is not known which of them actually causes the gall; possibly both the species are responsible for it. R^mkrishna records thai both the nymphs and adults of the thrips in this gall are destroyed in large numbers by the nymphs and adults of the Anthocorid *Montandiola thripodes* Berg. Ananthakrishnan has recently observed another Anthocorid, *Septicus* sp. also as predaceous on the thrips.

Distribution.—Goimbatore, Tanjore, Calcutta.

Mimusops hexandra Roxb

Gall No. 235 by *Pruthidiplosis mimusops kola* Mani on flower

Mani, M. S. 1934. *Rec. Indian Mus.,* 36 (4): 389-393, figs. 4-6; 1948 J. *Roy. Asiatic* ***Soc. Bengal (Sci.)*** **14(2): 144.**

Regular (fig. 47) globose, sometimes obpyriform or barrel-shaped, dark green glabrous, pedicelled, free, solid, spongy, but with a hard rind; dehiscent and deciduous swellings of the flowers, in which all the parts are affected. The calyx of the flower i* often persistent, accrescent and forms a sort of basal cup-like swelling; with the sepals, petals, stamens and style as minute, spine-like or fleshy but acute vestiges arranged in 2-3 whorls on the surface of the gall. The bulk of the gall is composed of white spongy parenchyma, enclosed in a moderately thick hard scleoroderm or the outer rind. This results in curious resemblance to the miniature berry with hard rind, as common in wood-apple tree. Within the spongy mass are found burried 4-6 larvae of the midge. When mature, the outer rind dehisces in irregular pieces, exposing the inner spongy mass with the pupae of the midge. The dehiscence commences on the summit and proceeds downwards. This also facilitates the escape of the adult midge at emergence from the pupa. The galls so completely look like fruits that they have found their way as such in many herbaria.

Distribution.—Tanjore in Madras State.

Gall No. 686 by midge on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal (Sci.)* 14 (2) : 104. No. 2350.

Regular, globose, brown, smooth, solid, hard, indchiscent, persistent terminal swellings of the tender branches, with 1-2 hard larval eells in the middle; size of gall 10 mm in diameter.

Distribution.—Tanjorc in Madras State.

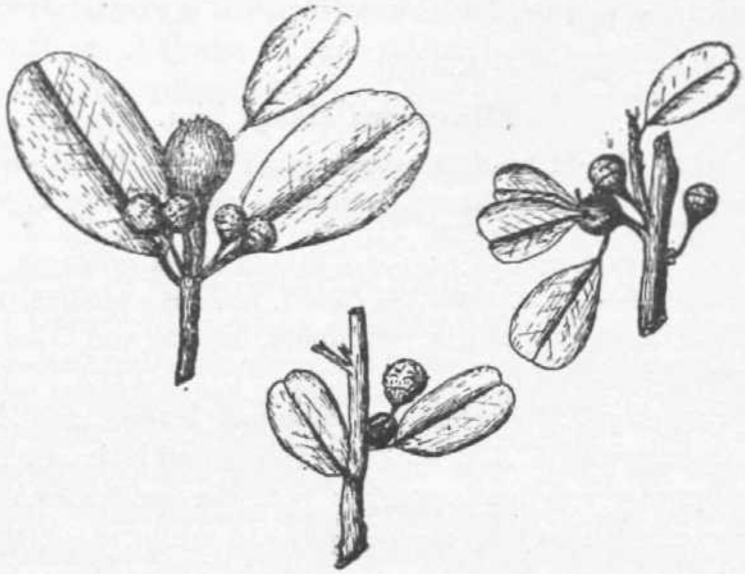

Fig. 47. Gall No- 235 on ihe flower of *MuitasqjH hexandra* by *Pr&kidiPlotis minwopshcola.* On the top left is shown also Gall No. 686 on the terminal stem by an unknown midge. In the axils of the leaves art; the Gall No. 235.

Gall No. 678 by midge on leaf

Mani.M. S. 1943. J. *Ray. **Asiatic** Soc. Bengal* (Sci.) 14 (2) : 144, No. 235b.

Regular, lenticular, subglobose and depressed, discoid, circular, solid, hard, greenish, smooth, indehiscent, parsistent galls, developed equally on both sides of the leaf blade, about 5-8 mm in diameter and 4-6 mm thick, with minute exit holes irregularly placed on the surface of the mature gall.

Dislribulion,— Tanjore in the Madras State

Natural Order EBENACEAE

Dispyros melonoxylon Roxb

Gall No. 70 by *Trioza obsoleta* (Buckton) on leaf

Alcock, A. 1900. *Indian Mus. Notes,* 5 (2) : 35.

Buckton. 1900 *Indian Mus. Notes,* 5 (2) : 35, pi. v, figs. 10-15.

Lerroy. 1909. *Indian Insect Life,* p. 743, fig. 516

Laing. 1930. *Indian Forest Rec,* 14 (8) : 44.

Sundar R*man, A. H. 1924 *J.Indian hot. .Soc.* 4 : 13. No. 30.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.*,26:623 (Psylla obsoleta).

Man!, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 80, 1 15.

YeJlowisrT-red, rough, epiphyllous, unilocular, sometimes agglomerate beutelgalls.

Distribution.—Western Ghats between Bombay and Poona.

Natural Order SYMPLOCOCEACE

Symplocos theaefolia D. Don

Gall No. 71 by *Gecidolrioza baccarum* KiefT. on bud

Kicffcr.J. J. 1908. *Mandlia, 1 :* 159-161, pj. iv, fig. 12-14.

Houard, C. 1923. Les Zoocecidies des Plantcs d'Afrique, d'Asie et d'Oceanie, P. 719-720, No. 2576.

Sundar Raman, A. H. 1924. J. *Indian bot. Soc.*, 4 : 14, No. 31.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 115.

Regular, globose or subglobose, smooth, glabrous, greenish, violet or bluish, solid, fleshy, uni- or bilocular, dehiscent swellings of the buds, with a conspicuous umbilicaie depression on the summit; about 8-10 mm in diameter; the gall cavity if single, spaciou and spherical; if double smaller and ellipsoidal; with 1-2 blue-green nymphs.

***Distribution.*—Kurseong: Eastern Himalaya.**

Gall No. 72 by *Ozotrioza styracearum* Kieff. on leaf

Kieffer.J. J. 1905. *Ann. Soc. Sci. Bruxelhs,*29 (2) : 179-181, No. 6, fig. 13, 14.

Houard, C. 1923. Les Zoocecidies des **Plantes** d'Afrique, d* Asie et d'Oceanie, P. 720, No. 2578.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc,* 4 : 14.

Mani, M. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 115.

Mainly hypophyllous, regular hemispherical orsubconical galls arranged on the midrib of the leaf, with flat, disc-like slight elevation on the upper surface of the leaf and having a conspicuous umbilicate pit in the center of a circular depression on the epiphyllous disc, which is about 5-6 mm in diameier and greenish; the hypophyllous immature hemispherical part of the gall measures about 5-6 mm in diameter but only 4 mm high; the gall is thick-walled, fleshy; at maturity the hypophyllous part grows out into a comcal projection about 6 mm high; on the apex of the cone now appears an oval ostiole, through which the psyllid escapes in September.

***Distribution.*—Kurseong; E. Himalaya.**

Gall No. 236 by *Contarinia pulckerrima* (Kieff.) on stem

Kieffer.J. J. 1908. *Marctllia,* 7 : 149-150.

Houard C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceame, p. 720, No. 2577.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc.*, 4 : 48, No. 75.

Mani, M. S. 1934. *Rec. Indian Mus.*, 36 (4) : 419 ; *J. Roy. Auatu Soc. Bengal* (Sci) 14(2)

Irregular unilateral or complete cortical, uniiocuW, subglobose or button-like swellings, scattered irregularly in large nnmbers on the surface ot the tender branches and nearly twice as thick as the branch itself; pupation in gall and adults described as emerging in December.

***Distribution.*—Kurseong : Eastern Himalaya.**

Natural Order STYRACACEAE

Styraec hookeri G. B. Clarke

Gall No. 125 by Aphid on bud

Houard, C. 1926. *Marcellia,* 23:60 No. 94.

Terminal galls recorded as like galls on *Styrax benzion* described by Houard (op. cit. p. 59, No. 89) from Java, Sumatra and Perak and caused by *Astegopteryx styracopkila* Karsch.

***Distribution.*—Sikkim Eastern Himalaya and Khasia.**

Styrax serrulatum Roxb.

Gall No. 571 *by Astegopteryx styracophila* Karsch on flower

Gurkef, M. 1890. Styraceae in EngW & Prantt: Die naturlichen Pflanzenfamilien Leipzig, 4 (1-2) : 174.

Drs. van Leeuween-Reijnvaan, W. & J. 1922. *Bull. Jardin bot. Buitenzorg,* (3) 4:154-155, No. 9-10, fig. 7-8

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2:722, No. 2582; 1926. *Marce Ilia,* 23:61, No. 97.

All parts of the flower wholly modified and abnormally developed. Peduncle is more or less swollen and the receptacle is also conspicuously enlarged: free centrally; encircled by whorls of cylindrically greatly elongated bracts; the peripheral floral envelopes 20-26, replicated and of increased height, with fine fleshy yellow pubescence; rarely the margins of these remain free the whole of their length; mostly fused basally into a cylindrical structure and above simply rolled up. The central cavity is filled by the aphids. Each gall is surmounted by a short point. This gall is described as greatly resembling the gall on *Styrax benzoin* Dryand caused by the same aphid in Java and Sumatra.

Distribution.—Naga Hills, Manipur (Assam).

Natural Order OLEAGEAE

Jasmimum dispermum Wall.

Gall No. 439 by an unknown midge on stem

PI. XXXII

Mani, M. S. 1953. *Agra Univ. J. Res. (Sci)* 2 (1): 150, pi. iv, Fig.3; *ibid.*, 3 (1):36 (1934).

Regular, local or extensive, occasionally unilateral, globose, oval or confluent or agglomerated, moniliform, persistent, indehiscent, solid, hard, woody, smooth brown swellings of branches, with larval cavities longitudinal and central within the medulla; cortex greatly hypertrophied; 10 mm in diameter and 20.30 mm long.

Distribution.—This gall is extremely abundant in various localities in Dharamsala, between 900 m and 1300 m but most of the galls are immature during May and early June. This is perhaps one of the commonest gall in the Kangra Valley. Also found in Chakrata and Mussurie hills

A similar gall on stem of *Jasminum* sp. is recorded to be caused by an unknown midge in Modagascar[31]

Jasminum grandif lorum Linn.

Gall No.^ 387 by *Puccinia jasmini* DC. on stem, petiole or leaf

Nayar, K. K. 1948. *J. Bombay nat. Hist. Soc.* 47 (4) : 674, 1949. *Proc. R.ent. Soc.* London (B) 18 (5-C) : 89.

Irregular, localised or more frequently greatly extensive patches of more or less pronouncedly unilateral or also complete subglobose, sometimes also cup-shaped, pitted, solid, fleshy, brownish, red, violet, or grey and black swellings of branches, petioles or equally developed on both sides of the leaf blade; all the affected parts being conspicuously curved, twisted or otherwise distorted with

« Houard, C. 1922. *Mar eel Ha,* 19:39-40, No. 10, fig. 13-14;

Drs. van Lecuwcn-Reijnvaan. 1922. *Bull. Jardin Bot. Buitenzorg.,* (3) 4:148, No. 1.

diffuse tumescence extending somewhat beyond the strict limits of the galled region. Size extremely variable from 0.2 mm in diameter to masses often exceeding 30 mm in diameter and as much as 60 mm long on the branches, the surface of the galled zone is covered with black, small button-like emergences. The larva of the mycophagous midge *Octodiplosis fungivora* Nayar feeds on the spores of the fungus on this gall.

Distribution'—South India.

Jasminum sambac Ait.

Gall No. 412 by *Contarinia maculipennis* Felt on flowers

Felt, E. P. 1933. *PTOC. Hawaii. Eni. Soc.* 8 : 247-248. •

Fullaway, D. T. 1934. *Ibid.*, 8 : 361.

Jcnson, D. C. 1946. *Pfoc. Hawaii ent. Soc.*, 12 : 525-534.

Barnes, H. F. 1949. Gall midges of economic Importance, Crosby Lock wood & Sons London, 6 : 108.

Irregularly swollen and somewhat fleshy, succulent, solid, indchiscent, deciduous, galls of flowers about 10-15 mm in diameter, with

Fig. 48. Gall No. 45 on the Leafof J&mmiM *Puittms* { ?) by *Eotftrips aswamukha.*

about a dozen or more larvae the midge, which are also heavily parasitized by Proctotrypid and Ghalcid parasites; pale yellow colour; sometimes ihe apices °f the petals remain unaltered, while basally they fuse together and become swollen into the fleshy mass.

Distribution.—South India.

Jasminum trichotoxnum Heyn.

Gall No. 368 by *Puccinia jasmini* DC. on stem, leaf, etc.

Mani, M. S. 1933. *Proc. monthly meltings, Asiatic Soc. Bengal* April, p. 11

Nayar, K. K. 1948. *J. Bombay* **not.** *Hist. Soe.*, 47 (4) : 674.

Similar to gall no. 387 on *J. gmndiflorum* described above, but of brighter colours, generally brilliant orange or red and also more extensive.

This gall generally develops more on leaf than on the branch. Extremely common.

Distribution.— South India.

This same species of fungus produces very similar gall on *Jasminum fruticans* in Moracco[32]

Compare gall by the fungus *Uromyees hobsonii* Vize on J. *starts* Park from Ethopia[33]

On *Jasminum floribundum* R. Br. is recorded a gall by *Uromyees hobsonii* Vize from Erithrea.[34]

Jasminum (pubescens Willd ?)

Gall No. 45 by *Eothrips aswamukha* on leaf[38]

Mani, M. S. 1948. ***J. Roy. Asiatic Soc. Bengal,*** **(Sci.), 14 (2) : 71, 108, fig. 5.**

Elongate, cylindrical or short fusiform, spirally twisted, verrucose, rugose, tuberculate, crinkled, greenish, hollow, leaf-roll-gall, 75 mm in diameter. The rolling up of the leaf blade begins from one margin and proceeds right to the other margin, beyond the midrib, which becomes also spirally twisted; and also extends from base to apex ; the upper surface of the blade being rolled in; thus the outer surface of the gall is made of the lower leaf surface. The blade thus affected more or less swollen, lacks tissue differentiation ; the cortex of the midrib and of the side veins conspicuously hypertrophied; no stomata on the gall surface. The labyrinthine spaces inside the gall are crowded with eggs, nymphs and adults of the thrips. The gall develops first as a small patch, but with the continuous breeding of the thrips, soon extends to the entire blade.

Distribution.—Udaipur (Mewar), also Uttar Pradesh.

Leptothrips jasmini Karny causes a similar gall on leaf *of Jasminum pubescens* Willd. in Java. Associated with *Leptothrips jasmini* Karny are *Haplothrips aculeatus* Fabr. and *Gynaikothrips chaivicae* Zimmermann.[35]

Natural Order SALVADORAGEAE .

Salvadora oleoides Dine.

Gall No. 168 by *Thomasiniana salvadorae* Rao on stem

Mani, M. S. 1948. ***J. Roy. Asiatic Soc. Bengal*** **(Sci.), 14 (2) : 145, fig. 9 (erroneously *Salvadora persica).***

Rao, S. N. 1951. ***Indian J. Ent.,*** **11 (2) : 117-120, fig. 63A (erroneously *S. persica).***

Subglobose, oval or fusiform, localised or extensively cylindrical, moniliform, glabrous, greenish or grey-brown, solid, hard, woody, indehiscent, persistent swellings of branches, usually about 25-30 mm long and 10-15 mm thick,

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a2 Houa/d, G. 1922. *MarceUia,* 19 : 106, No. 60.

»3 Trotter, A 1940-41. *Marcellia,* 30 (2) : 141, No. 64.

3* Trotter, A. 1940-41. *MarceUia,* 30 (1) : 234, No. 111.

3* Kama, H. & Drs. van Lecuwen-Reijnvan, W. &. J. 1913. *Bull. Jardin hot. Buitenzorg 2 (10) : 2425, 68, 80-81, 109-110, No. 23, fig. 76-78.**

Drs. van Leeuwen-Reijnvaan, W- &.J. 1914. *Bull. Jardin hot. Buitenzorg%2* (15): 35, No. 438.

Houari, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2: 729, No. 2617.

Houard, G. 1928. *MarceUia,* 25 : 29.

••In 1948 this gall was erroneously described as caused by *Neosmrinthothrips.* The plant may be either *J. pubescens* Willd. or J. *arbosecens* Roxb.

but when elongate-cylindrical, exceeding 70-80 mm in length; a single branch about 12 inches long bears about 8-10 separate galls; larval chambers numerous, cylindrical, with sclerenchyma walls, irregular, longitudinal; exit holes minute, circular and located without order on small pimple-like warts on the surface. Pupation in galls.

Emergence of adults frequent in March-April. Parasitisation of the larva by Proctotrypid, often very heavy.

Distribution.—Throughout Rajputana and Western parts of Agra and exceedingly common in summer and rainy season.

A somewhat **similar** gall is caused by an undescribed midge on *Dobera glabra* and *Salvadora persica* A. DC. in various parts of Eritrea[a7]

Salvadora persica Linn.

Gall No. 23 by *Eriopkyes* sp. on flowers

Mani, M. S. I94H. *J. Roy. Asiatic Soc. Bengal* {Sci.) 14(2) : 102.

Floral leaves Swollen, enlarged, crumpled, swollen partially fused, globose, multilocular galls, nearly 10 mm in diameter, smooth, yellow.

Distribution.—Drier parts of North Indian Plains, especially Western Ultar Pradesh and Rajasthan.

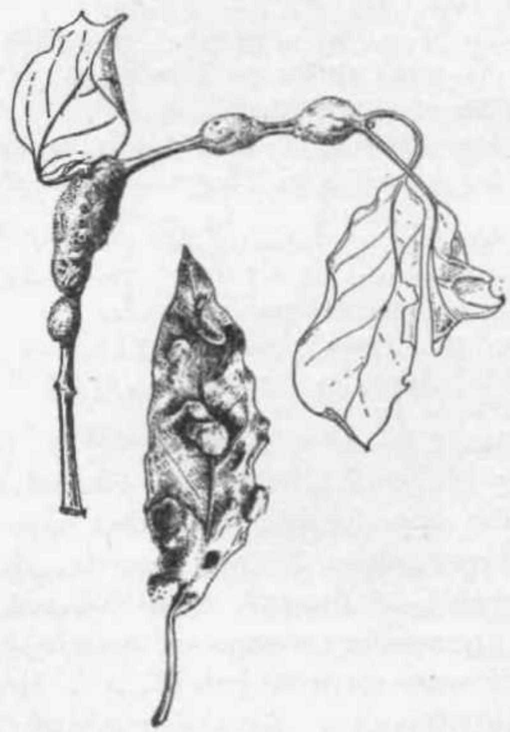

Fig. 49. On the left is Gall No. 163 on the stem of *Salvadora oleoidfS* by *Thomasiniana salvadorae* and on the right is a single leaf of *Salvadora persica* with Gall No. 356 by *Eiiopkyes* sp.

Gall No. 356 by *Eriophyes* sp. on leaf

PI. X

Mostly epiphyllous, globose or greatly irregular and agglomerated, lobed, smooth, yellow, hollow beutelgalls, with large, hypophyllous ostiole, leading

~« Trotter, A. 1904. *MarcMia,* 3: 99-100, No. 12, fig. 9-10); Houard, C. 1923. LesZoocecidies des Plantes d'Afrique, d'Asie et d'Occanie, 2: 729, No. 2624).

into the spacious and sparsely erineal gall cavity; moderately thick-walled and tough; often an entire leaf-blade converted into a dense bunch of continuously agglomerated mass ; size extremely variable from 5 mm to over 30 mm in diameter.

Distribution.—Common throughout Western Uttar Pradesh and Rajputana during summer.

Gall No. 691 by midge on stem

Regular globose or hemispherical, unilateral, sessile smooth, free, crowded or agglomerate solid, fleshy but hard, indehiscent swellings, on tender branches, never fusing completely into composite large fusiform or extensive masses as in case of gall No. 168 on *S. oleoides,* but even in agglomerate clusters each gall is distinct. Size 5 mm in diameter. Larval chambers minute.

Distribution.—Goimbatore : South India.

Natural Order APOCYNAGEAE

Alstonia scholaris R. Br.

Gall No. 73 by *Pauropsylla tuberculata* Crawf. on leaf

PI. XXIV

Rübsaamen, E. H. 1905. *Marcellia,* 4 : 7-8, No. 2.

Drs. van Leeuwen-Reijnvaan, W. & J. 1910. *Marcellia,* 8 : 38, No. 93, fig. 49; 1912. *ibid.* 11 : 52, No. 93, fig. 104; 1916. *Bull.Jardin bot. Buitenzorg,* (3) 1 : 24, No. 5, fig. 5.

Trotter, A. 1917. *Marcellia,* 16 : 151.

Uichanco, L. B. 1919. *Philip. J. Sci.,* 14 : 544, pi. v, fig. 1-2.

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2 : 738, No. 2650, fig. 1622, 1623.

Sunder Raman, A. H. 1924. *J. Indian tot. Soc,* 4 : 14, No. 33.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 465-466, No. 1234-1237, fig. 889-890.

Rahman, A. Khan, 1932. *Indian J. Agric. Sci.,* 2 : 359.

Mani, M. S, 1935. *J.Asiatic Soc. Bengal,* (Sci.), 1: 100-101 ; 1948. *J. R. Asiatic Soc. Bengal,* (Sci) 14 (2) : 75, 115-116, fig. 18.

Saksena, R. D. 1944. *J. Roy. Asiatic Soc. Bengal* (Sci.) 10 : 123, fig. 4, pi. i, 7-8.

Semiglobose (fig. 50), conical or obtusely conical on one side of leaf and truncated conical on the opposite side, the rather large ostiole opening at the apex of the truncated cone, about 2.5 mm diameter above and 3 mm below; the cone on the under side of the gall about 5-6 mm long; found on either side of leaves; pale green when young and yellowish when old, glabrous, hard unilocular, cystiferous; scattered irregularly in large numbers on the leaf and sometimes on petioles also. The ostiole is very narrow in young galls and widens as age advances. The epidermis mostly of relatively narrow and more elongated, cells, with extremely few stomata. Near the base, especially immediately below the surface, the palisade and spongy parenchyma have bcome hypertrophied, so that the cells of both the tissues can be easily made out elongated cells as in parallel rows with little interspace in the case of spongy side. Towards the apices and in the nighbourhood of the cavity, the cells gradully become undifferentiated, large, rounded parenchyma cells. Veins are completely disorganised, with the vascular bundles irregularly scattered in the parenchyma of the gall. The sderenchyma layer surrounds the gall cavity in mature specimens.

Distribution.—Throughont **India,** Burma, Siam, Malaya, Java and Philippines.

Gall No. 701 by *Pauropsylla tuberculata* on fruit

New gall. Diffuse, extensive, elongate, solid, cylindrical swellings of the young fruit, with numerous larval chambers in irregular linear series; each gall often of agglomerated masses from several centers of oviposition; size varying from 10 cm long to over 500 cm long and about 15-20 mm. thick; green, glabrous and sometimes with obscure tubercles.

Distribution.—West Bengal.

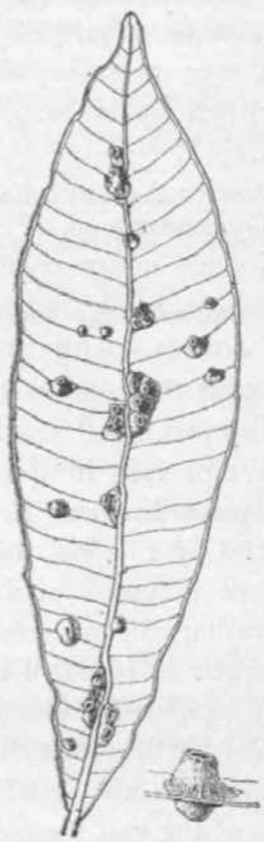

Fig. 50. Gail No. 73 **on leaf** of *Alitoma schofarU* by *Pattrof>syt!a tuberculata.*

Carissa carandas Linn.

Gall No. 237 by midge on stem

Mani, M.S. 1948. *J. Roy, Asiatic Sec. Bengal* (Sd.), 14 (2) : **145.**

Regular, ovoid or fusiform, often moniliform, solid, wcody, brownish, acystifcrous tumescencc, about 15 mm long and 7 mm thick; larval tunnels one to two and longitudinal; exit holes circular and irregularly placed.

Distribution.—Coromandal Coast.

Carissa spinarum Linn.

Gall No. 238 by midge on stem

Mani, M. & 1948. *J, Roy. Asiatic Sac. Bengal* **(Sci.), H (2)** : **145.**

Similar to No. 237 but somewhat larger and rather rare.

Distribution.—Corornandal Coast.

Ervatania (=Tabernemontana) coronaria Stapf.

Gall No. 239 by midge on leaf

Kieffer, J. J. 1908. *Marcellia,* 7 : 152.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 740, No. 2655.

Sundar Raman, A.H. 1924. *J. Indian hot Soc,* 4 : 40 No. 76.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 145.

Fusiform, solid swellings of petioles, midribs, secondary nervuns and occasionally of an entire leaf, fleshy, with numerous, oval larval chambers. An entire leaf is turned into coriaceous, reticulate and more or less contorted gall.

Distribution. —"India" without further indication of the precise locality,

Gall No. 240 by midge on flower

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14(2): 146.

Subglobose, solid, fleshy flower galls very similar to one on *T. durissima Stapt.* from French Congo, described by Houard.[38]

***Distribution.*—South India.**

Natural Order ASCLEPIADACEAE

Gymnemasp. (?)

Gall No. 464 midge on flowers

New gall. Regular, subglobose, solid, indehiscent, fleshy, soft, yellowish-green, pubescent swellings of flowers, with large fleshy, adnate foliaceous lobes free apically and representing the altered sepals. The flesh of the gall encloses numerous irregularly disposed small larval chambers.

Distribution.—South India, especially in the sub-montane districts.

Hemidesmus indicus R. Br. (?)

Gall No. 690 by Chalcid on ovary

New gall. Regular oval or ellipsoid or shortly fusiform, stout, smooth, yellowish-green, solid, hard, rather fibrous, indehiscent swellings of ovary, greatly resembling the normal fruit, 30-40 mm long and 25 mm thick. Beneath the somewhat thin but leathery epidermis are longitudinal stout fibers, with a peripheral layer of regular, oval hard, sclerenchymous larval chambers, with their axes radially disposed. Each chamber with a full grown larva, pupa or adult ready to escape. The core of the gall composed of soft parenchyma and hollow space representing the ovarian cavity. Emergence holes large and circular. The bulk of the old gall decays, leaving the fibres with the larval chambers adhering.

***Distribution.*—Coimbatore.**

Hoya parasitica Wall, on **Pyrus** commuuis Linn.

Gall No. 241 by unknown midge

Drs. van Leeuwen Reijnvaan, W. & J. 1926. Zoocecidia of Netherlands East Indies, p. 471, fig. 902.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2): 146.

Irregular, globose or ovoid, often conglomenate, swellings of the leaves, often of petioles also, glabrous and about 5-10 mm thick, with one or more larval

[38] Houard, O. 1923. Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 739 No. 2654, fig. 166.

cavities; very similar to gall on *H. coriacea* Bl. described by Drs. van Leeuwen-Reijnvaan from Java.

Distribution.—Dehra Dun.

Pergularia extensa N. E. Br.

Gall No. 462 by midge on flower

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sd.,), 3(2):256.

Regular, subglobose, solid, fleshy, solitary, simple, indehiscent, pubescent pale green swellings of flowers, 5 mm thick, with 2-3 larval cavities. Pupation in gall.

Distribution.—Marudamalai Hills near Coimbatore.

Natural Order LOGANIAGEAE

Strychnos nux-vomica Linn.

Gall No. 383 by *Diaphorina truncata* Crawf. on leaf

Crawford, 1924. *Rec. Indian Mus.,* 26:617.

Ramakrishna Ayyar, T. V. 1924. *Rec. Indian Mus.,* 26:624.

Mathur, R. N. 1935. *Indian Forest Rec,* (cnt.) 1 (2) : 42-

Nayar, K. K. 1948. *Bombay nat. Hist Soc,* 47 (4) : 672.

Epiphyllous small pouch galls, green, 0. 5-3. 0 mm in diameter.

Distribution.—Walayar, Trivandrum, Malabar and also from South China.

Strychnos potatorum Linn.

Gall No. 242 by midge on leaf

Mani, M. S. 1935. *Rec. Indian Mus.,* 37:452; 1948.J. *Roy. Asiatic. Soc. Bengal* (Sd.) 14 (2) 146.

Regular, globose, pyriform or clavate, often button-like, free or agglomerate, solid, hard, pale green or pale yellow, smooth and glabrous above and rugose below, developed more on the upper side of the leaf blade on the lower side, 3 mm in diameter.

Distribution.—Goromandal Goast.

Natural Order BORAGINACEAE

Gordia myxa Linn

Gall No. 24 by *Eriophyes cordiae* Nalepa on ieaf

Drs. van Leeuwen Reijnvaan, W. & J. 1910. *Mareellia,* 9:174, No. 161; 1911. *Marcellia, 40:92, No.* 9; 1912. *Mareellia,* 11:53, No. 161.1916. *Bull. Jardin hot. Buitenz.org,* (2) 21:28, No. 14; 1926. Zoocecidia of Netherlands East Indies, p. 479.

Nalepa, A. 1914. *Mareellia,* 13:56-57, 85.

Houard, C. 1923. Les Zoocecidies des Planets d'Afrique, d' Asie et d'Oceanie, 2:756, No. 2714

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14(2) : 63,102

Yellowish or pale green filzgalls, often pustular beutels, epiphyllous, cavity large and open; hairs long, multicellular, unbranched, twisted; galls about 3-4 mm in diameter.

Distribuion.—Throughout the plains in India, Java, Sumatra, Siam, Celebes and Cuba.

Gall No. 14 by 5am *cordiae* Marshall on leaf

Drs. van Leeuwen-Reijnvaan, W. & J. 1910. *Mareellia,* 9:174, No. 160, fig. 65.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Occanie, 2:755,2711.

Ramakrishna Ayyar, T. V. 1922 *Bull. Agric. Res. Inst.Pusa,* 125:20.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2): 87, 127, figs. 43-44.

Oval, fusiform, diffuse or local, often unilateral, solid, woody, pale brownish tumescence of leaf petiole, midrib and even sometimes one of the lateral veins, measuring about 15 mm long and 5 mm thick; cavity large; cortex, medullary rays, etc., seats of cell proliferation.

Distribution.—South India.

Gall No. 243 by unknown midge on flower

Houard, G. 1923. Les Zoocecidies des Plantes d'A^ri-iue, d'Asie et d'Oceanie, 2:755, No. 2710.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. Zoocccidia or Netherlands East indies, p. 915.

Mani,M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2): 146.

Ovarian gall; calyx enlarged into an urn-shaped or pyriform, apically dehiscent structure; larval chamber in a basal globose swelling of pistil, the upper part of which is also tumid.

Distribution.—Coromandal Coast and Bengal in India and also from Java and Indo-china.

Cynoglossum lanceolatum Forsk.

Gall No. 142 by Curculionid on root

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2) :128.

Irregular tumescence of the tap root from which a weevil, as yet unidentified, was reared.

Distribution.—Bengal, Bihar and Eastern Uttar Pradesh.

Cynoglossum micranthemum Desf.

Gall No. 516 by midge on flower

New gall. Irregularly subglobose, fleshy galls, enclosed in the somewhat enlarged sepals, and with tortuous passages inside, containing 1-2 larvae of midge. Size 4 mm in diameter.

Distribution.—Garhwal Himalaya.

Ehretia laevis Roxb.

Gall No. 318 by *Eriophyes ehretiae* Nalepa (?), on flowers[39]

PI. IX

Mani, M. S. 1953. *Agra Univ. J.Res.* (Sci.), 2(2):256-257.

Irregular, solid, fleshy, greenish swellings of the entire floral axis involving the calyx, corolla, stamens and pistil; their tips often enlarged and swollen into thick leafy stumps; often the entire tip of the inflorescence becomes galled. Each gall isJobulated, and encloses irregular narrow passages. The erineal pubescence white when young and fresh, but rusty-brown when old, unilocular elongate, straight, acute. The calyx expands into an irregular unlobed fleshy cup-like base, from which the other swollen floral parts project up; sometimes the tips of one or twp sepals remain free and form a leathery, incomplete sheath for the gall. All the floral parts turn to green and leafy, spongy outgrowths, enclosing numerous interspaces. The mites occur in enormous numbers both on the outer surface of the gall and in the crevices between the spongy mass.

3» Nalepa, A. 1914. *Mareellia,* 13: 57, 85.

Predatory mites are common. Each of the modified parts bear irregularly fleshy emergences, from which arise the trichomes. Size 20 mm in diameter and 10-15 mm thickness.

Distribution.—Common throughout Agra and parts of Rajasthan.

Gall No. 401 by *Eriophyes ehretiae* Nalepa (?) on leaf

Mani, M.S. 1953. *Agra Univ. J. Res. (Sci.),* 2(2):257.

Irregular out-pocketings, with leaf blade crumpled, swollen and deformed to give rise to small pustule like beutelgalls, filled with dense erincum. Usually isoloted or often extending to almost the entire leaf blade.

Compare galls on leaf of *Ehretia buxifolia* Roxb. by *Eriophyes ehretiae* Nalepa from Java.[40]

Distribution.—Agra and parts of Rajasthan.

Natural Order CONVOLVULACEAE

Aniseia uniflota Choisy (?)

Gall No. 465 by midge on flower

New gall. Solid, irregularly globose, fleshy, indehiscent, multilocular swellings of the flower, enclosed basally within the somewhat larger outer 3 and smaller inner 2 sepals, from which the gall is free, the corolla being the seat of gall formation; stamens and pistil not differentiated. Pale greenish to brown, free surface with numerous smaller or larger fleshy tubercles, finely pubscent, 15-20 mm in diameter; the larval cavities irregularly scattered and moderately large, elongate oval, up to 20 in each gall.

Distribution.—Walayar forests, South India.

Convolvulus pluricaulis Choisy

Gall No. 402 by Curculionid (?) on stem

New gall. Globose, yellowish-green gall on branches, with one circular small exit hole. Another example of the gall damaged by an insect.

Distribution.—Agra.

Gall No. 403 by *Eriophyes* sp. on bud

Rosette of swollen, twisted leaves, buds, bracts and flowers, at tips of branches, densely silvery-white pubescence.

Distribution.—Agra.

Cuscuta reflexa Roxb. parasitic on Phy Han thus sp.

Gall No. 143 by Curculionid on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):128, fig. 45, 46, 48 & 49.

Globose, extensive and moniliform, unilocular, solid, yellowish, glabrous, stem tumescence about 5 mm in diameter, with weevil larva in the cavity; larva about 3 mm long. Pupation in soil for about 8 days March-April. Larvae parasitised by *Tetrastichus* sp.

Distribution—Coromandal Coast.

Ipomaea cairica Sweet

Gall No, 244 by *Schizomyia cheriani* Mani on flower

Mani, M. S. 1935. *Rec. Indian Mus.,* 37 (4): 194; 1948. J. *Roy. Asiatic Soc. Bengal* 14 (2):146.

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[40] Drs. van Leeuwen-Reijnvaan, W. and J. 1910. *Marcellia,* 8:42, No. **101,** fig. 53. 1914. *Marcellia,* 13:57, 85; Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, dAsie et d' Oceanie, 2:757. No. 2721

Compare gall No. 245 on *Ipomaea sepiaria.*

Distribution.—South India.

Ipomaea pestigridis Linn.

Gall No. 26 by *Eriophyes* sp. on stem, leaf, etc.

PI. XXIX

Saksena, R. D. 1914. *J. Roy. AsiaticSoc. Bengal* (Sci.) 10:120, fig. 2, pi. i, fig. 2.

Mani, M. S. 1948. *J- Roy. Asiatic Sec. Bengal* (Sci.}, 14 (2): 103, fig. 7.

Irregularly globose, solid, parenchymatous, tubercutated, lobed, yellowish, sparsely pilose, rindengalls on branches, leaf petioles, leaves and sometimes also on bracts and other parts of flowers, about 25 mm to 40 mm in diameter. No true epidermis. Cortex the seat of cell proliferation; with primary and secondary vessels; vessels originating in the gall more or less completely connected with those of the main part of the mother organ. Mites live in between the tubercles.

Distribution.—Delhi, Agra, Bharatpur and neighbouring parts. Common during and immediately after the monsoon rains. A fungus seems to be associated with this gall. The dry galls persist on the dead plants for some time.

Fig. 51. On the left above is Call No. 25 on bud *of Ipomaea seindica* by *Eriophyes* sp. and on the right b<Jow arc Gall No. 26 on branch of *Ipomaea pes-tigridis* by *Eriophyes* sp.

Ipomaea seindica Stocks

Gall No. 25 by *Eriophyes* sp. on leaf, flowers, etc.

PI. XXIX

Mani M. S. 1948. *J. Roy. Asiatic Soe. Bengal* (Sci.) 14 (2) : 103, fig. 20.

Globose, solid, fleshy, irregularly lobed, agglomerated, parenchymatous, greenish swellings on leaves, flowers and even inflorescence, varying from 10 mm to 25 mm in diameter. When forming on leaves, tissue differentiation completely absent, veins completely disorganised. When forming on inflorescence and flowers, all parts lose their individuality and bocome fused together into a large fleshy mass, with parts of sepals, bracts, etc., visible here and there. Epidermis of comparatively smaller cells, without or with very few stomata.

Distribution.—Delhi, Agra and Rajasthan.

Ipomaea sepiaria Koen.

Gall No. 245 by midge of flower

PI. XXVIII

Mani, M. S. 1935. *Rec. Mian Mus.,* 37 (4):452; 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):146.

Saksena, R. D. 1942. J. *Roy. Asiatic Soc. Bengal* (Sci.), 8:20, pi. ii, fig. 3, 4.

Irregularly subglobose, solid, fleshy, pale yellow or brown, tubercled swellings of the whole flower, 15-25 mm in diameter; with numerous small oval larval chambers scattered in the flesh of the gall.

Distribution.—Coromandal Coast.

Ipomaea staphylina Roem. & Sch.

Gall No. 27 by *Eriophyes gastrotrichus* Nalepaon leaf and branch

PI. IV & XXIX

Nalepa, A. 1918 *Verh. zool.-bot. Ces. Wien,* 68:43-45, 90.

Sundar Raman, A. H. 1924. J. *Indian hot. Soc,.* 4:17.

Nayar, K. K. 1947. J. *Bumbay nat. Hist. Sc,* 47 (4):674, fig. 3, (plant not named).

Mani, M. S. 1948 J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):63, 103.

Globose, subsolid, sessile, yellowish, glabrous, multilocular, solitary, crowded or agglomerate, beutelgalls, mostly epiphyllous on leaves, and also extensively on petioles, stem, etc. Cavity more or less filled by fleshy excrescences from the wall, without any hairs, rarely with a few scattered hairs; about 4-6 mm in diameter and 2-4 mm in height, sometimes somewhat flattened above; ostiole below in case of galls on leaves, on the apex in case of galls on petioles, branches etc. There is often a minute conical fleshy projection on the lower side of the gall on leaves, with the ostiole in the centre. Practically every bit of plants for miles along bunds, banks, etc., bear thousands of gal/Is in South India.

Distribution.—This is one of the commonest galls in South India and occurs in truly enormous numbers, covering nearly every square millimetre of the surface of the plant. The same mite causes identical galls on *Ipomaea batatas* in Java.[41]

In the gall occur large numbers of larvae of predatory midges and parasitic *Tetrastichids* (Chalcidoidea).

Gall No. 246 by *A<phondylia ipomaeae* Felt on leaf

Felt, E. P. 1926. *Mem. Derpt. Agric. Inqla {ent.)t* 9:243.

PI. XIV

Mani, M. S- 1934. *Rec. Mian Mus.,* 36: 414-415. 1948. J. *Roy. Asiatic Soc. Bengal*), 14 (2):147.

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41 Drs. Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidiaof Netherlands East Indies, p. 475, No. 1267, fig. 911. Houard, G. 1922. Less Zoocecidies d-s PJantes d'Afrique, Asie et d'Oceanie, 2:749, No. 2689.

Epiphyllous, globose or pyriform, yellow or yellowish-green, glabrous, thick-walled, coriaceous, hollow, unilocular swellings, extending between and connecting the two halves of the leaf blade from either side of the midrib by a short, slender pedicel and usually 2-3, rarely upto 6 galls on each leaf and generally near the base. Gall cavity large with 1-2 larvae. Size 5-8 mm diameter. Galls always free) never agglomerate.

Distribution.—Coromandal Coast, especially in the deltaic and sub-hilly areas. *

Rivea **hypocrateriformis** Chnisy

Gall No. 247 by *Asphondylia riveae* Mani on leaf

PL **XIV**

Mani,M. S. 1934. ***Rec, Indian Mus.,*** **36:411-412; 1948.** ***J.*** *Roy. Asiatic Sot. Bengal* **(Sci.),14(2):147$_J$ fig. 8.**

Saksena, R. D. 1942. ***J.*** *Roy.* ***Asiatic*** *Soc.* ***Bengal*** (Sci.) **8:16, fig. 8, pi. i fig. 4, pi. ii, fig. 1.**

Regular, globose, ovoid or ellipsoid, rarely somewhat irregular and lenticular, pale yellow, yellowish-green or occasionally tinted brown or violet, smooth, soild, spongy, indehiscent and deciduous swellings of leaves, formed by the fusion and local swelling of two halves of the leaf blade, extending gradually to the midrib and to the margins, leaving a groove on one side and

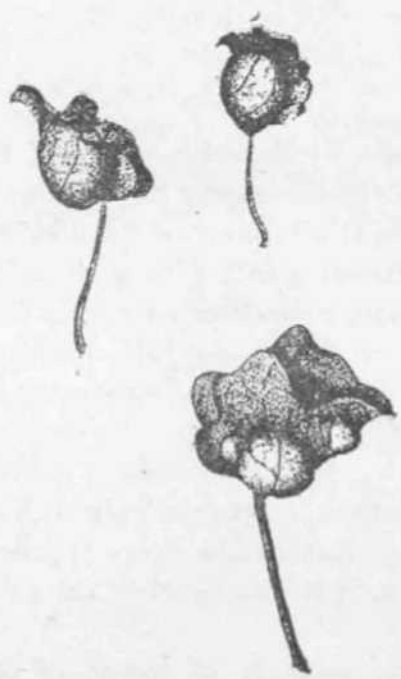

Fig. 52. G^lt No. 247 on leaf of *Rivea kypoerateriformis* by *Asphontfylia riveae.*

obscure rib on the other side of the gall. The gall surface represents the palisade side of the leaf blade. Apically the leaf blade remains normal as a wing-like process of the gall. The surface is often marked by obscure reticulations of deeper yellow-green, representing the veins. Rarely the gall surface is pubescent or obscurely finely tubercled. Sometimes the gall is elongate, subcylindrical and bright yellow. Size 75 mm long and 20 mm thick.

The gall epidermis is thick and has closely packed thin subepidermal layer of cells with some pigment. The great hulk of the gall is made of large, irregular, round or elongate parenchyma cells, with considerable interspace, giving the gall tissue a white spongy texture. Vascular elements scattered. Larvae in large numbers, irregularly burrowing in the flesh and pupating beneath the epidermis.

In a transverse section the midrib is seen on one side, more or less pronouncedly widened out, with some indications of the palisade cells nearly on the opposite side where,the normal leaf margin persists, the transition from the palisade and spongy parenchyma to the greatly hypertrophied undifferentialed gall parenchyma is distinct. The upper epidermal cells of the two halves of the blade may be recognised in places as irregular and generally hypertrophied zig-zag sutural lines in the middle. The cell proliferation is confined to the leaf parenchyma but the veins do not suffer conspicuous modification.

The eggs are deposited in between the fold of the leaf in the bud and the larvae at first remain in the middle of the rapidly swelling mass. The sides of the folds along the midrib swell enormously. The grown up larvae burrow up to the gall surface and pupate just beneath the intact epidermis. The central spaces with larvae often have copious growth of an unknown fungus, the myeclia of which ramify and penetrate in between the cells in the region.

Distribution-—South India.

Gall No. 248 by midge on flower

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):147.

Irregularly subglobose, lobed, rugose, tuberculated, solid, fleshy, indehiscent, deciduous, brownish swellings of an entire flower, with all parts swollen, fused together and undifferentiatedj somewhat flattened above; the pedicel

Fig. 53, Vertical section through Gall No. 248 on flower of *R'wta hypocraUri/ormis* by an unknown midge.

also slightly tumid; larvae numerous in small oval chambers scattered irregularly in the flesh of the gall. Size 15-25 mm in **diameter.** Midge larvae heavily parasitised by Chalcidoidea.

Distribution.—South India.

Plante icertae sedis

Gall No. 366 by bacteria or fungi on branch

Irregular rugose or tuberculated, solid, fleshy indehiscent unilateral cortical outgrowths of branches, about 15 mm. in diameter.

Distribution.—Calcutta.

Natural Order SOLANACEAE

Capsicum ∆nnimiw

Gall No. 341 by *Asphondylia capsici* Barnes on flower

Barnes, H.F. 1922. *Ann. Mag. nat. Hist.*, 9 (10) : 478.

Mani, M.S. 1953. *Indian J. Ent.*, 15 (2).121-122.

Irregular, soft, fleshy swellings of flower buds and ovaries, with 2-3 midge larvae in small chambers.

Distribution.—Hyderabad and parts of Andhra State.

Lycopersicm esculentum Mill

Gall No. 289 by *Heterodera marioni* on root

Barber, C.A. 1901. *Madras Dept. Land. Rec. Agric. 2, Bull.*, 45:229.

Houard, G. 1*923. Les Zoocecidies des Plantes d'Afrique,d'Asie et d'Oceanie, 2:789 No. 2853, Fig. 1697.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2) : 96.

Extensive root swellings. Common in several parts of India. Also reported from Algeria and other parts of Africa.

Nicotiana tabaccum Linn.

Gall No. 163 by *Phthorimaea heliopa* (Low) on stem

Lywer, 1900. *Proc. Linn. Soc. N.S. Wales*, 417.

Fletcher,T.B. 1914. Some South Indian Insects, Madras, p. 454, pi. xliii.

Mani, M.S. 1918. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14(2) : 79, 131.

Diffuse fusiform or oval hollow, indehiscent swellings of branches and leaf petioles.

Distribution.—Common in India, Ceylon, Burma, Java and Australia.

Solatium melongena Linn

Gall No. 348 by *Asphondylia beguni* Mani on flowers

Mani, M.S. 1953. *Indian J. Ent.*, 15 (2) :119-121.

Irregular or subglobose, fleshy, indehiscent swellings of flowers, with the petals irregularly rolled iip.

Distribution.—Hyderabad : Deccan (S. India). Also reported from Tanganyika (Africa).

Solanum tuberosum

Gall No. 395 by *Heterodera marioni* on tubers

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2:788, No. 2848, fig. 1696.

Mani M.S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 96

Irregular tuberosities and nodosities on the underground tubers and roote.

Distribution.—Simla Hills, and Hyderabad (India). Also from Algeria and Cape.

Natural Order SCROPHULARIACEAE

Striga orobanchoides Benth.

Gall No. 468 by an unknown weevil on stem

Mani, M.S. 1953. *Agra Univ.J. Rss. (Sci.)*, 2 (2):257.

Diffuse, local fusiform, indehiscent, hollow swellings of tender branches, with a single larval tunnel ; measuring about 8 mm. long and 5 mm. thick.

Distribution.—Hyderabad (Deccan)

Natural Order GESNERAGEAE

Aeschynanthus perottetti A. DC.

Gall No. 306 by *Prolasioptera aeschynanthus-perottetti* Mani on stem

PL XII

Mani, M. S. 1943. *InbianJ. Ent.* 5 : 151.

Nayar, K. K. 1945. *J. R. Asiatic Soc. Bengal* (Sci.), 11 : 18-19, fig. 1.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci,), 14 (2) : 147, fig. 41.

Regular subglobose or globose, solid, fleshy, brown, seessile, indehiscent, smooth or obscurely rugose, crowded or also agglomerate swellings on branches, about 5-8 mm in diameter, with more than one larval chamber irregularly disposed in the gall parenchyma.

Compare gallon *A. horsfieldii* R. Br., *A- javanica* Hook, and *A.pulchra* from Java[42].

Distribution.—Travancore.

Natural Order BIGNONIACEAE

Stereospermum tetragonum DC.

Gall No. 249 by Thrips (?) on ovary

„ Mani, M.S. 1935. *tee. Indian Mus.* 37: 452; 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 147.

Subcompressd, unilocular, hollow, thick, leathery-walled, fusiform or reniform, somewhat beaked, brown, smooth or somewhat pitted galls, 25 mm long and 15 mm thick, in place of the normal fruits over one-third of a metre long.

Distribution.—An&Ynal&i Hills (South India).

Tecoma undulata G. Don.

Gall No. by *Schizomyia indica* Kieff. on leaf

Kieffer, J. J. 1908. *Marcellia,* 7 : 153.

Houard, G. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie ct d'Oceanie, 2 : 908, No. 3287.

Sundar Raman, A. H. 1924. *J. Indian hot. Soc,* 4 : 41.

Mani, M. S. 1934. *tee. Indian Mus., 36* (4) : 406; 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14(2) : **141.**

Subglobose, shortly pedicellate, hypophyllous, smooth, bluish, sparsely clothed with procumbent hairs, inserted on one of the main veins, with an umbilicus at the s mmit; size of gall 4-6 mm in diameter. External fleshy, soft cortex, with a central hard woody core; larval cavity large, with a single krva each gall.

Distribution.—Kurseong : Eastern Himalayas.

Gall No. 566 by midge on stem

Kieffer, J. J. 1908. *Marcellia,* 7 : 154.

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2:907-908, No. 3284.

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[42] Houard, G. 1923. Les Zoocecidies **des** Plantes d'Afrique, d'Asie et d'Oceanie, 2:797-798, Nos. 2881-288; Drs. van Leeuwen-Reijnvaan, W. & J. 1926. Zoocecidia of Netherlands East Indies, 50-504, No. 1344-49, figs. 953-956.

Small swellings of stems, with small larval chambers, each containing one larva.

*Distribution^*—Kurseong: Eastern Himalaya.

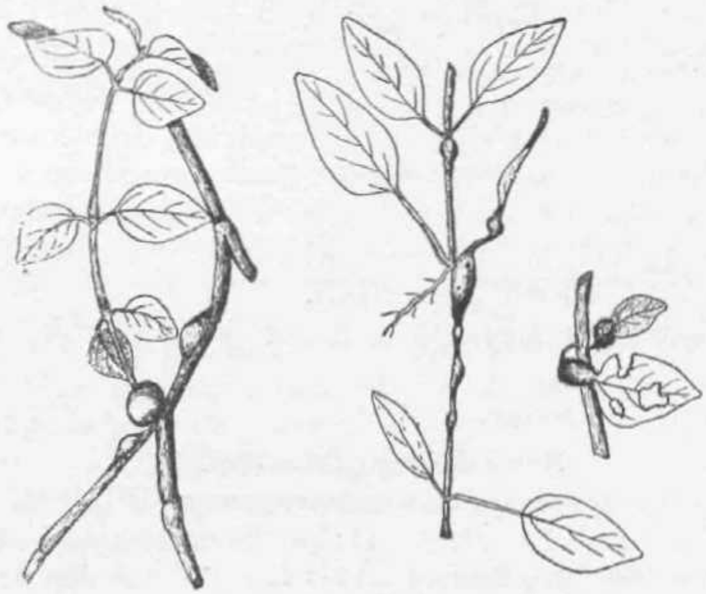

Fig. 54. Gall No. 252 on stem of *Ayslacea gangetica* by an unknown midge.

Natural Order PEDAUACEAE

Sesamum **indicum** Linn.

Gall No. 251 by *Asphondylia sesami* Felt on flower

Felt, E. P. 1916. *Canadian Ent.*, 48 : 31.

Fletcher, T. B. 1916. South Indian Insects, Madras, p. 364, fig. 225.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc,* 4 : 4 1 , No. 80.

Mafli, M. S. 1934. *Rtc. Indian Mas., 36* (4) : 410; 1948. *J.Roy. Asiatic See. Bengal,* (Sci.), 14 (2) : 148.

Irregular solid, fleshy but hard crumpled, contorted flower galls, with 4-5 larvae, often heavily parasitized by *Eurytoma* sp. and other Chalcids.

Distribution,—Common in India especially South India & Madhya Pradesh. Also **in** Uganda (Africa).

Natural Order AGANTHACEAE

Ad at **hod** a **vasica** Nees

Gall No. 347 by midge on stem

New gall. Regular, oval or stout, fusiform, or also unilateral, irregularly oval and bulged swellings, 30 mm long and 10 mm thick, green, smooth; solid, fleshy, indehiscent, persistent; with larval chamber single, short, cylindrical, slender, sclerenchyma tube, axial and longitudinal.

Distr'ib ulfan. —Trava ncore.

Asystacea gangetica T. And.

Gall No. 252 by midge on stem

Mani, M. S. 1935. *Rec. Indian Mus.*, 34 (4) ; 452 : 1948. J. *Roy. Asiatic Soc. Bengal,* (Sci.), 14 (2) : 148.

Subglobose, oval or fusiform (fig. 54), localised or also extensive, often unilateral, solid, smooth, brown or green emergences on, or swellings of branches, a hard outer rind and a central spongy core; larval chambers slender, elongate, with some sclercnchyma cells. Size 5-8 mm thick.

Distribution.—Goromandal Coast and extending up to south Bengal.

Asystacea violacea Dalz

Gall No. 305 by *Lasioptera asystasiae* Nayar on stem

Nayar, K.K. 1943. *J. Roy. Asiatic Soc. Bengal* **(ScL),** 11 : 19, fig. 2; 1944. *Indian jf.* £"(.,4(1-2) : 71.

Rao, S. N. 1955. *Agra Univ. J. Res. (Sci.),* 4 : 230.

Somewhat irregularly oval or stout fusiform, rarely subglobose, solid, fleshy swellingSj smooth but sometimes longitudinally furrowed; green to brownish-red and when old turning dark brown; larval cliembcrs elongate and sclerenchymatous, more than one. Size 5-30 mm long and 5-15 mm thick.

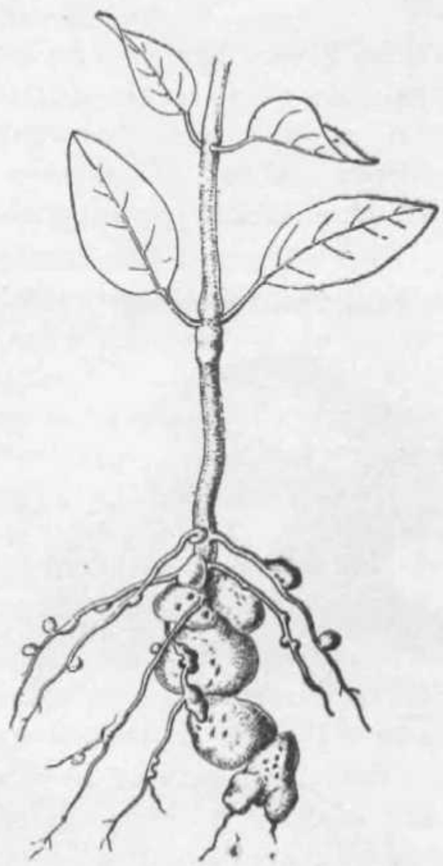

Fig. 55. Gall No. 2 on roots of *Ruellia prostrata* by *Heterodcra manoni.*

Distribution.—Pampadapara: Travancore.

Compare gall by midge on *A. intrusa* Blumc from Java*[3].

Justicia diffusa Willd.

Gall No. **144** by Curculionid on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.}, 14 (2); 128. **fig.** 62-65.

Elqngate oval or fusiform, solid, terminal or rarely internodal stem tumescence, about 10 mm long and 3-5 mm in diameter; larval chamber single,

[43] Houard, G. 1923. Les Zoocecidics des Plantes d'Afriquc, d'Asie et d'Occanic 2 : 808, No. 2923.

longitudinal; larva stout at thorax and abruptly tapering behind; pupation in gall; adult weevil black, unidentified.

Distribution.—Southern districts of Coromandal Coast.

Ruellia prostrata Poir.

Gall No. 2 by *HUerodera marioni* on root

Mani, M. S. 1948. *J. Roy. AsiatkSoc. Bengal* **fSd.),** 14 (2); 96, fig. 4.

Regular, globose, subglobose, local, rarely extensive, solid, fleshy outgrowth o.i roots measuring from 3 to 15 mm in diameter (fig. 55}; or tumescences of roots; with cortax, cambium and medulla proliferating. Vascular bundles completely disorganised, the individual vessels being scattered irregularly in the parenchyma of gall. Worms in small cavities situated irregularly in any part of the gall. Sometimes several galls agglomerate either in part or completely.

Distribution.—Calcutta,

Gall No. 304 by Aleurodid on leaf

Mani, M, S. 1948. *J. Roy Asiatic Soc. Bengal* (Sri.), 14 (2) 121.

Hypophyllous, circular, cup-like, pink coloured, granular, fleshy, solid emergences from the epidermis, about 2-3 mm in diameter, with a clear central depression, in which the aleurodid larvae remain. Campare gall No. 103 on *Achyranthes aspera.*

Distribution.—Coromandal Coast & Gangetic Plain.

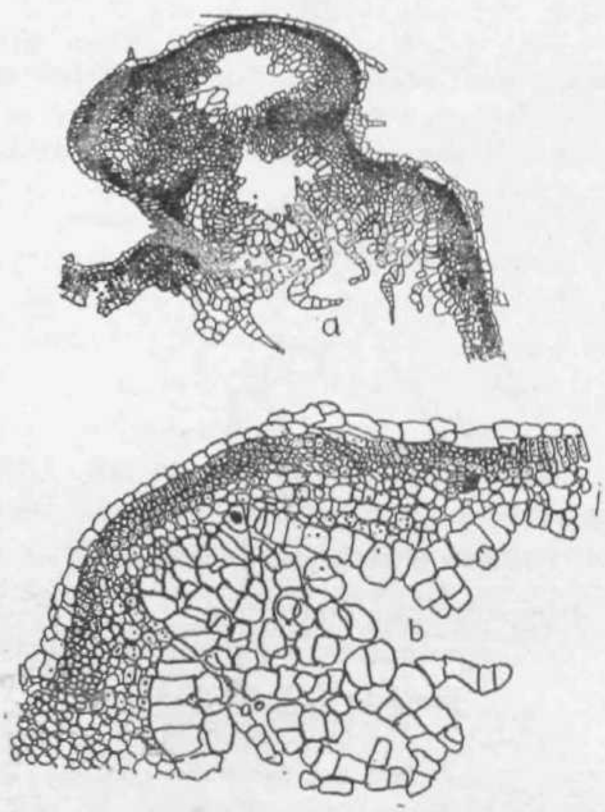

Fig. *56.* *(a)* Sagittal section of Gall No. 419 on leaf of *Strobilantkes dalfousiantts* Clarke by *Eriophyes* sp.; *(b)* part of the gall tissues *of* the same gall more highly magnified to sho*v the changes to the lower epidermis.

Strobilanthes dalhousianus Clarke

Gall No. 419 by *Eriophyes sp.* on leaf

PL VI

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.), 2 (1) : 150-152, pi. iv, fig. 10, text fig. 6; 1954. *ibid.*, 3 (1) : 36.

Mostly epiphyllous but sometimes also hypophyllous; irregularly globose or pyriform, lobed or agglomerate or tuberculate, pinkish-violet or yellowish-green, sessile beutelgalls, scattered irregularly in large number, especially on either side of and close to the midrib; with scattered, well separated, short, erect or somewhat curved, simple, transparent trichomes. Gall cavity extensive, with numerous, irregular, fleshy, multicellular, emergences from greatly hypertrophied epidermal cells. Ostiole open; size of gall 1-2 mm in diameter. The upper epidermis of the gall hypertrophied. Beneath this is a zone of small subglobose cells with chlorophyll, with intercellular air-spaces and continuous with palisade cells of the normal part of the leaf and 3-4 cell deep. Within this is a zone of greatly hypertrophied, irregular spongy parenchymatous cells, lacking chlorophyll but with more numerous intercellular spaces and often produced into large irregular fleshy emergences within the lumen of the gall or produced into irregular multicellular or branched hair-like outgrowths. The spongy mass of emergences are developed particularly opposite a vein and from the cortex. The inner epidermis of the gall, representing the lower epidermis of the leaf, is composed of enormously enlarged giant cells, contributing partly to formation of the fleshy emergencen the gall cavity. Trichomes larger than the parenchyma cells. The fleshy emergences grow towards each other and frequently coalesce and thus divide the gall cavity into compartments.

Distribution.—Throughout Garhwal-Kumaon Himalya up to elevation of nearly 2700m; Simla Hills, Dhauladhar Range in Punjab Himalya, especially on the more humid southern slopes.

Two spp. viz. *Eriophyes diantherae* Nal.,[44] and *E. strobilanthi* Nal.[45] cause a somewhat similar gall on *Strobilanthes filiformis* Bl.and *Strobilanthes* sp. respectively in Java. On leaf of *S. crispus* Bl. are described two other mite galls from Jawa.[46]

Gall No. 520 by *Albugo* (?) on stem

New gall. Irregularly subglobose or moniliform, white or dirty white, rough, solid, fleshy, often unilateral, sessile, free or agglomerate nodosities, scattered on branches; arising as epidermal and subepidermal cortical emergences, without mach affecting the central stele. Size 5-10 mm thick.

Distribution.—Garhwal Himalaya.

Strobilanthes integrifolia O. Kze

Gall No. 580 by Lepidoptera on stem

New gall. Regular, fusiform, hollow, unilocular, indehiscent, persistent,

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u Nalepa, A. 1914. *Marcellia,* 19:59.
Drs. van Leeuwen-Reijnvaan, W. and J. 1911. *Marcellia,* 10:71, No. 212;
t Nalepa, 1929. *Macellia,* 25:141.

« Nalepa, A. 1921. *Treubia,2:HS; Ibid.* 3:432 (1923); *Marcellia,* 25:141 (1929).

**** Drs. van Leeuwen-Reijnvaan, W. and J. 1911. *Marcellia,* 10:86-87, No. 243-244, fig. 100.).**

diffuse swellings of the main axis, about 12 mm long and 5 mm thick, finely pubescent, brown; with irregular emergence hole. Rare gall.

Distribution.—Mahabaleswar Hills (Bombay).

Natural Order VERBENAGEAE

Avicennia efficinalis Linn.

Gall No. 507 by *Eriophyes* sp. on leaf

PI. XXVI

Epiphyllous or hypophyllous, sessile, subglobose, free or agglomerate, indehiscent, solid, soft, fleshy, finely verrucose beutelgalls, about 2-4 mm in diameter; with fine, soft, fleshy, closely crowded, pale hair-like emergences on the surface: the gall tissue with irregular, narrow, erineum-filled and nearly obliterated interspaces; on the other side of the leaf with a small discoloured depression, having an irregular ostiole. The galls develop in large numbers in a lineal series on the margin of the leaf or along the midrib ;the same gall never visible on both sides of the leaf blade. The galls also often develop on the petiole and tender branches in closely crowded or agglomerated series.

Distribution.—South Travancore.

Compare gall on leaf of *Avicennia alba* by *Eriophyes* sp. from Java.[47]

This gall is different from the Javanese record on *A. officinalis* by *Eriophyes* sp.[48]

Clerodendron inerme Gaertn.

Gall No. 253 by midge on shoot

Drs. van Leeuwen-Reijnvaan, W. & J. 1911. *Marcellia,* 10:69-70, No. 209, fig. 83; 1916. *Bull. Jardin hot. Buitenzorg,* (2) 21:27, To. 12.

Dr. van Leeuwen, W. 1920. *Ann. Jam. bot.*9 31:64-65, No. 1, fig. 2.

Drs. van Leeuwee-Reijnvaan, W. & J. 1926. Zoocecidia of Netherlands East Indies, p. 487, No. 1298, fig. 933.

Houard, G. 1923. Les Zoocecidies des Plantes df Afrique, d'Asie et d'Oceanie, 2:769, No. 2770.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2): 148.

Galls on leaves, stems and buds; leaf galls: subglobose on one side and rather truncated on the other side; light green, white or pink; with fissures at apex when old; stem or petiole galls: coniform, rarely globose.

Distribution.—Coromandal Coast in South India and also from Java.

According to Drs. van Leeuwen-Reijnvaan *(loc. cit.),* this gall floats on water and thus gets dispersed by sea.

Clerodendron phlomidis Linn.

Gall No. 307 by *Paracopium cingalense* (Walk.) on flowers

PL XII

Walker, 1873. *Cat. Het.,* 6:178.

Distant, ^1902. *Ann. Mag. Nat. Hist.* ,(7) 9:3545 1904. *Fauna Brit. India,* Rhynch. 2:128, fig. 92.

« Drs. van Leeuwen-Reijnvaan, W. and J. 1918. *Bull. Jardin hot. Buitenzorg* (5\ s1 1 :?6, No. 524.

Houard, G. 1923. Les Zoocecidies des Plantes d' Afrique, d* Asie et d' Oceanie, 2:772, No. 2785.

48 Drs. van Leeuwen-Reijnvaan, W. and J. 1910. *Marcellia,* 8:41, No. 98, fie. 52. Houard, G. 1923. Les Zoocecidies des Plantes dJ Afrique, d* Asie et d'Oceanie, 2:771, No. 2776.

Fischer, C. E. 1911. *J. Bombay nat. Hist. Soc*,20:1169-1170, fig. 1-4.
Sundar Raman, A. H. 1924. *J. Indian hot. Soc,* 4:10, No. 9.
Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):72, 110.

Globose, thick-walled, coriaceous, dehiscent, pale green, hollow inflations of the corolla of the fiowers, contained partly within the greatly distended calyx. The normally tubular corolla has its limb enormously inflated, without development of the ovary and style. The tip occasionally remains as a shrunken vestige on the gall. The stamens remain vestigial. Inside, the cavity is spacious, simple, with 1-7 nymphs of nearly the same instar, very rarely of different stages of development. Outer surface clothed with multicellular hairs. Size 9-12 mm diameter.

Distribution.—Common nearly all over South, West and North India.

Premna **serratifolia** Linn.

Gall No. 28 by *Erlophyes premnae* Nalepa on leaf.

Drs. van Leeuwen-Reijnvaan, W. & J. 1910. *Marcellia,* 9:55-56, No. 137.
Nalepa, A. 1914. *Marcellia,* 13:57-58,85.
Houard, G 1923. Les Zoocecidies des Plantes des d'Afrique, d'Asie et d'Oceanie, 2:762, No. 2740; 763, No. 2743.
Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 489, No. 1306.
Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):65, 104.

Lop-sided, clavate, slender, petiolate, pale green or yellowish, unilocular, glabrous, epiphyllous, cepholonian beutelgalls, about 5 mm in diameter and 5 mm in height, with ostiole hypophyllous and covered by fine hairy outgrowths at the entrance to the ostiole only, cavity with fleshy outgrowths from the wall but almost free from hairs.

Distribution.—Walayar Forest near Coimbatore.

Compare with gall on *Premna integrifolia (=cyclopkylla)* by the same species of mite from several of the islands in the Tndian and Pacific Oceans.

fectona grandis Linn.

Gall No. 280 by midge on stem

Stebbing, E. P. 1899. Injurious Insects of Indian Forest, pp. 83-84.
Sundar Raman, A. H. 1921. *J. Indian hot. Soc.* 4:45, No. 98.
Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2):148.

Irregularly globose, verrucose, extensive, agglomerate, multi-chambered, solid, hard, woody, indehiscent, persistent, unilateral, cortical, composite swellings on branches, brown; rough; the swellings usually 100-200 mm long and 20-50 mm thick. With a single larva in each of the chambers, which are largely peripheral, oval, without conspicuous sclerenchyma wall, spacious.

Distribution.—South India.

Gall No. 414 by an unknown midge on leaf

PI, XXXI

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.), 2 (2) : 257-258, p. vi.

Regular, depressed, circular, discoid, hypoyhyllous beutelgalls about 3-4 mm in diameter and 1 mm high, solitary, isolated, shortly pedicelled, covered by moderately dense, long, straight, simple, cottony-white, pointed, villous trichomes, unicellular, thin-walled, indehiscent. Ostiole minute, epiphyllous. The galls are usually densely crowded on the leaf, often over 300 galls per leaf, giving it a cottony-woolly appearance. On the upper surface of the leaf the site of the gall is indicated by a small fleshy tubercle. Each gall is attached to a vein. A single larva in each gall.

Distribution.—Trivandrum, Walayar Reserve Forest south of Coimbatore.

Vitex negundo Linn

Gall No. 477 by *Eriophyes* sp. on leaf

New gall. Highly irregularly globose, sessile, solid, fleshy, soft, rugose beutelgalls, usually extensively agglomerate, with complicated, erineum-filled and nearly obliterated spaces in between parietal fleshy emegences within. Generally developing in large numbers on one or both sides of the left blade, petiole or tender branches. Single gall measures about 2-3 mm in diameter and the agglomerate masses often grow upto 50 mm in length and 10 mm in thickness.

Distribution,—Udaipur (Mewar).

Vitex pubescens Vahl.

Gall No. 29 *Eriophyes cryptotrichus* Nalepa on leaf

Drs. van Leeuwan-Reijnvaan, W. andj. 1912. *Marcellia,* 11:98, No. 342, fig. 153; **1916. *Bull Jardin bot. Buitenzorg,* (2) 21:19, No. 49.**

Nalepa, A. 1914. *Marcellia,* 13:58-59, 85.

Houard, C. 1923. Les Zooceidies des Plantes d'Afrique, d'Asie et d'Oceanie 2:766, No. 2756, fig. 1665.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 493, No. 1317.

Mani, M. S. 1948. *J.Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 63, 104.

Epiphyllous, hemispherical, verrucose beutelgalls, about 0.5 -5 mm in diameter, cavity large and open below, with very dense hairy outgrowths, yellow when old.

Distribution.—Coromandal Coast in South India; Java, Sumatra and Sebesi group of Islands.

Natural Order NYCTAGENGEAE

Boerhaavia spp.

Gall No. 254 by midge on flower

Mani, M. S. 1953. *Rec. Indian Mus.* 37:453; 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) :*149.

The smail pink coloured heads of flowers in the loose panicles have inferior* gamophyllous perianthus, with monocarpellary uniovular ovary. Immediately above the level of the ovary, the perianth tube is strongly constricted, so that it is divided distinctly into a stout basal part enclosing the ovary within, (which is however not adherent to the perianth tube) and a thin, membranous, pink-red expanding upper part. At the end of flowering, the upper membranous part shrivels up, but the basal portion persists, enlarges, becomes more or less hardened and constitutes a sort of outer envelope for the fruit. This also develops numerous sticky, short, stout, stigmatic hairs. During gall forma-

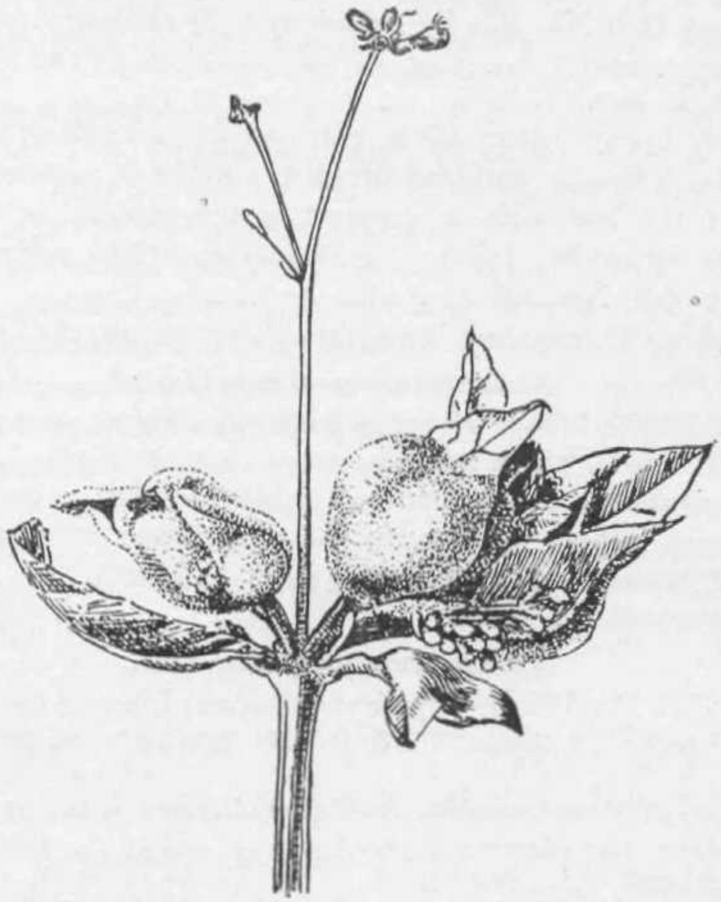


Fig. 57. Gall No. 255 on bud and leaf of *Bvtrkaivia* spp. by *Punarnavomyia boerh'-iaviae-foliae.*

tion the basal part of the perianth tube, below the charcteristic constriction, becomes enormously inflated and thickened into a hollow, simple, discoid, globose, or flask-shaped, unilocular, coriaceous sessile gall; pink-red, longitudinally five-ridged, covered by sticky, stout, capitate hairs; occasionally the shrivelled up upper part of the perianth tube may be found with vestiges of the stamens. The undeveloped ovary lies at the bottom of the gall cavity. Each gall contains 1-2 larvae. Size of the gall 5.0 mm in diameter.

Distribution.—Madras town.

Gall No, 255 by *Punarnavomyia bocrhaaviaefoliae* (Mani) on bud

Mani, M.S. 1943. *Indian* J. *EnL,* 7:161; *J. Roy. Asiatic Soc, Bengal* (Sci.), \\ (2) : 94, 149, fig. 6, (1948) ; *Indian J. EnL,* 15:122-125 (1953). Rao, S. N. 1954. *Agra Univ. J.* 7f«.(Sci.) ,4 (1) : 261.

Regular globose, subglobose or oval swellings of the vegetative buds, with the leaves greatly and irregularly enlarged, thickened and also curled, and lacking tissue differentiation; pale green or bright pink; densely covered by enlarged siicky glandular hairs; with a number of irregular spaces in between the deformed leaf-folds, in which numerous yellow larvae pf the midge occur. Pupation in soil

Distribution.—Common throughout India during rains.

Natural Order AMARANTACEAE

Achyranthes aspera Linn.

Gall No. 103 by *Bemisia* sp. (?) on leaf

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 81, 121.

Nayar, K. K. 1947. *J. Bombay nat. Hist. Soc*9 47 (4) : 671.

Irregular, hypophyllous, often extensive and spreading, a more or less circular, fleshy, granular and red or pink patches of parenchymatous solid emergences of the leaf, with a deep pit in the middle, in which is the nymph of the aleurodid; 1-5 mm in diameter; surface rugose.

Compare»gall No. 304 on *Ruellia prostrata.*

Distribution.—Throughout India, common during the rainy season.

Amarantus caudatus Linn.

Gall No. 145 by *Hypolixus truncatulus* (Fabr.) on stem

Mani, M. S. 1948. *J. Roy. Asiatic Soc Bengal* (Sci.) 14 (2): 128.

Diffuse internodal, fusiform or oval or often irregularly moniliform, rugose or smooth, green, almost solid, unilocular, in dehiscent swellings, usually close to the ground, with a single grub inside; pupation in gall.

***Distribution.*— South India.**

Amarantus gangticus Linn.

Gall No. 146 by *Hypolixus truncaiulus* Linn, on stem

Drs. van Leeuwen-Reijnvaan, W. & J. 1918. *Bull. Jardin hot. Buitenzorg,* (3) 1 : 22, No. 509.

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asic et d'Oceanie, 241, No. 887.

Ahmad, T. 1939. *Indian J. Agric. Sei.*, 9 (4) : 600-627, pi. xxxvii, xxxviii.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) :87, 128.

Regular, globose, fusiform, often moniliform and irregular and extensive, knotty, solid, glabrous, green or brown, indehiscent, persistent swellings of branches, about 50 mm long and 10 mm thick; with one wide linear larval chamber, containing a single larva or pupa.

Distribution:—Common all over India; also from Java.

Amarantus spinosa Lion.

Gall No. 147 by *Hypolixus truncatulus* (Fabr.) on stem

Drs. van Leeuwen-Reijnvaan, W. & J. 1918. *Bull. Jardin hot. Buitenzorg,* (3) 1 :22 No. 510.

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asic et d'Oceanie, 242.

ManirM. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 129.

Similar to gall No. 146 described above.

Distribution.—Coromandal coast in South India; also from Java.

Amarantus viridis Linn.

Gall No. 148 by *Hypolixus truncatulus* (Fabr.) on stem

Drs. van Leeuwen-Reijnvaan, W.& J. 1918. *Bull. Jardin hot. Buitenzorg,* (3) 1 : 22, fig. 511.

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asic et d'Oceanie 242.

Mani. M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 129.

Compare Gall No. 146 above. Java and South India.

Amarantus sp.

Gall No. 478 by *Heterodera marioni* on root

New gall. Irregular, extensive, diffuse, oval or elongate fusiform, solid, indehiscent and often moniliform swellings of the lateral roots, about 2-3 mm thick.

Distribution.—Agra.

Cyathula tomentosa Moq.

Gall No. 5j06 by. *Eriophyes* sp. on branch

PI. XXVI

Mani, M. S. 1954. *Agra Univ. J. Res.* (Sci.), 3 : 36, pi. viii, fig. 6.

Irregular, localised or extensive, warty, solid, rough, dark reddish-brown, indehiscent, persistent, hard, fleshy, unilateral, epidermal or cortical outgrowths, about 50 mm long and 20 mm in diameter, on petioles, branches, etc. Superficially covered by a moderately thick layer of dead cells, beneath which the mass of gall comprises small closely packed parenchyma cells, with irregular vascular elements. With the eriophyid of this gall a fungus is also probably associated.

Distribution.—Near Lakha Pass, 3000 m above mean sea level, Dhauladhar Range, Himalaya (Kangra Distt.), 13 kilometres from Dharmsala.

Digera arvensis Forsk.

Gall No. 299 by *Asphondylia digerae* Mani on ovary

Mani, M. S. 1943. *Indian J. Ent.,* 5:155;1948. *J. Roy Asiatic Soc. Bengal* (Sci.), 14 (2):92, 148

Subglobose, somewhat flattened, pinkish-red, solid, soft, fleshy, unilocular swellings of the ovary, with the perianth and ovules completely atrophied, 2 mm thick and 5 mm long, with a single dirty-white larva in each gall. Pupation in gall. *Bracon* parsite on larva.

Distribution.—Western parts of Uttar Pradesh, fairly common during the rains in August-September.

Natural Order CHENOPODIACEAE

Chet&opodium album Linn.

Gall No. 111 by *Brevicoryne chenopodii* (Sch.) on leaf

Das, B. 1918. *Mem. Indian Mus.,* 6:183, pi. xix, fig. 7,8,9,

Sundar Raman, A.H. 1924. *J. Indian hot. Soc,* 4:15, No. 39.

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14(2)-82,123.

Pod-like, pouch-shaped leaf gall formed by fusion of leaf margin or a part of its surface near one side is folded over the rest of the leaf and kept in than position, open at the ends, pinkish in colour.

A somewhat similar gall is described by Houard[4*] on leaf of *Chenopodium murale* Lifln. by *Aphis otriplicis* Linn, from Tunisia.

Salsola foetida Delile

Gall No. 570 by unknown midge on stem

Houard, G. 1914. *Marcellia,* 13:152, No. 33, fig. 48; 1915. *Marcellia,* 14:93, No. 1; 1922. Les Zoocccidies des Plantes d'Afrique, d'Asie et d'Oceanie, 1:235, No. 867, fig. **462.**

Trotter, A. 1940. *Marcellia,* 30:83, 86-87.

« Houard, G. 1922. Lcs Zoocecidies des **Plantes d'Afrique, d'Asie et d'Oceanie,** 1:221, **No. 822.**

Regular, subglobose, gemmiform, glomerulous swellings, 5-10 mm in diameter, with dense sublinear, unequal, acutely produced, foliaceous outgrowths covered by hairs and arising on a small, basal or central hispid core; bilocular or unilocular swellings of the tip of the branch; gall cavity conical. The gall is an agglomeration of the leaves, with the obliteration of the internodes and suppression of terminal growth of the branch.

Distribution.—Punjab; also recorded from Senegal, Arabia and Sahara (Tripoli).

Natural Order POLYGONACEAE

Polygonum alatum Ham

Gall No. 589 by fungus on stem

PL XVI

New gall. Regular, globose, oval or reniform, solid, fleshy, soft, smooth, grey, pale-blue, black or brown unilateral swellings of cortex of branches, inflorescence axis, flowers etc., dehiscent and deciduous, 10-12 mm in diameter.

Distribution.—Narkanda 2900 m above mean sea level, Himalaya.

Polygonum amplexicaule Don.

Gall No. 525 midge on stem

Diffuse, fusiform, indehiscent, solid, fleshy swellings of the stem, about 25-35 mm long and 15 mm thick, with longituinal larval gallery.

Distribution.—Chakrata.

Gall No. 586 by midge on bud

PL XVI

New gall. Regular, subglobose, ovate or cordate, solid, fleshy but moderately hard, indehiscent, smooth, reddish-brown swellings ofcauline buds close to the ground level, with a fleshy, obtusely conical mucro apically, 3-4 irregular larval chambers scattered in the middle, each larval'cavity surrounded by a spongy mass, a single larva in each cavity; gall yellow-brown or reddish and with the surface with acrescent large scales. Size 25 mm long and 20 mm diameter.

Distribution.—Narkanda, 3000 mm above mean sea level, Himalaya.

Polygonum molle D. Don.

Gall No. 256 by *Lasioplera textor* Kieff. on stem

Kieffer, J. J. 1905. *Ann. Soc.Bruxelles*, 29(2) :155-157, fig. 3.

Houard, G. 1922. Les Zoocecidies des Plantesd'Afriqiie, d'Asie et d'Oceanie, 1:218-219, No. 820.

Sundar Raman, A. H. 1924. *J.Infcn bot. Soc,* 3:36, No. 54.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci), 14(2) :149.

Irregular, unilateral, cauline, subglobose or extensive swellings of the stem, extending to about 50 mm in length; a sublignous paler inner zone with an outer cortical layer of about 1-2 mm thickness. Larval chambers elongate, 2-2.5 mm long, with an operculate opening on the surface of the gall. Pupation in gall. Adults emerge in June.

Distribution.—Kurseong: Eastern Himalaya.

Polygonum sp.

Gall No. 498 by *Eriophyes* sp. on leaf

New gall. Epiphyllous, lop-sided or curved, clavate, smooth or pubescent, yellowish-green beutelgalls, generally free but crowded. Unilocular, with erineum inside, ostiole hypophyllous. Size 8 mm long and 3-5 mm thick.

Distribution.— Dhauladhar Himalaya near Dalhousie, up to 2500 m above mean sea level.

Natural Order PIPERACEAE

Piper betle Linn

Gall No. 340 by *Gynaicothrips pallipes* Karny on leaf

Drs. van'Leeuwen-Reijnvaan, W. & J. 1909. *Marcellia,* 8:114, No. 78.

Karny & Drs. van Leeuwen-Reijnvaan, W. & J. 1914. £. *Wisssn. InsektenbioL,* (2) 10:202, No. 44, fig. 1.

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanic, 1:6*. No. 152.

Ramakrishna, T.V. 1928. *Mem. Depart. Agric. India* (ent.) 10 (7) :304.

Mani, M.S. 1948. J. *Roy. Asiatic Soc Bengal* (Sci.) 14:71, 109, No. 490.

Swelling and curling of the leaf blade upward on either side of the midrib, the part of the blade near the midrib strongly tumescent, rugose, crinkled; the midrib itself remains nearly normal; the swollen halves of the leaf blade often curl outwards and towards each other, so th t a tube is formed, which is as long as the leaf itself. The gall is hard and opened with difficulty. Young leaves when attacked by the thrips, turn completely into galls, even the apices of the blade are not wholly unrolled. The outer surface of the gall shows transverse corrugations and folds, of which the former represent the lateral veins. Various stages of the thrips in ide the elongate tubular cavity of the gall.

Distribution.—Wyanad : South India. Also Java.

Piper nigrum Linn

Gall No. 49 by *Gynaikothrips chaviae* Zimmerman on leaf

PL VII & XXIX

Ramakrishna, T.V. 1928. *Mem. Depart. Agric. India,* (ent.) 10 (7):302.

Mani, M.S. 1948 J. *Roy. Asiatic Soc. Bengal* (Sci) 14 (2):109.

Nayar, K.K. 1948. J. *Bombay nat. Hist. Soc,* 47 (4) :669,

Cylindrical, twisted, pale green, crinkled, folding and swelling of leaf blade, on either side of mid-rib.

Distribution.—Travnacore-Cochin Hills.

Gall No. 336 by gall midge on leaf

PI. VII & XXIX

Nayar, K.K. 1948, J. *Bombay nat. Hist. Soc,* 47 (4):668.

Hypophyllous, globose, hard, unilocular, grey, or brown,, rough, solitary galls, about 0.5-3.0 mm in diameter, often as many as a dozen on the leaf blade. Larvae and pupation inside the gall.

Distribution.—Travancore-Cochin.

Gall No. 341 by midge on stem

Nayar, K.K. 1948. J. *Bombay nat. Hist. Soc.*47 (4):668.

Irregular, soft, succulent, green outgrowths on branches, often clustered terminally, about 0.5-2.5 mm long and 0.5-1-0 mm in diameter, with dark coloured larval chambers.

Distribution.—Travancore,

Gall No. 400 by *Heterodera marioni* on root

Delacroix, G. 1902. *Agric. prat. pays-Chaud. Paris.* 1901-1902, pp. 67-8-680.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie 1:65 No. 156.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2j:96.

Irregular, solid, indehiscent nodosities.

Distribution.—South India

Natural Order SALICAGEAE

Populus alba

Gall No. 121 by *Briosoma tskhiri* Gulamulla on leaf

PL XXX

Ghulamulla. 1941. *Indian J.Ent.* 3 (2): 228.

Regular, epiphyllous, ovid or subglobose, somtimes laterally compressed and lop-sided and with obscure lobes, hollow, utricular, unilocular, clavate, dehiscent, beutelgall, with short, narrow, neck-like, pedicellate base; reddish-brown; rugulose and finely pubescent; ostiole narrow, hypophyllous. Size about 20-30 mm long and 15-25 mm thick; 1-2 galls on a leaf and never agglomerate.

Distribution.—North-West Frontier Province (Pakistan), Kashmir and Afghanistan.

Populus ciliata Wall

Gall No. 114 by *Pemphigus imaicus* Cholod. on leaf

PL XXVII

Cholodkovsky, *Rev. Russe.Ent.,* 12:495 (1912).

Houard, C. 1921. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 82, No. 215, fig. 139.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14(2) 123; 1954. *Agra Univ. J. Res.* (Sci.)3(l):41,pl.x,fig. 3-4.

Epiphyllous, irregularly elongate, compressed cylindrical, yellowish-green, often also tinged brown or pink, sessile, dehiscent, hard, unilocular, ostiolate beutelgalls, often measuring up to 70 mm long and 15-20 mm thick, 25 mm high, 3-4 on a single leaf, usually on or along the midrib like an enormous ridge on the leaf, mistaken for the caterpillar of moth and very conspicuous against the foliage from a distance; with the ostiole elongate and irregular and almost obliterated, hypophyllous and longitudinal; gall cavity elongate, smooth with numerous aphids.

Distridution.—Common in Kumaon, Garhwal, and in North-West Himalaya between 1500 m to about 2500 m above mean sea level.

GalltsTo. 115 by *Pemphigus mordwilkowi* Cholod. on branch

Cholodkovsky, *Rev. Russs Ent.,* 12:493, No. 1, fig. 3-4, (1912).

Houard, C 3922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceacnie, p. 82 fig. 137,xNTo. 213.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):123: 1954. *Agra Unw. J. Res.* (Sci.) 3:42, pi. x, fig. 1.

Regular, subspherical, thick-walled, unilocular, sessile, dehiscent, yellow, yellowish-green or dark-brown galls in axils of leaves or tips of branches, smooth, about 10 to 30 mm in diameter, usually solitary, rarely 1-2 clustered; gall cavity large.

Successori : *Coccinella septempunctata* in old galls.

Distribution.—From Kumaon to Kasmir upto about 2500 m above mean sea level.

Gall No. 116 by *Pemphigus nainitalensis* Gholodk on branch

Gholodkovsky, *Rev. Russe Ent.*, 12:494, fig. 5-7, No. 2 (1912).

Houred, G. 1922. Les Zoocecidies des Plantes*d'Afrique, d'Asie et d'Oceanie 1:82, No. 214, fig. 138.

Mani,M.S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):124.

Regular, subglobose or globose, sessile, lateral, dehiscent yellow-green swelling, about 5-7 mm in diameter.

Distribution.—Kumaon Himalaya.

Gall No. 117 by *Pemphigus napeus* Buck, on branch

Sundar Raman, 1924. *J. Indian hot. Soc.*, 4:15, No. 37.

Mani, M.S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2):124.

Regular, globose, unilocular, sessile, dehiscent, gall on branch, veined, brown or yellow-spotted green, smoth, 25 to 75 mm long.

Distribution.—Darkot pass in North-West Himlaya.

Populus euphratica Oliv.

Gall No. 98 by *Phylloplecta gardneri* Laing on leaf

Mathur,R.N. 1935. *Indian For. Rec.*, (N.S.) 1 (2):52.

Mani,M.S. 1948. *J. Roy. Asiatic Soc. Bengal,* (Sci.) 14 (2): 120

Subglobose, separate or sometimes conglomerate, green, pale yellow or rich olive, glabrous, unilocular galls on both sides of leaves, about 5 mm in diameter; ostiole hypophyllous and covered by a thin membrane, which bursts when mature; old galls hard and pale brown or dark-brown.

Distribution.— Multan (Punjab).

Gall No. 99 by *Phylloplecta* sp. on branch

Mathur, R.N.1935. *Indian for. Rec,* (N. S.) 1 (2) : 52

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 120.

Regular, globose, unilocular, thick-walled, rough, shrunken, green galls on twigs, often upto 12 mm. in diameter.

Distribution.—Multan (Punjab).

Gall No. 100 by *Phylloplecta* sp. on branch

Mathur, R. N. 1935. *Indian for. Rec,* (N. S.) 1 (2) : 59.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14(2) : 120.

Pitgalls on branches not further described.

Distribution.—Multan (Punjab.)

Populus sp.

Gall No. 118 by *Pemphigus immunis Buckt.* on branch

Sundar Raman, 1924. *J. Indian bot. Soc.*,*4:15,* No. 38.

Mani, M.S. 1958. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2):124.

Regular, fusiform, woody, hard, smooth, sessile, dehiscent, often deep-furrowed, rough, cavate galls on branch, about 25-50 mm long and 25 mm thick; with ostiole at apex corrugated at the edge.

Distribution.—Gilgit, North West Himalaya.

Salix daphnoides Willars

Gall No. 418 by unknown midge on leaf

PL V

Mani, M.S. 1953. ***Agra Univ. J. Res.*** **(Sci.) 2(1) : 155;** ***ibid.*** **3 (1) : 42 (1954)**

Regular, solid, indehiscent, hard, unilocular, epi- or hypophyllous, free, agglomerate or compound beutelgalls, with the ostiole obliterated except for a conspicuous circular shallow crater-like hypophyllous depression on the gall. The galls are crowded in very large numbers on either side and on the midrib, which is usully more or less greatly intumescent and curved. Larval cavity small, elongate oval. Each gall cavity may contain 2-3 larvae. Each gall measures about 7-10 mm in diameter; reddish-yellow or reddish-brown.

Distribution.—Garhwal and Dhauladhar Himalaya in Punjab.

Salix elegans Wall.

Gall No. 492 by *Eriophyes* sp. on leaf

PL XX

Mani, M. S. 1953. ***Agra Univ. J.Rcs.*** **(Sci.) 2 (1): 155, plate X.**

Regular, epiphyllous, sublobose, free or also agglomerate, fleshy, densely villous, yellowish-green, separate, multilocular, sessile beutelgalls, with large hypophyllous ostium, covered by dense white straight erineum. Each Ieaf9ften with over 50 galls. Size of the gall ranges from 2—5 mm in diameter.

Distribution.—Dalhousie, Dhauladhar Range.

Gall No 268 by *Oligitrophus saligneus* Coq. on stem

Goquillett, D. W. 1903. ***Indian Mus.*** **JVrt«,6(l):l.**

Sundar Raman, 1924. ***J. Indian hot. Soc,*** **4:36, No. 52.**

Mani, M.S. 1947. ***Bull. ent. Res.,*** **38(3) :439; 1948.** ***J.Roy. Asiatic Soc. Bengal*** **(Sci.), 14(2):151.**

Variable, localised, globose, fusiform or irregular, extensive, woody tumescence of branches, about 75 mm long and 25 mm in diameter; larval cavities numerous.

Distribution.—Tehri-Garhwal Himalaya, 2730 m above meam sea level.

Salix fragilis

Gall No. 575 by *Pontania* sp. on leaf

PI. XVIII

Regular, epi- or hypophyllous or also often visible equally on both sides of the leaf blade; subglobose, globose, ovoid, reniform or sometimes also shortly-sausage-shaped, indehiscent, glabrous, solid, spongy, yellow and usually tinged red or brown or sometimes yellowish-green or also green, free, never agglomerated though usually crowded in large numbers and often involving swelling of an entire leaf-blade. Size ranging from 15 mm to over 50 mm in diameter. Larval chamber relatively small, centrally situated, with a single larva.

Distribution.—Chamba (Himachal Pradesh) and Lahaul, usually at elevation between 2500 and 3000 metres in the North-West Himalaya.

Salix hastata

Gall No. 295 by *Eriophyes* sp. on leaf

PL XII

Regular, epi- or hypophyllous, globose, subglobose, subconical or sub-cylindrical, free or often agglomerated, yellow, glabrous, semi-solid, fleshy, indehiscent, with dense erineum-filled ostiole usually hypophyllous, gall cavity nearly nearly obliterated by fleshy emergences from the sides and filled with white erineum and crowded with mites; size about 3-7 mm in diameter; often ^over 200 galls develop on a single leaf.

Distribution.—North-West Frontier Province (Pakistan), parts of Kashmir and Afghanistan.

Natural Order FAGACEAE

Alnus nitida Endl.

Gail No. 593 by *Eriophyes* sp. on leaf

PI. XVI

Epiphyllous, irregularly subglobose, hemispherical, agglomerate, sessile, reddish-brown or yellowish-brown, indehiscent, beutelgalls, about 7-10 mm long and 5 mm high; with hypophyllous, wide open ostiole, convered by rusty-brown erineum; often up to a dozen gall on each leaf.

Distribution. - Upper Beas Valley (North-West Himalaya).

Gall No. 606 by midge on stem

Irregularly fusiform, terminal, unilocular, indehiscent, fleshy but hard, green or brown tumescence of the tender branches, about 10 mm long and 5. mm thick. Larval chamber spacious, elongate.

Distribution.—Upper Beas Valley (North-west Himalaya).

Quercus dilatata Lindl

Gall No. 448 by *Eriophyes* sp. on leaf

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2:156; 1954. *ibid.,* 3:40.

Mostly epiphyllous, regular, hemispherical, circular, blister-like beutelgalls, about 4 mm in diameter, yellowish-green, smooth, glabrous, with wide open hypophyllous cavity covered, by dense erineum of long, brown, curled, simple hairs.

Distribution.— Vinayak Hill 2200m Ramgarh (Naini Tal); Dalhousie 2200—2300 m above mean sea level.

Gall No. 450 by Cynipid on leaf

PI. XIII

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2:156; 1954. *ibid.,* 3:40.

Regular, subglobose, ovoid or hemispherical, solid, multilocular, hard, indehiscent, sessile, smooth, glabious, slaty-grey, persistent swellings of leaf blade, about 10-13 mm in diameter, 9 mm thick, usually conspicuously gibbous on one side of the blade; larval chambers crowded, oval, radially arranged in the peripheral zone of the gall and usually communicating-into a large central chamber; with numerous circular exit holes in the old galls. The great bulk of the gall is parenchyma of elongate cells with dense pigment. The larval cavities are lined by smaller unpigmented proliferating cells.

Distribution.—Kumaon Himalaya up to 2200 m, Dalhousie (North-West Himalaya) up to 2500 m above mean sea level.

Gall No. 451 by unknown Cynipid on leaf

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.). 2:155.

Regular, globose, hypophyllous, pinkish-brown, smooth, glabrous, sessile, indehiscent, unilocular galls placed near the midrib; sometimes epiphyllous; larval cavity large, with 1-2 pupae of the cynipid. Pigmented parenchyma cells surround the central zone of unpigmented small proliferating cells. Size of gall 3-3 5 mm in diameter. The gall readily falls off on slightest touch, leaving behind a scarcely visible scar.

Distribution.— Ramgarh (Kumaon Himalaya), 2300 mm above mean sea level.

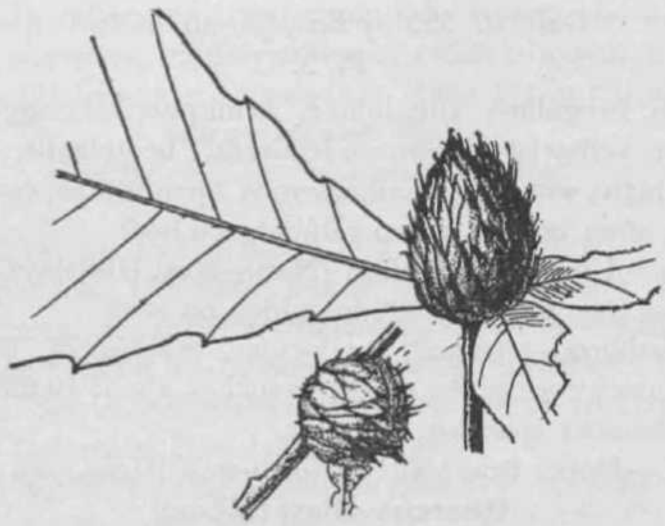


Fig. 58. Gall No. 285 on terminal bud of *QuerOU gri/filhi* by an unknown cynipid.

Gall No. 596 by Cynipid on stem

Globose or often irregularly oval, solid, hard, woody, indehiscent swellings of branches, similar to gall No. 294 on *Q. incana.*

Distribution.—Beas Valley 2200 m above mean sea level.

Quercus griffithi

Gall No. 285 by Cynipid on bud

Mam, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 (3) : 156, 29.

Regular, subglobose or conical, spiny, imbricately scaly, unilocular gall on branch.

Distribution.—Shillong.

Qixercus incana Roxb.

Gall No- 292 by *Enophyes* sp. on leaf

Mani, M»S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci), 14(2):136, fig. 35 ; *Agra Univ. J. Res.* (Sci.) 2:156 (1953) ; *ibid.,* 3:40 **(154).**

Epiphylloui, regular, solitary, hemispherical, pustule-like beutelgalls, about 5 mm in diameter, upto about 20 per leaf, yellowish-green, smooth, glabrous above and below with brown erineum.

Distribution.—Kumaon Himalaya 2300 m, and D haramsala, Dalhousie 1200-1800 m, above mean sea level.

Gall No. 293 by unknown midge on leaf

PI. XI

Mani, M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.) 14 2) : 152, fig. 34 ; *Agra Univ. J.Res.* (Sci.) 2:156-157, pi. iii, fig. 6-7 (1963); *ibid.*, 3 : 41(1954).

f Mostly hypophyllous, very rarely epiphyllous, regular, free, never agglomerate, elongate-oval, mango-fruit-shaped, pedicellate, somewhat laterally compressed, uni- or bilocular, hard, woody, thick-walled, indehiscent, deciduous, brownish-green, densely tomentose, beutelgalls on leaves, somewhat bluntly produced into a conical curved beak apically. On the opposite side of the leaf the site of the gall is indicated by a short, solid, hard, subtruncate tubercle. Gall about 15 mm long, 8 mm broad and 5 mm thick. Upto about a dozen galls form on a single leaf. Trichomes in stellate bundles. Larval cavity with very hard, brittle cyst, surrounded by proliferating cells. Outside this lies the gall parenchyma. Larvae 1-2 in each gall. Pupation in gall.

Distribution. — Kumaon and N. W. Himalaya up to 2300 m, mostly between 1500 m and 1800 m above mean sea level.

Gali No. 294 by an unknown Cynipid on bud

'Mani,M. S. 1948. *J. Roy. Asiatic Soc. Bengal* (Sci.), 14 (2) : 155, fig. 36 ; *Agra Univ. J.Res.* (Sci.) 2 : 157-158 (1953).

Irregular, local or extensive, solid, woody, globose, val or fusiform ndehiscent, multilocular, persistent, cortical swellings of branches, with smooth surface; about 15-20 mm thick; with larval cavities of hard cells; exit holes numerous and circular.

Distribution.'-Kumaon Himalaya.

Gall No. 421 by unknown Gynipid on bud

PI. XIII

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 :558; iW., 3:41 (1954).

Irregular, globose, oval or pyriform solid, indehiscent, multilocular, hard, rugose, dark reddish-brown, compound galls on buds, about 25-30 mm in diameter.

Distribution.— Mussurie Hills, Ramgarh (Kumaon Hills) 2000-2500 m, Kangra Valley 1500-1900 m and Dalhousie 2000 m (N. W. Himalaya).

Gall No. 433 by an unknown Cynipid on leaf

PI. XXXII

Mani, M. S. 1953. *Agra Univ.J. Res.* (Sci.) 2. 157, pi. iii, fig. 8-9.

Regular, globose or oval, sessile, unilocular, hollow, free, simple, indehiscent, hypophyllous, smooth, glabrous, pale reddish-brown galls, covered in close series on the midrib on either side, with exit holes, 1-2 on each gall; 5 mm long and 2 mm thick.

Distribution.—Chakrata Road, Mussurie Hill.

Gall No. 449 by unknown Gynipid on leaf

PI. XIII

Mani, M.S. 1953. *Agra Univ. J. Res.* (Sci.) 2:157 *;ibid.₉3:4* (1954).

Epiphyllous or hypophyllous, regular, solitary, subglobose, sessile, deciduous, pinkish-brown, smooth or with one or two obscure, mucronate tubercles, glabrous, indehiscent, about 5 mm in diameter and situated on the side of the midrib; unilocular, gall cavity central, large, with a thick zone of colourless proliferating cells, surrounded by the pigmented parenchyma.

Distribution.—Kumaon and parts of N. W. Himalaya up to 2300m above mean sea level.

Quercus pachyphylla Kwiz

Gall No. 282 by Gynipid on leaf

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles,* 29 (2) : 182.

Houard, G. Les Zoocccidies des Plantes d'Afrique, d'Asie et d' Oceanie, p. 151, No. 540 (1922).

Sundar Raman, 1924. J. *Indian hot. Soc,* 4 :44, No. 91.

Mani, M. S. 1948. J. *Roy. Asiatic Soc. Bengal* (Sci.) 14 (2) : 156.

The entire leaf blade swells up very much into an oval mass, 22 mm long, 18 mm wide and 7-9 mm thick, leaving only a narrow margin of the blade thin; surface of the gall with numerous tubersities, convexities and fleshy protuberances, each of which corresponds to a larval chamber inside, larval chamber oval, numerous, 8 mm in diameter, without lignification.

Distribution.—Kurscong (Eastern Himalaya).

Quercus semicarpifolia Smith

•Gall No. 283 by *Callirhitis semicarpifoliae* Cam. on gland

Cameron, 1902. *Entomologist,* 35:38-39.

Houard, G. 1922. Lcs Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 151, No. 542.

Sundar Raman, 1924. *J. Indian hot. Soc,* 4:44, No. 90.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2): 156.

"Def rmed Gland." Not fully described.

Distribution.—N. W. Himalaya.

Gall No. 603 by *Eriophyes* sp. on leaf

Epiphyllous beutelgalls, with wide-open, hypophyllous, erineum-clothed ostiole, similar to gall No. 448 on (£. *dilatata.*

Distribution.—Upper Beas Valley, 2600 m above mean sea level.

Gall No. 605 by Cynipid on bud

Irregularly globose, smooth, green or brown, solid bud gall, similar to gall No. 21 on (£• *incana.*

Distribution.—Upper Heas Valley.

Quercus spicata Smith

Gall No. 284 by *Neuroterus haasi* Kieff. on stem

Kieffer, J J . 1905. *Ann. Soc. Sci. Bruxelles,* 29 (2): 182-184.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 151, No. 541.

Sundar Raman, 192 K *J. Ivdian bot. Soc,* 4:44, No. 92.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2): 156.

Irregular, unilateral, subglobose or also elongated and oval, usually agglomerate and extensive and involving the whole length of a tender branch, solid, brown, 20-50 mm long and 15-20 mm thick; larval cavities numerous, irregularly disposed in the spongy mass of the gall, each about 2-3 mm long and 1.5 mm in diameter. Pupation in gall.

Distribution.—Kurseong (E. Himalaya).

Natural Order LAURAGEAE

Beilschmeidia sikkimensis King

Gall No. 86 by *Ozotrioza laurinearum* Kieff. on leaf

Kicffer, J. J. 1905. *Ann. Soc Sci. Bruxelles* p. 181, No. 7.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et. d'Oceanie, p. 272. No. 990.

Sundar Raman, 1924. *J. Indian bot. Soc,* 4:11, No. 16.

Mani, M. S. 1948. *J. R. Asiatic Soc Bengal* (Sci.) 4 (2): 118.

Subconical galls on both sides of the leaf along the midrib, resembling gall No. 72 but when old having a circular hypophyllous ostiole, breaking up into lobes, measuring about 6 mm in height and 5-6 mm in diameter.

Distribution.—Kurseong (E. Himalaya).

Gall No. 87 by Psyllid (?) on leaf

Sundar Raman, 1924. *J. Mian tot. Soc,* 4:11, No. 7.

Broad agglomerated, reddish, unilocular galls on twigs about 6-10 mm lonjs; and 7 mm broad.

Distribution.—Kurseong (E. Himalaya).

Cinnamomum camphora T. Nees & Eberm.

Gall No. 83 by *Trioza camphorae* Sasaki on leaf

Sasaki, *Tokyo* 1910. *J. Coll. Agric,* 2:227-268, pi. xv-xvi.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 263, No. 952.

Sundar Raman. 1924. J. *Injian bot. Soc.*9 4:11, No. 19.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.), 4 (2): 118.

Circular hypophyllous depression, 2-3 mm in diameter, with larva in it; the epiphyllous convexity brown or red or black.

Distribution.—Mangalore (West Coast, South India); also from Java.

Cinnamonum iners Reinw.

Gall No. 564 by Hemiptera on leaf

Houard, G. 1917. *Marcellia,* 16:84, No. 13, fig. 8-12.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 265, No. 962.

Regular, unilocular beutelgalls visible on both sides of the leaf blade; about 2 mm high; the epiphyllous part is conical with an obtuse summit, the hypophyllous part is ellipsoidal and with elongate and prominently bordered ostiole; cavity large, smooth and partly with lignified wall.

Distribution.—Ceylon and South India, especially on hills.

Cinnamonum macoacarpum Hook.

Gall No. 89 by Psyllid (?) on leaf

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 4 (2): 118.

Galls measuring about 2 mm high, visible on both sides of leaf; epiphyllous region obtuse; hypophyliar region conical or obtusely conical with the ostiole opening through; somewhat woody; generally resembling gall No. 73.

Distribution.—Ceylon and South India, especially on hills.

Cinnamonum nitidum Blume

Gall No. 90 by Psyllid (?) on leaf

Muller, 1873. *Trans, ent. Soc,* (3) 1, (proc.) : ix.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 263, No. 953.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14 (2) : 118.

Isolated epiphyllous beutelgall, about the size of a pin-head, smooth, glabrous, reddish-brown; ostiole hypophyllous.

Distribution.—Western Ghats near Bombay.

Gall No. 279 by Cynipid on leaf

Neitner. *\857,)Ent. &g. Stettin,* 18:39.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 263, No. 954.

Mani, M. S. 1955. *J. R. Asiatic Soc. Bengal* (Sci.), 4 (2): 155.

Irregular galls about the size of a pea.

Distribution.—"India" without mention of exact locality.

Cinnamonum sp.

Gall No. 91 by *Phacosema gallicola* Kieff. on leaf

Kieffer, J J . 1906. *Z- WE». InsektenbioL,* 2:387-389, fig 1.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Asie et d'Oceanie, p. 266, No. 967.

Sundar Raman. 1924. J. *Indian hot.* 5<w\,4:ll, No. 18.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 4 (2): 119.

Oval, fleshy, unilocular gall, prominantly visible on both sides of the blade, about 10-15 mm high and 8-10 mm thick; epiphyllar region conically pointed and basally surrounded by a cushion-like swelling of the blade; hypophyllous region sub-hemispherical.

Distribution.—South India, especially the low hills.

Gall No. 510 by Psyllid on leaf

PI. XXVI

Epiphyllous, subglobose, agglomerate, unilocular, yellow or brown beutel galls, about 5-10 mm in diameter, mostly arranged along the three principal veins; ostiole irregular, hypophyllous.

Distribution.—Kanakappalam (Travancore).

Cinnamonum **zeylanicum** Breyn.

Gall No. 30 by *Eriophyes doctersi* Nalepa on leaf

PI. XXIX

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique d'Asie et d'Oceanie. p. 263-264, No. 255, fig. 542-544.

Drs. van Leeuwen-Reijnvaan W. & J. 1924. Zoocecidia of Netherlands East Indies, pp. 197-198, No. 432, fig. 310.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 4 (2): 104.

Ovoid or irregularly conical, rarely subglobose, mostly hypophyllous, sometimes epiphyllous, beutelgalls on leaves, often also on branches, petioles, terminal buds, etc., generally however near one of the three main nervures of leaves, measuring about 10-15 mm in diameter, pale greenish or yellowish, surface somewhat ridged. Termi ally often pyramidal, especially on branches, with a minute ostiole; basally somewhat constricted. Ostiole below in galls on leaves. Cavity single, large, densely hairy, hairs silvery-white. Sometimes conglomerate. When numerous galls form on a single leaf, the latter becomes deformed and curled very badly.

Distribution.—South India.

Gall No. 31 by *Eriophyes* sp. on leaf

Houard, C. 1928. Les Zoocecidies des Plantes d'Afrique d'Asie et d'Oceanic, p. 264, No. 958.

Mani, M. S. 1948. ***J. R. Asiatic Soc. Bengal*** **(Sd.) 14 (2) :104.**

Hypophyllous, unilocular beutelgalls, with rugose surface and cavity with long hairs; on the opposite side the leaf bears a small mucronate process.

Distribution.—Ceylon and South India.

Gall No. 92 by Psyllid on leaf

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 264, No. 956.

Mani, M. S. 1948. J. ***R. Asiatic Soc. Bengal*** **(Sci), 14(2): 119.**

Cylindroconic, unilocular, epiphyllous galls on leaves along the three median nervures, and measuring abot 2-3 high and 1-2 mm thick at base.

Distribution.—Ceylon & South India.

Gall No. 93 by Psyllid on leaf

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique d'Asie et d'Oceanie, p. 264, No. 957.

Mani, M. S. 1948. ***J. R. Asiatic Soc. Bengal (Sci.)*** **14 (2) : 119.**

Conical, epiphyllous, glabrous, unilocular gall on leaves, about 3 mm high and 3 mm thick at base; hypophyllous region with only minute mucronate projection.

Distribution.—Ceylon and South India.

Gall No. 312 by Psyllid on leaf

Epiphyllous, hemispherical, unilocular, isolated, yellowish-brown galls, almost 5 mm in diameter.

Distribution.—Pampadapara (Travancore).

Gall No. 381 by gall midge on inflorescence

Nayar, K. K. 1948. ***J. Bombay nat. Hist. Soc,*** **47 (4): 671.**

Regular, globose or oval, rarely irregular swellings oi the stalk of infloresence; cavity narrow, slit-like; gall externally bright-green; soft, fleshy, indehiscent; 1-5 mm in diameter.

Distribution.—Kottarakarai (Travancore).

Cinnamonum zeylanicum ovalifolium

Gall No. 94 by Psyllid on leaf

Houard, C. 1917. ***Marcellia,*** **16:85, No.** ***15,*** **fig. 14-15, ; Les Zoocecidies des Plantes d'Afriqe, d'Asie et d'Oceanie, p. 265, No. 959 (1922).**

Mani, M. S. 1948. J. ***R. Asiatic Soc. Bengal*** **(Sci.) 14 (2):119.**

Globose, hard, unilocular galls on both sides of leaf about 3 or 4 mm in diameter; cavity large.

Distribution,—Ceylon and low hills in South India.

Lindera assamica Kurz.

Gall No. 32 by *Eriophyes* sp. on leaf

Kieffcr, J. J. 1905. *Ann. Soc. Sci. Bruxelles,* pp. 198—99.

Houard, G. 1922. Lcs Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 274, No. 998.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.), 14 (2): 105.

Hypophyllous erineum, with slight cpiphyllous bulge, crumpling or crinkling, 3-5 mm in diameter, reddish.

Distribution.— Kurseong (E. Himalaya)

Gall No. 95 by Psyllid on leaf

Kiffer, J.J. 1905. *Ann. Soc. Sci. Bruxelles*, p. 181-182, No. 8.

Houard, G. 1922. Les Zoocecidies dcs Plantes d'Afrique d'Asie et d'Oceanie, p. 274. No. 997.

Sundar Raman, A. H. 1924. *J. Indian hot. Soc*, 4:7, No. 28.

Mani, M. S.', 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14(2) :119.

Leaf roll gall, the blade rolled upwards along the midrib and involving arrest of growth of leaf.

Distribution.—Kurseong (E. Himalaya).

Lindera pulcherrima Benth.

Gall No. 33 *byEriophyes linderae* Corti on leaf

Keiffer, j. J. 1905. *Ann. Soc. Sci. Bruxelles*, p. 196-198.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afiique, d'Asie et d'Oceanie, p. 274, No. 996.

Sundar Raman, A. H. 1924. J. *Indian hot. Soc*, 4:7.

Mani, M. S. 1948. *J. R. Asiatic Soc Bengal* (Sci.), 14(2): 125.

Irregular, globose, rounded discoid, conical, glabrous, somber green; fissured, solid, spongy parenchymatous swellings of leaf veins; especially the three main ones and visible on both sides of the leaf, about 10 mm in diameter; on the opposite side a conical projection marks the site of the gall.

Distribution.—Kurseong (E. Himalaya).

Gall No. 258 by *Daphnephila linderae* Kieff. on leaf

Kieffer, J. J. 1905. *Ann. Soc Sci. Bruxelles*, 149-151, No. 3, fig. 1.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrque, d'Asic et d'Oceanie, p. 274, No. 995.

Sundar Raman, 1924. J. *Indian hot. Soc*, 4:36, N. 55.

Mani, M. S. 1941. *J. R. Asiatic Soc. Bengal* (Sci.), 14(2):149.

Epiphyllous, yellowish, globose, unilocular, thick-walled, sessile, on one of the three main nervures, about 3 mm in diameter; open by longitudinal slit; on the opposite side the site of the gall is marked by a discoloured spot.

Distribution.—Kurseong (E. Himalaya).

Litsea glabra

Gall No. 415 by *Eriophyes* sp. on leaf

Irregular, unilocular, subglobose, epiphyllous beutelgall, about 5-10 mm in diameter ; ostiole large, hypophyllous.

Distribution.—Thenmalai (S. India).

Litsea lingustrina Hook.

Gall No. 34 by *Eriophyes* sp. on leaf

Mani, M. S. 1948. J. *R. Asiatic Soc Bengal* (Sci.), 14 (2) : 105.

Epiphyllous, irregular, clavate, unilocular, beutelgalls, about 5 mm long and 2-3 mm in diameter ; pale yellowish-green; cavity with whitish hairs.

Distribution.—Marudamalai Hills, Western Ghats near Coimbatore.

Litsea polyantha Juss.

Gall No. 96 by *Pauropsylla beesoni* Laing on leaf

Mathur, R. N. 1935. *Indian for. Rec,* (N. S.) 1(2) :45.

Mani, M. S. 1948. J. *R. Asiatic Soc. Begnal* (Sci.), 14 (2) : 119.

Globose, ovate, often irregular, conglomerate, green, chocolate-brown, unilocular swellings about the size of a pea, confined to the secondary veins, sometimes visible equally on both sides of the leaf, about 19 galls often being found on a single leaf, generally dehiscing in 3-4 lobes, but sometimes becoming hard indehiscent and then fully emerged adult cecidczoen dies inside.

Distribution.—Dehra Dun, Chakrata, Mussurie Hills.

Litsea wightiana Hook.

Gall No. 55 by *Eriophyes* sp. on leaf

Houard, G. 1922. Les Zoocecidies des Plantcs d'Afrique, d'Asie et d'Oceanie, p. 268-69, No. 972, fig. 562, 563, 564.

Sundar Raman, 1924. *J. Indian bot. Soc,A* : 7, No. 4.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 105.

Epiphyllous, cephaloneon or irregularly globose, unilocular beutelgall, about 5 mm in diameter, with surface irregular, often conglomerate; ostiole rather broad; cavity shallow with whitish hairs while young and brownish when old.

Distribution.—Nilgiri Hills.

Machilus gamble! King

Gall No. 97 by *Neotrioza machili* Kieff. on leaf

Kieffer, J. J. 1905. *Ann. Soc. Sci. Bruxelles,* 29 (2): 176-178, No. fig. 12, pi. ii, 2-9, 14-16.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 268, No. 970, fig. 558-559.

Sudar Raman, A.H. 1924. J. *Indian bot. Soc,* 4 : 10, No. 15.

Mani, M. S. 1948. *J. R. Asiatic Soc Bengal* (Sci.), 14 (2) : 120.

Epiphyllous, regular, globose or subglobose, sessile, dehiscent, green or reddish, smooth, fleshy or hard, unilocular beutelgall, about 5-6 mm in diameter, with a hypophyllous small verrucose projection having the nearly obliterated ostiole.

Distribution.— Kurseong (E. Himalaya).

Gall No. 259 by *Daphnephila glandifex* Kieff. on stem

Kieffer, J. J. 1905. *Ann. Soc.Sci. Bruxelles,* 28 (2) : 148-149, No. 2, pi. ii, 3, 4, 7, 18.

Houard, G. 1922. Les Z ocecidicsdes Plantes d'Afiique, d' Asie et d' Oceanie, p. 267, No. 963, 554, 555.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.), 14(2) : 149.

Regular, subcylindrical, fusiform or basally rounded and apically subconical, sessile, indehiscent, usually agglomerated bunches of 4-20 cortical galls; 8-12 mm long, 8 mm thick, yellowish or reddish when young and dark when old and dry; thick-walled, solid, fleshy smooth: larval cavity single, axial, elongate, narrow-cylindrical, about 2 mm wide and covered by a thin epidermal operculum on summit of gall; larva at bottom; pupation in gall.

Distribution.—Kurseong (E. Himalya).

Gall No. 260 by *Daphnephila haasi* Kieff. on leaf

Pl. XXVIII

Kieffer, J. J. 1905. *Ann. Soc. Sci.Bruxelles,* 28 : 144-148, pi. ii, 1, 5, 6, 8, 17.

Houard, G. 1922. Les Zoocecidies des Plantcs d'Afriquc d'Asie et d'Oceanic, p. 267-268, No. 969, fig. 556, 557.

Sundar Raman, A.H. 1924. J. *Indian bot. Soc,* 4 : 37, No. 56.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) 150 ; *Agra Univ. J. Res.,* (Sci.) 2 (2) : 258, pi. vii (1953;.

Regular, free, solitary, hypophyllous, fusiform, somewhat basally stout beutelgalls, solid, indehiscent, yellowish-green, glabrous, parenchymatous, moderately hard, shortly and narrowly pedicellate; apically with a short, stumpy, fleshy, subconical, mucronate process; unilocular; the gall cavity axial, elongate, slender, cylindrical and extending from nearly the very base of the gall to its apex, with a single larva; often very crowded or in bunches but never conglomerate; each gall is inserted on the midrib or also one of the larger side veins; size about 12-18 mm long and 3-5 mm thick sub-basally; occasionally epiphyllous.

Distribution.—Kurseong (Himalaya) and Dehra Dun.

Gall No. 322 by *Stephanitisgallarum* only leaf

Horwath, *Ent. month. Mag.,* p. 33 (1906).

Gall not properly described but reported to be common in Kurseong. Not seen by me.

Machilus macrantha

Gall No. 36 by *Eriophyes* sp. on leaf

Sundar Raman, A.H. 1924. *J. Indian bot. Soc.,* 4 : 7, No. 3.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.), 14 (2) : 105.

Epiphyllous, low convex beutelgall, with shallow hypophyllous, wide-open cavity, covered with brownish erineum.

Distribution.—Anamalai Hills (S. India).

Machilus odoratissima Nees

Gall No. 479 by *Neolasiptera* sp. on leaf

Pl. XVII

Mani, M. S. 1954. *Agra Univ.J. Res.* (Sci.) 3(1) : 37, pi. ix, fig. 5.

Regular hypophyllous, free, solitary, solid, indehiscent, shortly petiolate, oval or subpyriform beutelgalls, about 15 mm long and 8 mm thick. As many as 50 galls form crowded close together in a bunch on a single leaf. On the upper surface of the leaf blade the site of the gall is indicated by an obscure, acute, fleshy, short, mucronate process. The tomentose hairs long, simple, closely matted together, deep reddish. Gall cavity elongate-ovate or cylindrical, axial. Emergence hole apical. The leaf tissues hypertrophied and partly undifferentiated around the site of insertion of the gall. The vascular elements of the gall derived from those of the adjacent veins.

Distribution.—Dharamsala on Dhauladhar Range at elevations of 1500-1900 m above mean sea level.

Gall No. 481 by unknown midge on leaf
PL XVII

Mani, M. S. 1953. *Agra Univ. J. Res.*, (Sci.) 3(1) : 37, pi, ix, fig. 3-6.

Regular, hypophyllous, free, solitary, shortly petiolate, solid, hard, fleshy, indehiscent, oval or stout fusiform, green, smooth, unilocular galls, about 15 mm long and 8 mm thick, with a few scattered, short, fine pubescent hairs. Site of the gall on the upper surface of the leaf blade indicated by an obscure minute fleshy discoloured bulge. Several galls, often as many as 15 clustered together on a single leaf. Gall cavity axial, narrow, cylindrical, straight and opening apically as exit holes and surrounded by a zone of thick-walled cells. This gall is relatively sparse.

Distribution.—Dharamsala on Dhauladhar Range at elevations of 1500-1900 m above mean sea level.

Gall No. 482 by an unknown Psyllid on leaf
PI. XX

Mani, M.S. 1953. *Agra Univ. J. Res.*, (Sci.) 3 (1):38, pi. ix. fig. 1.

Regular, epiphyllous, free, solitary, cordate, pyriform or shortly conical, hard, unilocular, thick-walled, indehiscent, sessile, persistent, reddish-brown to dark brownish, smooth, glabrous beutelgalls near one of larger vein sand mostly on the midrib or petiole, about 15 mm long and 6-8 mm thick, apically produced into a more or less long, slender, often curved, nipple-like process. Site of the gall is indicated on the opposite side by a small discolourised spot. Gall cavity large, with reticulately veined inner surface and a single nymph of the psyllid. In the gall cavity is often found the caterpillar of an unknown lepidopteran that bites its way in and feeds on the gall substance and finally pupates within the partly damaged gall, in which case the psyllid nymph may or may not survive. This gall is more scarce than the two preceding ones.

Distribution.—Dharamsala on the Dhauladhar Range, at elevations of 1500 — 1900 m above mean sea level.

Gall No. 495 by unkown Aleurodid on leaf

PL XX

Mani, M.S. 1953. *Agra Univ. J. Res.*, (Sci.) 3 (1):38, pi. viii, fig. 5.

Epiphyllous beutelgalls similar to gall No. 400 on *Phoebe lanceolata*, but rather rare and found only in isolated patches on some trees in Dharamsala.

Neolitsea zeylanica Merr.

Gall No. 370 by Psyllid (?) on leaf

Biconvex or subglobose, isolated, sessile, green, smooth galls about 8 mm *n diameter, visible on both sides of the leaf ; hypophyllous, somewhat curved, fleshy, obtuse process, with the nearly obliterated ostiole.

Distribution.—Travancore.

Phoebe lanceolata Nees.

Gall No. 440 by an unknown Aleurodid on leaf

Mani"; M.S. 1953. *Agra Univ. J. Res.*, (Sci.) 2:152.

Epiphyllous, subconical, yellowish, glabrous, pitgalls on leaf, about 2 mm ln diameter; ostiole wide, hypophyllous and plugged by the larva of the

aleurodid, the dorsum of which is flush with the rim of the ostiole and the venter filling the gall cavity.

***Distribution.*—Chakrata Road : Mussurie Hills, also Jeolikot near Narayani Karkhana (Naini Tal Distt.), at elevations of 1500 — 2200 m above mean sea level.**

Phoebe sp.

Gall No. 314 by psyllid on leaf and stem

Mani, M.S. 1948. *J.R. Asiatic Soc. Bengal* (Sci.), 14 (2)120.

Leaf Gall : Hypophyllous, globose, simple, soft, fleshy, sessile, green or yellowish-brown, about 4-9 mm in diameter.

Stem Gall : Simple, globose or ovoid, irregular, free, sessile, subterminal, dark brown and often red-tinged, somewhat spotted white, pitted, unilocular, dehiscent, about 7 mm in diameter and 12 mm long.

***Distribution.*—Pampadapara (Travancore)**

Natural Order LORANIHACEAE

Loranthus sp. parasitic on *Pyrus communis* Linn.

Gall No. 74 by PsyJlid on leaf

Mani, M.S. 1948. J./J. *Asiatic Soc. Bengal* (Sci.), 14 (2): 116.

Oval, elliptical, subglobose, unilocular, fleshy, brownish, beutelgalls on margins of leaves and visible on both the sides, about 10-15 mm long and 5-8 mm thick.

***Distribution.*—Dehra Dun.**

Loranthus elasticus Desr.

Gall No. 38 by Thrips on leaf

Nayar, K.K. 1948. *J. Bombay not. Hist. Soc,* 47 (4) :673.

Epiphyllous leaf margin rolling towards midrib, cylindrical, 25-25 mm long, 5-8 mm thick, grey coloured or reddish-brown; numerous thrips in between the folds.

***Distribution.*—Travancore.**

Natural Order BUXACEAE

Sarcococca brevifolia Stapf.

Gall No. 467 by *Eriophyes* sp. on leaf

PL XIX

Mani, M.S. 1953. *Agra Univ. J. Res.,* (Sci.) 2 (2):258-259.

Irregular, epiphyllous, hemispherical beutelgalls, with large ostiole below. Yellow-green, reticulate, glabrous; erineum inside the gall cavity simple, brownish when youag and rusty when old. Size about 5 mm in diameter. Often agglomerate. Usually about 50-60 galls per leaf. Occasionally a gall may be hypophyllous.

***Distribution.*—Doddabetta 2400 m elevation, Nilgiris (S. India).**

Natural Order EUPHORBIAGEAE

Aporosa lindlayana Baill.

Gall No. 369 by midge on stem

Nayar, K.K. 1948. J. *Bombay nat. Hist. Soc,* 47 (4):672.

Irregularly globose, verrucose or tubercled, brown, solid, hard, woody, indehiscent, swellings of branches, ranging from 10 to 30 mm in diameter.

Distribution.—Travancore.

Aporosa (=Lepidostachys) roxburghi Baill.

Gall No. 565 by insect on leaf

Houard, C. 1917. *Marcellia,* 16:91, No. 24, fig. 33-36; Les Zoocecidies des Plantcs d'Afrique, d'Asie et d'Oceanie, 1:441, No. 1620, fig. 946-949 (1922).

Hypophyllous, subglobose, black gall, about 0.5-1.5 mm in diameter, with irregular surface and an apical small tubercle.

Distribution.—Chittagong (Pakistan) and Parts of Assam.

Cyclostomon assamicas Hook.

Gall No. 261 by *Clinodiplosis nodifex* Kieff. on stem

Kieffer, J. J. 1905. *Marcellia,* 7:155, pi. iv. fig. 8.

Houard, C. 1923. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 908, No. 3286.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc,* 4:38, No. 62.

Mani, M. S. 1948. *J.R. Asiatic Soc. Bengal* (Sci.), 14 (2) :150.

Irregular tumscence of branches, about 5-30 mm long and 3-20 m thick, with numerous larval cavities.

Distribution.—Kurseong (Eastern Himalaya).

Dimorphocalyx glabellus Thw.

Gall No. 311 by unknown Psyllid on leaf

Nayar, K. K. 1944. *Indian J. Ent.,* 6:72.

Regular, simple, globose, somewhat ovoid, sessile, sometimes with a neck-like short basal constriction, epiphyllous, smooth, fleshy, brownish-violet, ostiole hypophyllous and with a circular yellowish-brown lip; 4-5 aggregate; unilocular; cavity large, central; 2-5 mm diameter.

Distribution.—Pampadapara (Travancore).

Emblica officinalis Gaertn.

Gall No. 165 by *Betousa stylophora* (Swinhoe) on stem

Drs. van Leeuwen-Reijnvaan, W. &. J. 1922. *Bull.Jardin bot. Buitenzorg,* (3) 4: 276.

Bose, B. B. *Indian J. Agric. Sci., 5 (6)* : 738.

Nayar, K. K. 1948. *J. Bombay nat. Hist. Soc,* 47 (4) : 671-672.

Mani, M. S. 1948. *J.* ***R.*** *Asiatic Soc. Bengal (Sci.)* **14** (2) : 131.

Globose, (fig. 59) fusiform, compressed, simple, free, terminal or internodal, local tumescence of branches, cavate, lignose, brownish or reddish-brown when young, smooth or with rugose and large tubercles, lobed, punctate, sparsely ramentaceous, sometimes longitudinally striated; with a soft outer cortex, an inner hard, woody annular thick rind, without medulla, but enclosing an elliposidal larval cavity, communicating by a small hole to the outside irregularly placed on the surface; about 20-25 mm and 10-15 mm thick; often unilateral swellings of branches.

Distribtion.— Throughout India. Also Honkong.

Gall No. 262 by *Asphondylia phyllanthi* Felt on leaf

Houard, G. 1922. Les Zoocidies des Plantcs d'Afrique, d'Asie et d' Oceanie, p. 434, No. 1586.

Sundar Raman, A. H. 1924. J. *Indian bot Soc,* 4 : 38, No. 61.

Mani, M. S. 1948. *J. R. Asiatic Soc Bengal* (Sci.), 14 (2) : 150, fig. 32.

Regular, subglobose, sessile, solitary, solid, echinate galls composed of several nearby leaves.

Distribution.—Burma and South India,

Gall No. 472 by an unknown midge on leaf

PL **XIX**

Mani, M. S. 1953. *Agra Univ. J. Res.* (Sci.) 2 : 259, pi. vi.

Regular, globose, fleshy, solid, unilocular, soft, glabrous, pale green or yellow-green galls in the axils of the leaf, about 3 ram in diameter.

Distribution.—Walayar Forest, South of Coimbatore.

Fig. 59. Gall No. 165 on branch of *Emblica ojftcinalii* by *Betausa stylophota.*

Macaraga indica \Y.

Gall No. 82 by PsylHd on leaf

Mani, M.S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) **14(2)** : 117.

Epiphyllous, globose, brownish, unilocular, beutclgall on leaves, with ostiole in a conical projection below, abut 3 mm in diameter.

Distribution.—Dehra Dun.

Gall No. 308 by *Sckizomyia macarangae* Nayar on leaf

Nayar, K. K. 1945. *J. R. Asiatic Soc. Bengal,* (Sci.) II : 19 *Proc. goat. Soc. Bengal,* 6 (2) : 131-134 fig. 1 (1953).

Hypophyllous, globose, villous, hard, fleshy, thick-walled, yellowish-green, unilocular, 1-4 mm in diamethr; cavity at bottom.

Distribution.—Travancore.

Mallotus philtppinensxs M. Ar.

Gall No. 308 by *Rhynockothrips raoensis* Ramakr. on leaf

Ramakrishna, T. V. 1928. *Mem. Depi. Agric. India (ent.)* 10 (7) 282-283

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.), 14 (2) : 109.

Leaf roll gall. Rolling upwards of the two margins towards the midrib, which becomes spirally twisted. Pale green or yellowish-green.

Distribution.—Talipararnba and Nilgiris (S.India).

Gall No. 83 by *PhyltopUcta malloticola* (Crawf.) on leaf

Mathur, R. N. 1935. *Indian for. &(;* (N. S.), I (2) ; 54.

Mani, M. £ 1948.7- *R- Asiatic Soc. Bengal* (Sci.) 14 (2) : 117.

Subglobose, subpyrifrom, regular, epiphyllous, unilocular, isolated, crowded, or often conglomerate, hard, thick-walled, greenish when young and beautiful reddish when mature, sparsely pubescent beutelegall on leaves, about 5-8 mm in diameter, osriole almost closed at first but later when old widening and cracking into lobes.

Dislributiou.—Dehra Dun, Chakratra-Mussurie Hills.

Gall No. 84 by *Phylloplecta* sp. on leaf

Mathur, R. N. 1935. *Indian for. Rec,* (N. S.) 1 (2) : 56.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 117.

Subglobose, subconical, pale green beutelgalls on the surgace of the leaf, often about 200 galls on a single leaf.

Distribution.—Dehra Dun.

Trewia nudiflora Linn.

Gall No. 85 by *Trioza fletcheri* Crawf. on leaf

PI. XXVII

Sundar Raman, A. H. 1924. *J. Indian hot. Soc.,y* 4 : 12, No. 24.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocccidia of the **Netherlands East** Indies, p. 320, fig. 569.

Mani, M. S., 1935. ***J. Asiatic Soc. Bengal*** **(Sci.) 1 (2) : 104 ;** ***J. R. Asiatic Soc. Bengal,*** (Sci.) 14(2) : 118 (1948).

Grennish, pouch-shaped, membranous, epiphyllous, unilocular, reticulated, agglomerate beutelgalls on leaves, about 10 mm in diameter, often ostiolated, with cavity open below and sometimes finely pubescent. Differentiation of tissues of the mesophyl absent.

Distribution.—Throughout India and also Java.

Natural Order ULMACEAE

Holoptelea integrifolia Planch.

Gall No. 37 by *Eriophyes* sp. on leaf

PI. XXIV

Sundar Raman, 1924. *J. Indian hot. Soc,* 4 : 7, No. 1.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 106.

Pale yellowish, pustulate, epiphyllous, hemispherical beutelgalls, with a single erineal cavity; tomentum in the cavity dense and brownish in colour. Sessile, placed near midrib, about 30-40 mm in diameter and 15-20 mm high; often agglomerate; ostiole large, wide open and hypophyllous.

Distribution.—Throughout the eastern and submontane districts of South India.

Ulmus laevigata Royle

Gall No. 591 by aphid on leaf

PI. XVI

Compare gall No. 112 by *Schizomeura compestris* (?) on leaf of *Ulmus wallichiana.*

Distribution.—Upper Beas Valley, above Manali, 2100 m, N. W. Himalaya.

Ulmus wallichiana Planch.

Gall No. 493 by an unknown aphid on leaf

PL XV

Mani, M. S. 1954. *Agra Univ. J. Res.* (Sci.) 3 : 39, pi. ix.

Regular, epiphyllous, free, solitary, petiolate, clavate, cephaloneon, lop-sided, hollow, unilocular, utriculate, thick-walled, dehiscent, beutelgalls, deep reddish-brown, with rough, finely pubescent surface, about 15-20 mm long and 5 mm thick. Ostiole hypophyllous, narrow. The gall dehisces by an elongate or irregular sub-basal rupture on one side. The galls are usually inserted near the leaf margin.

Distribution.—Dalhousie 2500 m. (Dhauladhar Himalaya).

Gall No. 112 by *Schizoneura campestris* (?) on leaf

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) **14** (2) : **123,** fig. 70.

Irregular epiphyilous leaf roll gall.

Distribution.—Kashmir.

Natural Order URTICACEAE

Boemeria platyphylla Don.

Gall No. 446 by unknown midge on leaf

PI. XIII & XXXII

Mani, M. S. 1953. *Agra Univ. J. Res.*, (Sci.), 2:153, pi. iv., fig. 9.

Regular, globose, free, reddish-brown, smooth beutelgalls with well separated long, erect, white, unbranched, straight trichomes; 5 mm in diameter; visible equally on both sides of the leaf blade; upto about 10 on a single leaf and usually close to one of the larger veins; hollow, unilocular, indehiscent. Gall cavity large, globose, central, smooth, with single larva.

Distribution.—Kumaon Hills.

Bwehmeria sp.

Gall No. 417 by Psyllid on leaf

New gall. Epiphyilous, hemispherical or sometimes nearly globose, pubescent, reddish-brown, unilocular beutegalls, about 5 mm in diameter.

Distribution.—Mussurie Hills.

Gerardiana heterophylla Dec.

Gall No. 595 by *Puccinia* sp. on stem

Irregularly globose or fusiform, often curved extensive, solid, fleshy, indehiscent swellings of terminal branches and petioles and midribs of the leaves; about 5-10 mm thick and often as much as 30-50 mm long.

Distribution.—Upper Beas Valey, 6500 ft.

Lecanthus wightii Weed.

Call No 427 by an unknown Psyllid on leaf

PI. VI & XIII

Mani, M. S. 1953. *Agra Univ*. J. *Res.*, (Sci.) 2:154, pi. iv, fig. 1-2, text fig. 4.

Regular, hollow, membranous, succulent, conical, horn-shaped beutelgalls-with wide open hypophyllous ostiole; white, smooth, glabrous, about 10-15 mm high and 1.5-3 mm thick basally; apically obtusely rounded; never more than 3-4 on a leaf and always free, solitary. Outer epidermis of (fig. 45) gall of simple hypertrophied flat cells without stomata and continuous with upper epidermis of the normal, part of the leaf. Beneath his lies a mass of closely packed, irregular parenchyma of giant cells, 4-5 deep. The inner epidermis of the gall incomplete. A few vascular bundles in the gall parenchyma entering from the veins. The transition from the normal to the gall tissue is abrupt at the base of the gall, where the leaf blade is suddenly and deeply invaginated upwards. A single nymph of the psyllid in each gall. Most of the galls collected were empty.

Distribution.—Mussurie Hills (Himalaya).

Piles umbrosa

Gall No. 618 by midge on stem

Difiuse oval or fusiform, solid fleshy, succulent, pale brown or green, smooth, indehiscent, pubescent swellings of branches, with a central large irregular larval cavity. 20 mm long and 8 mm thick.

Distribution.—Narkanda (Himalaya) 2750 m above mean sea level.

Natural Order MORAGEAE

Ficus arnotiana

Gall. No. 680 by unknown insect on stem

Irregular swellings of branches.

Distribution.—Sinhgad (Bombay).

Ficus asperrima Roxb.

Gall No. 309" by Psyllid on leaf

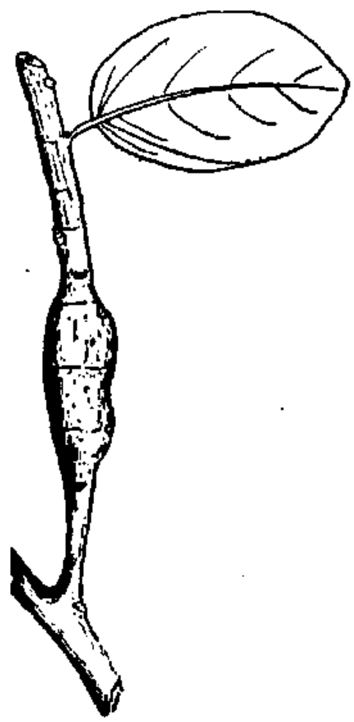
Nayar, K. K, 1944. *Indian J. Ent.*, 6:73.

Epiphyllous, globose or irregular, sessile$_3$ simple beutelgalls, 1-3 mm in diameter, green, unilocular; sometimes 2-3 galls agglomarate.

> *Distribution.*—Travancore.

Ficus bengalensis Linn.

Gall No. 164 by Lepidoptesra on stem



Pig. 60. Gall No. 164 on stem of *Ficus bengalensis* by an unknown Lepidoptera

Mani, M. S. 1943. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2): **131.**

Regular, fusiform, solid, hard, woody, smooth, indehiscent swellings of tender branches, about 25-39 mm long and 10-15 mm thick, with a narrow axial larval canal.

Distribution.— Tanjore and Coimbatore (S. India).

•Echinate Gall No. 263 by chalcid on leaf

PL XXVIII

Mani, M. S. 1935 *Rec. Indian Mus.*, 37 (4) :453;J. *R. Asiatic Soc. Bengal* (Sci.), 14 (2): 150 (1948).

Nayar, K. K. 1945. *J. R. Asiatic Soc. Bengal,* (Sci.) 11:20.

Subglobose, reddish, solid, uni- or bilocular, cystiferous, sessile, hypophyllous galls, with very peculiar, fleshy, conical, echinate processes on the surface. Fully described in my earlier paper.

Distribution.—Tanjore, Goimbatore, Kallar (Niigiri Hills) and Travancore.

Gall No. 469 by an unknown midge on leaf

Mani, M. S. 1953. *Agra Univ.J. Res.*, (Sci.) 2:259.

Regular, minute, lenticular, yellowish, solid, pustuloid, nearly circular, indehiscent, unilocular, glabrous swellings of the leaf blade, about 2.5 mm in diameter, visible equally on both sides of the blade.

Distribution.—Coimbatore.

Ficus dalhousiae Miq.

Gall No. 375 by midge on leaf

Nayar, K. K. 1948. J. *Bombay nat. Hist. Soc.*, 47 (4) 669.

Hypophyllous, subglobose, rarely agglomerate, yellow or yellowish-brown, unilocular, fleshy, soft; about 4-10 mm in diameter.

Distribution.—Kottarakarai (Central Travancore).

Ficus foveolata Wall.

Gall No. 426 by an unknown midge on leaf

PL XXXI

Mani, M.S. 1953. *Agra Univ. J. Res.* (Sci.) 2 (1):152, pi. iv, fig. 4-5; *ibid.*, 3:38 (1954).

Regular, fleshy, solitary, rarely agglomerate but compound, unilocular, yellowish, smooth, glabrous; subglobose or hemispherical on the upper surface of the leaf; bluntly truncated conical on the lower side; ostiole circular, hypophyllous, operculate; the ostiolar operculum a circular, black lid of dead cells slightly within a small crater-like depression. Larval cavity small, surrounded by a thick zone of colourless small proliferating cells. Outside of this lies a thick zone of pigmented, parenchyma of elongate, closely packed cells derived partly from the palisade and partly from the spongy tissues of the leaf. Each gall about 2-3 mm in diameter, 4 mm high; ostiole about 1 mm in diameter. Often as many as 10-15 galls on a single leaf.

Distribution.—Jeolikote, Chakrata, Dharamsala (Himalaya) between elevants of 1500-mm and 2500 m above mean sea level.

« **Ficus glomerata** Roxb.

Gall No. 75 by *Pauropsylla depressa* Crawf. on leaf

PI. XXVII

Sundar Raman, A. H. J. 1924. *Indian bot. Soc.*, 4:10.

Mani, M. S. 1935. *J. Asiatic Soc. Bengal* (Sci). 1(2): 101, pi. i, fig. 1 *; J. R. Asiatic Soc. Bengal (Sci.)* 14(2) :48 (1948).

Mathur, R. N. 1935. *Indian for. Rsc.* (N. S.) 1(2):48.

*** In earlier publications this gall was erroneously described as produced by a midge.**

5-10 mm in diameter, regular, simple, globose or obpyriform, sessile, perfoliate, unilocular; or 15-30 mm in diameter, irregular, compound, multilocular; with large, spherical or convex tubercles; the tubercles representing the several simple galls which have incompletely fused into the compound mass due to forming very close to each other; yellowish, orange, reddish or reddish-brown, almost entirely devoid of chlorophyll, very conspicuous against the background of dark green foliage, glabrous or reticulate, with the preminently raised veins or dotted with small dark red scales; generally thick walled and almost solid, carnose, sometimes less so; dehiscent when old by lacerated openings on the under sides, which let out the Psyllid.

The following structure is made out in a tranverse section: The epidermis encloses a broad annular strip of undifferentiated parenchyma, which surrounds the central hollow space. Concentric, broken, irregular circles of proliferating cells occur in the annular prenchyma. Numerous veins are scattered superficially and deeply in the parenchyma. There is no trace of the palisade or spongy tissue of the leaf, both having completely degenerated into the simple undifferentiated parenchyma. In some young specimens a small fistular opening is found on the under side of the gall, while in the older galls this passage closes more or less completely due to cell proliferation. The galls are really the invaginated and swollen leaf. The seat of cell proliferation is the parenchyma of the leaf.

***Distribution.*—India, Burma, Ceylon, Java, Hongkong, Philippines.**

Gall No. 76 by *Pauropsylla* sp. on leaf

Mathur, R. N. 1935. *Indian for. Rec,* l(2):7l, pi. i-ii.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14(2): 116.

Minute, rough, papillar beutelgalls, epiphyllous on leaves, completely open below, often in very large numbers, colour yellowish-green.

***Distribution.*—Dehra Dun.**

Gall No. 264 by *Dyodiplosis fici* Rao on leaf

Pl. XXVII [

Houard, G. 1922. Les Zoocecidies des Plantcs d'ACrique, d'Asie et d'Oceanie, p. 182.

Drs. van Lceuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies, p. 359.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14(2): 150.

Rao, S. N. 1950. *Indian J. EnL,* **10(1) :123-126,** fig. 63 **B.**

Circular, biconvex, depressed, smooth, solid, fleshy, indehiscent, sessile, nearly equally visible on both sides of the leaf, yellow when young and dark reddish-brown when old; somewhat more pronouncedly swollen on the lower surface of leaf than above; small circular holes 1-2 on each gall when old; often as many as 50 galls per leaf.

***Distribution.*—Calcutta, Agra, Banaras, Madras.**

Gall No. 265 by *Horidiplosis mathuri* Mani on leaf

Mani, M. S. 1935. *Rec. Indian Mas.,* 37(4) :439-441; *J. R. Soc. Bengal* (Sci.) 14(2):150 (1948). o

Compare gall No. 264, but somewhat smaller or more convex.

***Distribution.*—Dehra Dun.**

Gall No. 376 by Psyllid on stem

Nayar, K. K. 1948. J. *Bombay nat. Hist. Soc*, 47(4) :670.

Irregular, brown, rough or tuberculated ourgrowths on stem; often agglomerate, 5-15 mm long and 4-10 mm thick.

Distribution.—Pampadapara (Travancore).

Gall No. 683 by Psyllid on stem

Nayar, K. K. 1944. *Indian J. Era.*, 6: 73.

Irregular, globose or ovoid, sometimes single but usually agglomerated masses, with rough tuberculated surface, brown; size varying from 5-15 mm long and 4-10 mm thick; forming usually on a branch or also on the petiole; cavity of single gall large, with the nymph of the psyllid inside.

Distribution.—Pampadpara : Travancore.

Ficus hookeri Roxb.

Gall No. 77 by *Pauropsyllaficicola* Kieff. on leaf

Kieffer,J.J. 1905. *Ann. Soc. Sci. Bruxelles,p.* 169-172, fig. 2, pis. ii.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 176, No. 628.

Sundar Raman, A. H. 1924. *J. Indian hot Soc,* 4:10, No. 11.

Mani M. S. 19*8. *J. R. Asiatic Soc. Bengal,* (Sci.), 14(2) :116.

Hemispherical or obtusely conical, hard, epi- or hypophyllous, unilocular galls about 3 mm high, 3-4 mm thick, solitary or often more or less confluent; on the other side it is a small pointed conical projection; greenish-yellow when young, rather dark and brittle when old and dehiscing into lobes at the conical point below.

Distribution.—Kurseong (Eastern Himalaya).

Gall No. 78 by *Pauropsylla globuli* Kieff on leaf

Kicffcr, *Ann. Soc. Sci. Bruxelles,* pp. 172-173, No. 3, fig. 9-10.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 175-176 No. 627.

Sundar Raman, A. H. 1924. *J. Indian hot. Soc.,* 4:10 ,No. 12.

Mani, M. S. 1948 J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 117.

Globose, coriaceous, unilocular, greenish or brownish, dehiscent galls on both sides, but relatively more numerous on the upper side of the leaves, and specially near the margins, about 5-6 mm in diameter.

Distribution—Kurseong (E. Himalaya).

Ficus infectoria Roxb.

Gall No. 79 by Psyllid on leaf

Mani M. 5. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 117.

Epiphyllous, hemopherical, smooth beutelgalls, with wide open hypophyllous ostiole. Size 2.3 mm.

Distribution.—Tanjore and Coimbatore.

Gall No. 266 by *Horidiplosis fici* Felt on leaf

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 183, No. 663.

Mani, M. S. 1948, *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 151.

Biconvex, unilocular galls visible on both sides of the leaf.

Distribution.—Bengal, Bihar and Eartern parts of Uttar Pradesh.

GaU No. 702 by *Trioza* sp. on leaf*

PI. V

Mani, M. S. 1953. *Agra Univ.J. Res.* (Sci.) 2:259, pi. vii.

Regular, simple, occasionally agglomerate, free and isolated or frequently crowded, epiphyllous, dehiscent, unilocular, thick fleshy-walled, glabrous, yellow or pale-white, globose beutelgalls, with hypophyllous ostiole; size of each gall ranging from 3 to 6 mm in diameter. Single nymph of the psyllid in each galh On an average up to about a dozen galls per leaf.

Distribution.—Marudamalai Hills near Goimbatore.

Gall No. 584 by Hymenoptera on stem >

Regular, subglobose or oval, often also lateral or fusiform, solid, indehiscent, multilocular, smooth brown swellings of branches, with minute circular emergence holes on the surface; 10-15 mm in diameter. Occasionally one or two galls forming close together agglomerate.

Distribution.—Jejuri (Bombay).

Ficus nervosa Roth.

Gall No. 80 by *Dinopsylla grandis* Crawf. on leaf

[0] **Mani, M.S. 1935. *J. Asiatic Soc. Bengal* (Sci.) 1:103; *J. R. Asiatic Soc. Bengal* (Sci.) 14(2) : 117 (1948).**

Epiphyllous, simple, globose, rarely oval, sessile, dehiscent, pale yellowish-green and densely clothed with long, slender brown hairs; fleshy, unilocular; usually placed near the midrib or the base of the larger side veins; 15 mm in diameter.

Distribution.—Malabar Distt. (S. India.)

Ficus religiosa Linn.

Gall No. 267 by *Pipaldiplosis pipaldiplosis* Mani on leaf

PL XXVIII

Mani, M. S. 1935. ***Rec.*** *Indian Mus,* 37:45*; *Indian J. Ent.,* 4 (1) : 46, fig. 15 (1945); J- *R. Asiatic Soc. Bengal* (Sci.) **14** (2) : **151** (1948).

Hypophyllous, localised or extensive oval or fusiform, solid, hard, woody, indehiscent, brown swellings of midrib and other veins, often continuous and branched; with irregular, narrow, longitudinal larval cavities extending nearly the whole length of the gall; old galls often persist; when mature the surface cracks irregularly.

Distribution.—Common throughout India.

Gall No. 323 by *Trioza* sp. on leaf

PI. XII

Mani, M. S. 1953. *Agra Univ.J. Res.* (Sci.) 2: 260.

Regular, free, subglobose or hemispherical, epiphyllous, hollow, thin-Walled, indehiscent, unilocular, persistent beutelgalls, with wide-open hypo-Phyllous ostiole, green or yellowish-green, glabrous; with a single nymph of the PsyUid in the bottom of the pit-like gall cavity; size abone 2 mm in diameter.

^__^*istHbution.*—Agra.

* This gall was erroneously numbered 407 in 1953 *{loc. cit.)* No. 407 refers to gall on *Artedmisia vulgaris.*

Ficus retusa Linn.

Gall No. 46 by *Arrhenothrips dhumrapaksha* Ramkr. on leaf

Ramakrishna, T. V. 1928. *Mem. Dept. Agric. India* (ent.) 10 (7) : 280.

Leaf roll gall.

Distribution.—Mysore.

Gall No. 47 by *Alesothrips bhimrabahu* Ramark. on leaf

Ramakrishna, T. V. 1928. *Mem. Dept. Agric. Mia* (ent.) 10 (7) : 306.

Leaf roll gall.

Distribution.—Kollegal.

Gall No. 47 a by *Mesothrips apetelus* Karny on leaf

Ramakrishna, T. V. 1928. *Mem. Dept. Agric. India* (ent.), 10 (7):305.

Leaf roll gall.

Distribution—Kollegal.

Gall No. 281 by Hymenoptera on aerial root

Houard, C. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie etd'Oceanie, p. 188.

Drs. van. Leeuwen-Reijnvaan, W. & J.I925. The Zoocecidia of Netherlands East Indies, p. 132-133 fig. 107.

Houard, G. 1926. *Marcellia,* 23:17, No. 22, fig. 44-45.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 155.

Fusiform, solid, hard, indehiscent swellings, 10 mm long and 2 mm thick, larval cavity elongate, axial.

Distribution.—Coimbatore (S. India). Perhaps the same gall also comes from Java and Indo-China.

Ficus rumphii

Gall No: 674 by Pauropsylla sp. on leaf

Epiphyllous, regular, unilocular, subglobose, fleshy gall, yellow or brown.

Distribution.—Surat.

Ficus roxburghii

Gall No. 81 by *Pauropsylla* sp. on leaf

PI. XXVII

Mathur, R. N. 1935. *Indian forest Rec.* (N. S.) 1 (2) : 50.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 117; *Agra Univ. J. Res.*, ((Sci.) 2: (19S3); *ibid.*, 3 : 39 (1954).

Regular, subglobose or pyriform, solitary but also agglomerate or compound, hollow, thick-walled, fleshy, dehiscent, smooth, glabrous, greenish or yellowish beutelgalls, but visible on both sides of the leaf blade, though largely hypophyllous; ostiole hypophyllous and nearly obliterated. About 10-12 mm in diameter^

Distribution.—Kumaon and Garhwal Himalaya, upto about 2200 m; Dehra Dun (Siwaliks); Dharmsala and Dalhousie (Punjab Himalya).

^ **Ficus scandens** Roxb.

Gall No. 480 by *Eriophyes* sp. on leaf

PI. XX

Mani, M. S. 1954. *Agra Univ.J. Res.*, (Sci.) 3 : 39, pi. x, fig. 2.

Epiphyllous, agglomerate sessile, nodular or tubercular, subglobose beutelgalls, yellow above and scattered in enormous numbers, often as many as 500 on a single leaf, with hypophyllous ostium, covered by bright-red or pink-coloured, fleshy emergences and erineum. The gall cavity complex, with fleshy emergences and erineal growth. Single gall varying in size from 1 mm to 3 mm in diameter and agglomerate ones often as large as 5 mm wide.

*Distribution**—Dharamsala up to 2000 m.

Ficus sp. (?)

Gall No. 475 by psyllid on leaf

PI. XVII

Hypophyllous, regular, globose, sessile, free, dehiscent, unilocular, hollow but thick-walled, pubescent, about 10-15 mm in diameter.

Distribution.—Dehra Dun.

Gall No. 511 by Psyllid on leaf

Regular, mostly epiphyllous, globose, thick-walled hollow swelling of the midrib near the base of leaf, about 15 mm in diameter.

Distribution.—Travancore.

Ficus talboti King (?)

Gall No. 313 by *Dinopsyllagrandis* (?) on leaf

Nayar, K. K. 1944. *Indian J. Ent.,* 6: 69-73; J. *Bombay nat. Hist. Soc,* 47 (4) ; 670 (1948).

Epiphyllous, subglobose, depressed; with stony interior when old.

Pistribution.— Pampadaparai Hills (Travancore).

Natural Order CASUARINACEAF

Casuarina equisetifolia Forst.

Gall No. 186 by Hymenoptera on stem

Houard, C. 1922. Les Zoocecidies des Plantes d'Afriqur, d'Asie et d'Oceanic, p. 69 No. 170.

Drs. van Leeuwen-Reijnvaan, W. & J. 1926. The Zoocecidia of Netherlands East Indies p« 96.

Mani, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2): 156.

Regular, globose or ovoid, internodal swellings of branches, covered by bracts, about 3 mm in diameter; larval cavities 2-3, sometimes terminal and agglomerate.

Distribution.—Coromandal Coast.

Gall No. 104 by Bacteria on roots

Ghaudhari, H. 1931. *Bull. Soc. bot. France,* 78:447-452 fig. 2.

Root nodules similar to the bacterial root nodules of Legumes.

Distribution.—"India."

Natural Order GNETAGEAE

Gnetum sp.

Gall No. 331 by unknown insect on leaf

MulIer,A. 1872. *Trans, ent. Soc. London,* (3)1 proc. p. ix.

Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et et d'Oceani*-, 1:35, No. 59.

Unilocular, epiphyllous small gland-like galls, along midrib.

*Distribution.—K&ndl** (Bombay).

Natural Order ZINGIBERAGEAE

Eletteria cardamomum Maton

' Gall No. 372 by *Hallomyia cardamomi* Nayar on root

Nayar, K. K.1948. J. *Bombay nat. Hist. Soc,* 47 (4) : 668; *Proc. R. ent. Soc. London,* (B) 18 (5-6) : 84 (1949).

Unilatetral obscure swellings of the roots, 2-8 mm long and 1-2 mm thick, succulent, with one larval cavity.

Distribution.—Travancore High Ranges.

Natural Order ARAGEAE

Pothos scandens Linn.

Gall No. 50 by *Eothrips foliiperda* Karny on leaf

Ramakrishna, T. V. 1928. *Mem. Dept. Agric. India* (cnt.) 10 (7) : 298.

Manj, M. S. 1948. *J. R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 110.

Leaf roll gall, not fully described. *Mesothrips melinocnemis* Karny is also found in the same gall.

*Distribution**— Taliparamba (Malabar; S. India).

Natural Order CONIFERAE

Pinus longifolia Roxb.

Gall No. 269 by unknown gall midge on leaf

Stebbing, E. P. 1905. *Indian Forester,* 31 : 429-434, pi. xxxviii.

Houard, G.1922. Les Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, p. 27, No. 31.

Sundar Raman, A. H. 1924. *J. Indian bot. Soc,* 4 : 36, No. 51.

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14 (2) : 151.

The young needles swell up, coalesce and form galls; after escape of larvae, the gall dries but persists on the plant for a considerable time; size varying from 12-20 mm.

*Distribution**—Himalaya.

Picea morinda (smlthiana)

Gall No. 122 by *Sacchiphanta abietis* (Linn.) on stem

Mani, M. S. 1948. J. *R. Asiatic Soc. Bengal* (Sci.) 14a(2) : 124.

Fir-cone-like swellings of branches.

Distribuion.—Chakrata.

Podocarpus chinensis

Gall No. 693 by bacteria on roots

Chaudhari, K. and A. R. Aktar 1931. J. *Indian bot. Soc.* 10 : 92.

Globose or fusiform tubercular swellings of roots.

Distribution.—"India".

GALLS ON SOME UNIDENTIFIED PLANTS

Gall No. 291 by *Eriophyes* sp. on leaf

Epiphyllous, pale green or yellow, subglobose beutelgalls. South India.

Gall No. 389 by midge on leaf

Regular, hypophyllous, globose, free, solid, hard, brown, pepper-corn-like galls, about 2 mm in diameter and somewhat similar to the galls on mango leaves.

Distribution.—Poona. (From Mr Sarod Ketkar Coll.)

Gall No. 459 by midge on leaf

Regular, subglobose or nearly biconvex, solitary or rarely 2-3 galls agglomerated swellings of the larger veins, nearly equally developed on both sides of the leaf blade; with smooth or only obxurely and finely pubescent surface, yellow or greenish-yellow; solid, fleshy, indehiscent; about 5-10 mm in diameter; with single gall cavity.

Distribution.—Walayar Forest near Coimbatore.

Gall No. 460 by *Eriophyes* on leaf

PL XIX

Irregular, epiphyllous, hemispherical **and** localized or also elongate, semi-cylindrical, curved, indehiscent beutelgalls, with the surface smooth or rugose and coriaceous; gall cavity spacious, with wide-open hypophyllous ostiole; gall cavity with irregular erineum; surface yellowish-green or also brownish; usually several galls are crowded on either side of the midrib and somewhat resembling gall No. 37 on leaf of *Holaptelea integrifolia* Plamch., but smaller and more conspicuously coriaceous. Size about 10-15 mm in diameter.

Distrubution.—Mahabaleshwar.

Gall No. 473 by *Eriophyes* on leaf

PL XVII

Irregular, mostly hypophyllous, elongate, worm-like or ridge-like, nearly submarginal beutelgalls in parallel rows, 10-20 per leaf, about 10-25 mm long, 3-5 mm thick and 10-15 mm high; the surface green, finely rugose; gall cavity spacious, elongate, irregular, hypophyllous, filled with fine erineum. The leaf blade bearing the gall is often crumpled or curled. The site of the gall is indicated on the upper surface of the leaf blade by a deep groove.

Distribution.—Walayar Forests near Coimbatore.

Gall No. 474 by midge on leaf

PL XVII

Regular, subglobose or thick-biconvex, solid, spongy, indehiscent swellings of the leaf, equally developed on both sides of the blade, usually near the leaf tip, about 5-10 mm in diameter, pale green or greenish-yellow, tuberculated or reticulate; larvae numerous in each gall.

Distribution.—Goimbatore.

Gall No. 518 by *Eriophys* sp. on leaf

PL XVI

Regular, epiphyllous, hemispherical or nearly subglobose, sessile, glabrous beutelgall, yellowish-green, yellow, brown or also tinged red, with wide open hypophyllous ostiole but nearly obliterated by dense erineum ; on the lower side the site of the gall is indicated by a conspicuous concave depression ; size of the gall 5 mm in diameter ; usually about 20-30 gall on a single leaf.

Distribution.—Ghakrata Hill (Outer Himalaya)at elavations between 1800 and 2500 metres.

Gall No. 522 by Coleoptera or midge on stem

Fusiform, solid swellings of stem of a plant probably of Labiatae. Narkanda Hills.

Gall No. 524 by midge on flower

Irregular, subglobose, solid swellings of flowers. Narkanda Hills.

Gall No. 676 by *Cecidothrips bursarum* Kieff on leaf

Kieffer, J. j. 1908. *Marcellia,* 7:165-167, fig. 4, pi. iv. 15. : Karny, H. 1930. *Verh. zooL boL Ges. Wian,* 63:10. Houard, C. 1922. Les Zoocecidics des Plantes d'Afrique, d'Asie et d'Oceanie, 2&09, No. 3290.

Depressed pouch gall, about 30-40 mm long, 6-10 mm thick and 15-20 mm high, fixed to the leaf blade close to the midrib; with the surface smooth, glabrous, sometimes also finely tuberculated, partly hard; ostiole on a small elevation on the opposite side of the leaf blade; often the gall is in the form of a compressed cylinder, 25 mm long and 12 mm thick, with an epiphyllous ostiole. Exact locality is not mentioned.

Gall No. 694 by midge on leaf

Kieffer, J.J. *1905. Ann. Soc. Sci. Bruxelles, 29* (2):158, No. 8. Houard, G. 1922. Les Zoocccidies des Plantes d'Afrique, d'Asie ct d'Oceanie, 2:907, No. 3281.

Leaf gall, about 6 mm long and 3-4 mm thick, with a central umbilicus, on the other side of the blade about 2-3 mm high ; the gall surface glabrous, smooth, green or yellowish, with a reniform gall cavity containing a single midge larva. Exact locality not mentioned.

Gall No. 695 by Psyllid on leaf

Kieffcr, J.J. l£08. *Marcsllia,* 7:161. Houard, G. *\91≥*. Les Zoocecidies des Plar.tcs d'Afrique d'Asic et d'Oceanie, 2:907, No, 3282.

This gall is described as being similar to gall No. 694, but equally developed on both sides of the leaf blade, viz. only 2 mm high on both sides, 7-8 mm long, 5 mm thick; and with a hypophyllous umbilicus. Exact locality not mentioned.

Gall No. 696 by Psyllid on shoot or petiole

Kieffcr, J. J. 1908. *Marcellia,* 7:161. Houard, G. 1922. Les Zoocecidies des Plantes d'Afrique d'Asie et d'Occanie, 2:908, No. 3285.

Small, often agglomerated bulge-like swellings on the tender shoot or also on the petioles, about 4-7 mm wide and 6-10 mm thick (high) ; somewhat obscurely depressed in the summit ; often when formed on leaves about 8-10 mm long, 6 mm wide ; on the opposite side the site of the gall is almost fleshy ; gall cavity single, with one nymph. Exact locality not mentioned.

Gall No, 697 by *Clinodiplosis cellularis* Kieff. on stem

Kicffer, J. J. 1S08. *Marcellia,* 7:165-157, pi. iv, 9. Houard, C. 1922. Les Zoocccidies des Plantes d'Afrique, d'Asie ct d'Oceaive, 2:908-9C9 No. 3288.

Cauline, unilateral, irregular swellings of the stem, about 30 mm long, 15 mm thick, with spongy texture, brown; gall cavity sunglobose; 3 mm lon^, with a single pale yellow larva. Exact locality not mentioned.

Gall No. 698 by *Pemphigus indicus* Kieff. on leaf

Kieffer, J. J. 190 3. *Morcellia,* 7:161-162, fig. 1. Houard. C. 1922. Lcs Zoocecidies des Plantes d'Afrique, d'Asie et d'Oceanie, 2:£09, No. 3289

Irregularly globose galls, about 40-50 mm in diameter, with lobed and rugose surface, when mature resembling a gall by *Schizoneura lanuginosa* Hartig. from Europe ;*gall cavity spacious, with numerous aphids. Exact locality not mentioned.

Gall No. 699 by midge on leaf

Kieffcr, J.^J. 1908. *Macellia,* 7:158, pi. iii. Houard, C. 1922. Les Zoocecidies Plantes d'Afrique, d'Asie et d'Oceanie, 2:909, No. 3291

Cylindrical galls, about 5 mm high and 1.5-2 mm in diameter, inserted on the leaf blade in the middle of a small depression ; the surface finely pubescent ; gall cavity two, elongate and parallel, each with one larva. Exact locality not mentioned.

INDEX TO GALLS

Gall No.	Plant	Gall maker	Part of plant bearing gall
1.	Centolla asiatica	Heterodera marioni	root
2.	Ruellia prostrata	Heterodera marioni	root
3.	Polanisia viscosa	Eriophyes sp.	overy
4.	Gadaba indica	Eriophyes sp.	leaf
5.	Gossypium herbaceum	Eriophyes gossypii	leaf
6.	Hibiscus micranthus	Eriophyes hibisci	leaf
7.	Hibiscus rosasinensis	Eriophyes hibisci	leaf
8.	Hibiscus tiliaceus	Eriophyes hibiscitileus	leaf
9.	Grewia microcos	Eriophyes sp.	leaf
10.	Triumpheta rhomboidea	Eriophyes javanicus	leaf
11.	Zizyphus jujuba	Eriophyes cernuus	stem
12.,	Nephelium litchi	Eriophyes chinesis	leaf
13.	•Sapindus laurifolius	Eriophyes sp.	leaf
14.	Acacia leucophloea	Eriophyes acaciae	leaf
15.	Dalbergia sissoo	Eriophyes cheriani (?)	leaf
16.	Dichrostachys cinerea	Eriophyes dichrostachia	leaf
17.	Pongamia glabra	Eriophyes cheriani	leaf
18.	Prosopis juliflora	Eriophyes prospidis	leaf
19.	Prosopis juliflora	Eriophyes prosopidis	flower
20.	Tcrminalia glabra	Eriophyes sp.	leaf
21.	Mussacnda hirsutissima	Eriophyes sp.	sepal
22.	Randia dumetorum	Eriophyes sp.	leaf
23.	Salvadora persica	Eriophyes sp.	flower
24.	Gordia myxa	Eriophyes cordiae	leaf
25.	Ipomaca scindica	Eriophyes sp.	leaf and flower
26.	Ipomaca pes-tigridis	Eriophyes sp.	stem
27.	Ipomaca staphylina	Eriophyes gastrostrichus	stem and leaf
28.	Premna scrratifolia	Eriophyes prcmnae	leaf
29.	Vitex pubcsccns	Eriophyes cryptotrichus	leaf
30.	Ginnamomum zeylanicum	Eriophyes doctersi	leaf
31.	Ginnamomum zeylanicum	Eriophyes sp.	leaf
32.	Lindera assamica	Eriophyes sp.	leaf
33.	Lindera pulchcrrima	Eriophyes lindcrae	leaf
34.	Litsea lingustrina	Eriophyes sp.	leaf
35.	Litsea wightiana	Eriophyes sp.	leaf
36.	Machilus macrantha	Eriophyes sp.	leaf
37.	Holoptelca intcgrifolia	Eriophyes sp.	leaf
38.	Acacia lcucophloea	Thilakothrips babuli	flower
39.	Acacia lcucophloea	Thilakothrips babuli	bud
40.	Galycopteris floribunda	Austrothrips cochinchinensis	bud
41.	Terminalia catappa	thrips	leaf
42	Memt'cylon sp.	Brachythrips dantahasta	leaf
43.	Syziguim jambolanum	Eothrips jambuvasi	leaf
44.	Mimusops clcngi	Arrehcnothrips ramakrishnai	leaf

Gall No.	Plant	Gall maker	Part of plant bearing gall
45.	Jasminum pubescens (?) or arborescens	Eothrips aswamukha	leaf
46.	Ficus retusa	Arrhenothrips dhumrapaksa	leaf
47.	Ficus retusa	Mesothrips bhimabahu	leaf
48.	Mallotus philippinensis	Rhynchothrips raoensis	leaf
49.	Piper nigrum	Gynaiocothrip chavicae	leaf
50.	Pothos scandens	Eothrips foliiperda	leaf
51.	Schima wallichi	Cecidothrips schimae	leaf
52.	Shorea robusta	Phylloplecta sp.	leaf
53.	Kydia calycina	Pauropsylla sp.	leaf
54.	Chloroxylon 'swetiana	Arytaina ramakrishni	leaf
55.	Garuga pinnata	Phacopteron lentigenosum	leaf
56.	Ilex wightiana	psyllid (?)	leaf
57.	Mangifera indica	Apsylla cistella	bud
58.	Spondias mangiferae	Pauropsylla spondiasae	leaf
59.	Terminalia arjuna	Megatrioza hirsuta	leaf
60.	Terminalia arjuna	Trioza fletcheri	leaf
61.	Terminalia catappa	Phylloplecta hirsuta	leaf
62.	Terminalia paniculata	Phylloplecta hirsuta	leaf
63.	Terminalia sp.	psyllid (?)	leaf
64.	Terminalia sp.	psyllid (?)	leaf
65.	Terminalia sp.	psyllid (?)	leaf
66.	Terminalia tomentosa	Phylloplecta hirsute*	leaf
67.	Eugenia malaccensis	Megatrioza vitiensis	leaf
68.	Syzigium jambolanum	Trioza jambolanae	leaf
69.	Syzigium ope rcu la turn	psyllid	leaf
70.	Diospyros melanoxylon	Trioza obsoleta	leaf
71.	Symplocos theaefolia	Cecidothrips baccarum	leaf
72.	Symplocos theaefolia	Ozotrioza sytracearum	leaf
7.1.	Alstonia scholaris	Pauropsylla tuberculata	leaf
74.	Loranthus sp.	psyllid	leaf
75.	Ficus glomerata	Pauropsylla depressa	leaf
76.	Ficus glomerata	Pauropsylla (?)	leaf
77.	Ficus hookeri	Pauropsylla ficicola	leaf
78.	Ficus hookeri	Pauropsylla globuli	leaf
79.	Ficus infectoria	Pauropsylla (?)	leaf
80.	Ficus nervosa	Dinopsylla grandis	leaf
81.	Ficus roxburghii	Pauropsylla sp.	leaf
82.	Macaranga indica	psyllid	leaf
83.	Mallotus philippinensis	Phyllopecta malloticola	leaf
84.	Mallotus philippinensis	Phylloplecta sp.	leaf
85.	Trewia ntfdiflora	Trioza fletcheri	leaf
86.	Beilschmedia sikkimensis	Ozotrioza laurinarum	leaf
87.	Beilschmedia sikkimensis	psyllid (?)	branch
88.	Cinnamornum camphorae	Trioza sasaki (?)	leaf
89.	Cinnamomum macrocarpum	psyllid (?)	leaf
90.	Cinnamornum nitidum	psyllid (?)	leaf
91.	Cinnami-mum sp.	Phacosema gallicola	leaf
92.	Gnnamomum zeylanicum	psyllid	leaf
93.	Cinnamomum zeylanicum	psyllid	leaf
94.	Cinnamomum zeylanicum ovalifolium	psyllid (?)	leaf
95.	Lindera assamica	psyllid	leaf

Gall No.	Plant	Gall maker	Part of plant bearing gall
96.	Litsea polyantha	Pauropsylla beesoni	leaf
97.	Machilus gamblei	Neotrioza machili	leaf
98.	Populus euphratica	Phylloplecta gradneri	leaf
99.	Populus euphratica	Phylloplecta sp.	leaf
•100.	Populus euphratica	Phylloplecta sp.	leaf
102.	Tephrosia purpurea	Alenromariginatus tephrosiae	leaf
103.	Achyranthes aspera	Bemisia tabacci	leaf
104.	Gasuarina equisetifolia	Bacteria	root
105.	Pistacia integrimma	Dasia aedifactor	leaf
106.	Pistacia khinjuk	aphid	leaf
107.	Pistacia sp.	Geratopemphigus zehntneri	leaf
108.	Pyrus com munis	Toxoptera punjabipyri	leaf
109.	Pyrus mali-	Eriosoma lanigera	leaf
110.	Terminalia chebula	aphid	root
111.	Ghenopodium album	Brevicoryne chenopodii	leaf
112.	Ulmus wallichiana	Schizoneura ulmi (?)	leaf
113.	Pyrus paschia	midge	leaf
114.	Populus ciliata	Pemphigus imaicus	leaf
115.*	Populus ciliata	Pemphigus mordwilkowi	branch
116.	Populus ciliata	Pemphigus nainitalensis	branch
117.	Populus ciliata	Pemphigus napeus	branch
•118.	Populus nigra pyramidalis	Pemphigus immunis	branch
121.	Populus alba	Eriosoma taskhiri	leaf
122.	Picea morinda	Sacchiphanta abieties (?)	branch
123.	Mesua ferrea	Amorphococcus mesuae	branch
124.	Thea sinensis	Ghionaspis manni	stem
125.	Styrax hookeri	aphid	terminal bud
126.	Maesa perotettiana	psyllid or aphid (?)	leaf
127.	Gossypium sp.	Alcidodes sp.	stem
128.	Gossypium spp.	Pempherulus affinis	stem
129.	Aegle marmelos	Glitea picta (?)	stem
130.	Pyrus malus	Alcidodes mali	stem
131.	Acacia leucophloea	Sphadosmus brahminus	stem
132.	Alysicarpus monilifer	Gurculionid	stem
133.	Butea frondosa	Pachyonyx quadridens	stem
134.	Dolichos lablab	Sagra nigrita	stem
135.	Dolichos lablab	Alcidodes collaris	root and cauline stem
136.	Dolichos lablab	Desmidophorus (?)	stem
137.	Sesbania acgyptiaca	Alcidodes bubo	stem
138.	Sesbania grandiflora	Alcidodes bubo	stem
139.	Sesbania aculeata	Alcidodes bubo	stem
140.	Jusseiua repens	Goeolptera	fruit
141.	Cordia myxa	Baris cordiae	stem
142.	Gynoglossum lanceolatus	Pachyonyx cynoglossi	tap root
143.	Cuscuta refflexa	Gurculionid	stem
144.	Justicia diffusa	Gurculionid	stem
145.	Amarantus caudatus	Hypolixus truncatulus	stem
146.	Amsrantus gangcticus	Hypolixus truncatulus	stem

*Gall Nos. 101 and 110-121 are on exotic plants, and though in my collection, are not mculdcd in this work. They have been described eleswhere already.

Gall?*o.	Plant	Gall maker	Part of plant bearing gall
147.	Amarantus spinosa	Hypolixus truncatlus	stem
148.	Amarantus viridis	Hypolixus truncatulus	stem
149.	Gapparis aphylla	Lepidoptera	stem
150.	Capparis brevispina	Lepidoptera	stem
151.	Capparis stylosa	Lepidoptera	stem
152.	Tamarix articulata	Amblylapis olivierella (?)	stem
153.	Crotolaria juncea	Laspeyresia pseudonectis	stem
154.	Crotolaria juncea	Laspeyresia tricentra .	stem
155.	Crotolaria sajtiana	Grapholitha subrufillana	stem
156.	Crotolaria semperflorens	Lepidoptera	stem
157.	Grotolaria verrucosa	Lepidoptera	stem
158.	Crotolaria willdenoviana	Lepidoptera	stem
159.	Desmodium pulchellum	Lepidoptera	stem
160.	Tephrosia purpurea	Dactylethra Candida	stem
161.	Tephrosia hirta	Lepidoptera	stem
162.	Tephrosia spinosa	Lepidoptera	stem
163.	Nicotiana tabaccum	Phthorimea heliopa	st?m
164.	Ficus bengalensis	Sepiduptera	stem
165.	Emblica officinalis	Betousa stylophora	stem
166.	Cardiospermum halicacabum	Agromyzid fly	stem
167.	Cadaba indica	midge	leaf
168.	Salvadora oleoides	Thomasiniana salvadorae	stem
169.	Capparis sepiaria	midge	leaf
170.	Capparis viminea	Oligotrophus indicus	stem
171.	Crataeva religiosa	Aschistonyx crataevae	leaf
172.	Crataeva religiosa	Aschistonyx crataevae	flower
173.	Maerua arenaria	Schizomyia maeruae	leaf
174.	Tamarix dioica	Misospatha tamaricis	stem
175.	Tamarix gallica	Misospatha tamaricis	stem
176.	Camellia drupifera	Lasioptera longispatha.	bud
177.	Eurya japonica	Schizomyia incerta	leaf
178.	Schima wallichi	Lasioptera trilobata	leaf
179.	Hopea parvifolra	midge	shoot
180.	Hibiscus vitifolius	midge	shoot
181.	Sida acuta	midge	stem
182.	Grewia (Eugrewia) orientalis	midge	leaf
183.	Aegle marmelos	Cecidomyia duttai	leaf
184.	Murraya exotica	midge	leaf
185.	Toddalia aculeata	midge	flower
186.	Zizyphus* jujuba	midge	leaf
187.	Zizyphus xylopyra.	midge	fruit
188.	Cardiospermum halicacabum	midge	flower
189.	Mangifera* indica	Oligotrophus mangiferae	stem
190.	Mangifera indica	Alassomyia tenuispatha	leaf
191.	Mangifcra indica	midge	leaf
192.	Mangifera indica	Procontarinia mateiana	leaf
193.	Mangifera indica	Indodiplosis mangiferae	leaf
194.	Mangifera indica	midge	leaf
195.	Mangifera indica	Dasyneura mangiferae	flower
196.	Mangifcra indica	Amradiplosis echinogalliperda	leaf
197.	Mangifera indica	Rhabdophaga mangiferae	stem

Gall No.	Plant	Gall maker	Part of plant bearing Gall
198.	Odina wodier	Odinadiplosis odinae	leaf
199.	Desmodium biarticulatum	Asphondylia sp. (?)	flower
200.	Indigofera aspalathoides	midge	fruit
201.	Pongamia glabra	Myricomyia pongamiae	stem
202.	Pongamia glabra	Asphondylia pongamiae	fruit: ovary
203.	Acacia leucophloea	midge	leaf
204-	Acacia leucophloea	Schizomyia sp. (?)	leaf
205.	Acacia leucophloea >	midge	branch
206.	Acacia leucophloea	Asphondylia trichocecidarum	leaf
207.	Acacia leucophloea	Schizomyia acaciae	leaf
208.	Acacia leucophloea	midge	stipular thorn
209.	Acacia catechu	Lobopteromyia bivalviae	leaf
210.	Dichrostachys cinerea	Asphondylia utriculae	ovary
211.	Prosopis juliflora	Loboperomyia prosopidis	branch
212.	Prosopis spicigera	Lobopteromyia prospidis	branch
213.	Pyrus pashia	midge	stem
214.	Kubus assamcnsis	Schizomyia assamensis	leaf
215.	Rubus micropetalus	midge	leaf
216.	Syzigium jambolanum	midge	stem
217.	Syzigium operculatum	midge	stem
218/	Bryonia sp.	Lasioptera bryoniae	stem
219.	Coccinia (Cephalandra) indica	Neolasiptera cephalandrae	stem
220.	Gymnostenma pedatum	midge	stem
221.	Luffa aegyptiaca	midge	stem
222.	Melothria amplexicaulis	midge	stem
223.	Melothria heterophylla	midge	stem
224.	Melothria madaraspatana	midge	stem
225.	Melothria perpusilla	Prolasioptera javanica	stem
226.	Momordica charantia	Lasioptera falcata	stem
227.	Momordica dioica	Lasioptera falcata	stem
228.	Morinda tinctoria	Asphondylia morindae	fruit and flowers
229*	Artemisia sp.	Clinodiplosis artemisiarum	stem
230.	Artemisia sp.	Rhopalomyia sp.	leaf
231.	Artemisia sp.	Panteliola haasi	bud
232.	Embelia ribes	midge	ovary
233.	Maesa perotettiana	midge	fruit
234.	Maesa perotettiana	Oligotrophus quadrilobatus	leaf
235.	Mimusops hexandra	Pruthidiplosis mimusopsicola	ovary and fruit
236*	Symplocos theaefolia	Contarinia pulcherrima	stem
237.	Carissa carandas	midge	stem
238.	Carissa spinarum	midge	stem
239.	Ervatania coronaria	midge	, petiole and leaf
240.	Ervatania coronaria	midge	flower
241.	Hoya parviflora	midge	leaf
242.	Strychnos potatorum	midge	leaf
243.	Corda myxa	midge	ovary
244.	Ipomaea cairica	Schizomyia cheriani	flower
245.	Ipomaea sepiaria	midge	flower
246.	Ipomaea staphylina	Asphondylia ipomaeae	leaf
247.	Rivea hypocrateriformis	Asphondylia riveae	leaf
248.	Rivea hypocrateriformis	midge	ower

Gall No.	Plant	Gall maker	Part of plant bearing gall
249.	Stereospermum tetragonum	midge (?)	leaf
250.	Tecoma undulata	Schizomyia indica (?)	leaf
251.	Sesamum indicum	Asphondylia sesami	flower
252.	Asystasia gangetica	midge	stem
253.	Clerodendron inerme	midge	stem and leaf
254.	Boerhaavia diffusa	midge	flower
255.	Boerhaavia diffusa	Punarnavomyia boerhaaviae-folia	bud and leaf
256.	Polygonum molle	Lasioptera textor	terns
257.	Piper nigrum	Trichoperrisai pipericola	leaf
258.	Lindera pulch?rrima	Daphnephila linderae	leaf
259.	Machilus gamblci	Daphnephila gamblei	stem
260.	Machilus gamblei	Daphnephila haasi	leaf
261.	Cyclostomon assamica	Clinodiplosis modifex	branch
262.	Emblica officinalis	Asphondylia phyllanthi	leaf
263.	Ficus bengalensis	chalcid (?)	leaf
264.	Ficus glomerata	Dyodiplosis fici	lèaf
265.	Ficus glomerata	Horidiplosis mathuri	leaf
266.	Ficus infectoria	Horidiplosis fici	leaf
267.	Ficus religiosa	Pipaldiplosis pipaldiplosis	leaf
268.	Salix elegans	Oligotrophus saligneus	stem
269.	Pinus longifolia	midge	needles
270.	Acacia concinna	chalcid	fruit
271.	Acacia leucophloea	chalcid	stem
272.	Acacia leucophloea	chalcid	flower
273.	Acacia leucophloea	cynipid (?)	leaf axil
274.	Prosopis juliflora	chalcid	stem
275.	Terminalia arjuna	cynipid	fruit
276.	Terminalia crenulata	cynipid (?)	bfanch
277.	Terminalia tomentosa	cynipid	ovary
278.	Terminalia tomentosa	cynipid	ovary
279.	Cinnamomum nitidum	cynipid (?)	leaf
280.	Tectona grandis	midge	branch
281.	Ficus retusa	chalcid	areial root
282.	Quercus pachyphylla	cynipid	leaf
283.	Quercus semicarpifolia	cynipid	gland
284.	Quercus spicata	cynipid	branch
285.	Quercus griffithi	cynipid	bud
286.	Casuarina equisetifolia	Hyminoptera	branch
287.	Falcourtia ramontchi	midge	branch
288.	Hibiscus esculentus	Heterodera marioni	root
289.	Lycopersicum esculentum	Heterodera marioni	root
290.	Zinnia sp.	Heterodera	root
291.	unidentified^ plant	Eriophyes sp.	leaf
292.	Quercus ihcana	Eriophyes sp.	leaf
293.	Querns incana	midge	leaf
294.	Quercus incana	cynipid	branch
295.	Salix has.ata	Eriophyes sp.	leaf
296.	Viburnum cotinifolium	Eriophes sp.	leaf and fruit
297.	Juglans regia *	Eriophyes sp.	leaf
298.	unknown plant	unknown	leaf
299.	Digera arvensis	Asphondylia digerae	flower

Gall No.	Plant	Gall maker	Part of gall bearing gall
300.	Zizyphus sp.	midge	leaf
301.	Tephrosia Candida	Asphondylia tephrosiae	ovary
302.	Salvadora persica	Eriophyes sp.	leaf
303.	Salvadora persica	psyllid (?)	bud
304.	Ruellia prostata	Aleurodid	leaf
305.	Asystasia violacea	Lasiopterinini (?)	stem
306.	Aeschynanthes perottetti	Prolasioptera aeschynanthes perottetti	stem
307.	Clerodendron inerme	Paracopium cingalense	flower
308.	Macaranga indica	Schizomyia macarangae	leaf
309.	Ficus asperrima	psyllid >	leaf
310.	Ghomelia asiatica	psyllid	leaf
311.	Dimorphocalyx glabellus	psyllid	leaf
312.	Cinnamomum zeylanicum	psyllid	leaf
313.	Ficus talboti (?)	psyllid	leaf
314.	Phoebe sp.	psyllid	leaf
315.	Triumpheta rhomboidea	Heterodera marioni	root
316.	Memecylon edule	midge	leaf
317.	Bassia latifolia	midge	leaf
318.	Ehretia laevis	Eriophyes sp.	flowers
319.	>Thea sinensis	Heterodera marioni	root
320.	Anogeissus latifolia	psyllid	leaf
321.	Bassia latifolia	Hymenoptera	leaf vein
322.	Machilus gamblei	Stephanitis gallarum	leaf
323.	Feus religiosa	Trioza sp.	leaf
324.	Mangifera indica	Amradiplosis viridigallicola	leaf
325.	Mangifera indica	Amradiplosis araemyia	leaf
326.	Mangifera indica	Amradiplosis brunneigallicola	leaf
327.	Terminalia sp.	thrips	leaf
328.	Randia malabarica	midge	stem
329.	unidentified plant	thrips	leaf
330.	Grewia sp.	psyllid	leaf
331.	Gnetum sp.	midge (?)	leaf
332.	Mangifera indica	Amradiplosis keshopurensis	leaf
333.	Rhyncosia minima	pachyonyx menoni	stem
334.	Grataeva religiosa	Aschistonyx crataevae	flower
335.	Adina stipulata	Eriophyes sp.	leaf
336.	Piper nigrum	midge	leaf
337.	Indigofera enneaphylla	Eriophyes sp.	leaf
338.	Melhania futteporensis	midge	leaf
339.	Hydnocarpus wightiana	Eriophyes p.	leaf
340.	Medicago sativa	Heterodera marioni	root
341.	Desmodium sp.	Heterodera marioni	root
342.	Hibiscus solandra	fungus	leaf
343.	Alhagi camellonm	weevil	stem
344.	Momordica dioica	Heterodera marioni	root
345.	Dalbergia sissoo	Eriophyes p.	leaf
346.	Calycopteris floriburda	midge	stem
347.	Adhathda vasica	midge	stem
348.	Solahum melongina	Asphondylia beguni	flower
349.	Cocculus hirsutus	Schizomyia cocculi	flower
350.	Cyamopsis psoraloides	Asphondylia sp.	flower

Gall No.	Plant	Gall maker	Part of gall bearing gall
351.	Capsicum indicum	Asphondylia capsici	flower
352.	Bassia longifolia	midge	leaf
353.	Bassia longifolia	midge	leaf
354.	Vaccinum leschnaulti	aphid	bud
355.	Grewia sp.	Eriophyes sp.	leaf
356.	Salvadora persica	Eriophyes sp.	leaf
357.	Brassica juncca	Bacterium	leaf
358.	Allagium salvifolim	Eriophyes sp.	leaf
359.	Zinnia sp.	Bacterium	leaf
360.	Acacia leucophloea	fungus	branch and fruit
361.	Citrus aurantii	Sphaeropsis tumefaciens	stem
362.	Bassia longifolia	midge	stem
363.	Coccinia indica	fungus	stem
364.	Tamarix articulata	Eriophyes sp.	flower
365'	Acacia leucophloea	fungus	stem
366.	unknown Convolvulaceac	Bacterium (?)	branch
367.	Cucurbita pepo	Bacterium (?)	branch
368.	Jasminum trichotomum	Puccinia jasmini	branch, leaf and petiole
369.	Aporosa lindleyana	midge (?)	stem
370.	Neolitsea zeylanica	Eriophyes sp. (?)	"leaf
371.	Mesua ferrae	midge	leaf
372.	Eletteria cardamomi	Hallomyia cardamomi	root
373.	Leea sp.	midge	branch, leaf, petiole, etc.
374.	Tinospora cordifolia	midge	stem
375.	Ficus dalhousiae	midge	leaf
376.	unknown plant	thrips	leaf
377.	Memecylon amplexicaule	Diptera	leaf
378.	Eugenia corymbosa	Lepidoptera	stem
379.	Eugenia corymbosa	midge	leaf,
380.	Glycosmis cochinchinensis	midge	inflorescence axis
381.	Cinnamomum zeylanicum	psyllid	petiole and stem
382.	Calophyllum decipiens	Diaphorina truncata	leaf
383.	Strychnos nux-vomica	thrips	leaf
384.	Loranthus elasticus	thrips	leaf
385.	Desmodium sp.	Lepidoptera	stem
386.	Phaseolus sp.	Agromyza sp.	stem
387.	Jasminum grandiflorum	Puccinia jasmini	branch and leaf
388.	Holigrana arnotiana	midge	leaf
389.	unknown plant	midge	leaf
390.	Cassia mimosoides	Heterodera marioni	root
391.	Cinchona* sp.	Heterodera marioni	root
392.	Oldenlandia sp.	Heterodera marioni	root
393.	Impatiens blasamina	Heterodera marioni	root
394.	Impatiens kleinii	Heterodera marioni	root
395.	Solanum tuberosum	Heterodera marioni	root
396.	Ageratum conyzoides	Heterodera marioni	root
397.	Centran.herum reticulatum	Heterodera marioni	root
398.	Senicia zeylanicus	Heterodera marioni	root
399.	Mollugo pentaphylla	Heterodera marioni	root
400.	Piper nigrum	Heterodera marioni	root
401.	Ehretia laevis	Eriophyes sp	leaf

Gall No.	Plant	Gall maker	Part of plant bearing gall
402.	Convolvulas pluricaulis	midge (?)	stem
403.	Convolvulas pluricaulis	Eriophyes sp.	buds
404.	Acacia sp.	fungs	branch
405.	Capparis sepiaraia	Lepidoptera	stem
406.	Mangifera indica	midge	leaf
407.	Artemisia vulgaris	Lepidoptera	stem
408.	Ficus bengalensis		leaf
409.	Commiphora caudata	Eriophyes sp.	inflorescence
410.	Commiphora caudata	Eriophyes sp.	leaf
411.	Pongamia glabra	Agromvzid	stem
412.	Jasminum sambac	Contarinia maculipennis	flower
413.	Grcwia microcos	Eriophyes sp.	**leaf**
414.	Tectona grandis	midge	**leaf**
415.	Litsea glabra	Eriophyes sp.	leaf
416.	Terminalia sp.	psyllid	leaf
417.	Boehmeria sp.	psyllid	leaf
418.	Salix daphnoides	midge	leaf
419.	Strobilanthes dalhaousianus	Eriophyes	leaf
420.	Berberis lycium	Trypeid	bud
421.	Quercus in can a	cynipid	bud
422.	Prunus cerasoides	Schizoneura sp. (?)	leaf
423.	Holbocllia latifolia	midge	stem
424.	unknown plant		
425.	Berberis lycium	fungus	stem
426.	Ficus foveolata	midge	leaf
427.	Lecanthus wightii	psyllid	leaf
428.	Rhododendron arboreum	Exobasidium sp.	leaf
429.	Indigofera dosua	midge	leaf
430.	Indigofera dosua	midge	bud
431.	Indigofera dosua	Eriophyes sp.	leaf
432.	Vitis semicordata	midge	branch
433.	Quercus incana	cynipid	leaf
434.	Galium mollugo	midge	branch
435.	Galium mollugo	midge	bud
436.	Rhamnus virgata	Eriophyes sp.	stem
437.	Rhamnus virgata	Eriophyes sp.	leaf
438.	Inula cappa	fungus	leaf
439.	Jasminum dispermum	midge	stem
440.	Phoebe lanccolata	Aleurodid	leaf
441.	Sageretia oppositifolia	midge	bud
442.	Viburnum coriaceum	midge	leaf
444.	Artemisia vulgaris	Eriophyes sp.	leaf
445.	Artemisia vulgaris	aphid	bract and leaf
446.	Boehmeria platyphylla	midge	leaf
447.	Rhus javanica	midge	leaf
448.	Quercus dilatata	Eriophyes sp.	leaf
449.	Quercus incana	Eriophyes sp.	teaf
450.	Quercus dilatata	cynipid	leal
451.	Quercus dialtata	cynipid	leaf
452.	Hibiscus vitifolius	cynipid	leaf
453.	Acacia suma	bacteria	stem

Gall No.	Plant	Gall maker	Part of plant bearing gall
454.	Cucumis sativus	midge	leaf
455.	Artemisia vulagris	Dacus cucurbitae	stem
456.	Acacia suma	Eriophyes sp.	inflorencence
457.	Indigofera pulchella	Lobopteromyia ramachandrani	leaf
458.	Memecylon umbellatum	midge	stem
459.	unknown plant	midge	leaf
460.	unknown plant	Eriophyes	leaf
461.	Hydnocarpus wightiana	midge	leaf
462.	Pergularia extensa	midge	flower
463.	Triumpheta - rotundifolia	midge	leaf
464.	G>mnema sp.	midge	flower
465.	Aniseia uniflora (?)	midge	flower
466.	Terminalla paniculata	midge	buds and branch
467.	Sarcococca brcvifolia	Eriophyes sp.	leaf
468.	Striga orobanchoides	weevil	stem
469.	Ficus bengalensis	midge	leaf
470.	Cleome monophylla (?)	midge	bud and leaf
471.	Prunus pcrsica	aphid	leaf
472.	Emblica officinalis	midge	leaf
473.	unknown Euphoribaceae	Eriophyes sp.	" leaf
474.	unknown plant	midge	leaf
475.	Ficus sp.	psyllid	leaf
476.	Inula cappa	midge	stem
477.	Vitcx negunda	Eriophyes sp.	branch and leaf
478.	Amarantus sp.	Heterodera marioni	root
479.	Machilus odoratissima	Neolasioptera sp.	leaf
480.	Ficus scandens	Eriophyes sp.	leaf
481.	Machilus odoratissima	midge	leaf
482.	Machilus odoratissima	psyllid	leaf
483.	Indigofera dosua	midge	branch
484.	Indigofera dosua	midge	stem
485.	Meliosma rigida	midge	leaf
486.	Indigofera gerardiana	Oxasphondylia echinata	bud
487.	Indigofera gerardiana	midge	inflorescence axis
488.	Desmodium sp.	weevil	stem
489.	Lecanthus (?)	Eriophyes sp.	leaf
490.	Indigofera gerardiana	Oxasphondylia floricola	flower
491.	Rhamnus virgata	fungs	stem and leaf
492.	Salix elegans	Eriophyes sp.	leaf
493.	Ulmus wallichiana	aphid	leaf
494.	Indigofera gerardiana	Eriophyes sp.	leaf
495.	Machilus 'odoratissima	Aleurodid	leaf
496.	Deutzia staminea	midge	leaf
497.	Rosa macrophylla	cynipid	stem
498.	Polygonum sp.	Eriophyes sp.	leaf
499.	Rosa macrophylla	cynipid	leaf
500.	Sabia campanulata	Acroectasis campanulata	stem
501.	Quercus dilatata	cynipid	bud
502.	Xolisma ovalifolia	Eriophyes sp.	
503.	Indigofera pulchella	midge	leaf rachis
504.	Aesculus indica	Eriophyes sp.	leaf

Gall No.	Plant	Gall maker	Part of plant bearing gall
505.	Achillea millefolium	Rhopalomyia millefolii	bud
506.	Gyathula tomentosa	Eriophyes sp.	stem
507.	Avecenia officinalis	Eriophyes sp.	leaf, petiole and branch
508.	Alaeocarpus serratus	Eriophyes sp.	leaf
509.	Ficus sp.	midge	stem
510.	Cinnamomum sp.	psyllid	leaf
511.	Ficus sp. (?)	psyllid	leaf
512.	Althea rosea	Eriophyes sp.	leaf
513.	Indigofera pulchella	midge	bud
514.	Erigeron sp.	midge	shoot
515.	Heracleum canescens	midge	flower
516.	Gynoglossum micranthemum	midge	ovary
517.	Indigofera pulchella	midge	stem
518.	unknown plant	Eriophyes sp.	leaf
519.	Unknown Gucurbitaceae	Lasiopterini	branch
520.	Strobilanthes dalhousianus	Albugo sp.	branch
521.	Airsliaea aptera	Eriophyes sp.	leaf
522.	unknown plant		stem
523.	Achyranthes aspera	midge	branch
524.	Unknown plant		flower
525/	Polygonum amplexicaule	midge	stem
526.	Schleicera trijuga	midge	leaf
527.	Achillea millefoliia	Rhopalomyia mllefolii	leaf
528.	Tectona grandis	midge	leaf
529.	Evodia roxburghiana	Eriophyes sp.	leaf
*564.	Ginnamomum iners	Hemiptera	leaf
565.	Aporosa (Lepidostachys) roxburghi	Insect	leaf
566.	Tecoma undulata (?)	midge	branch
567.	Brassica campestris	Urocystis coralloides	bud
568.	Eurya japonica	midge	leaf
569.	Hopea wightiana	midge	fruit
570.	Salsola foetida	midge	branch
571.	Styrax serralatum	Astegopteryx styracophila	flower
572.	Ariolaena quinquilocularis	Eriophyes sp.	leaf
573.	Semicarpus anacardium	psyllid	leaf
574.	Gayratia pedata	midge	leaf & branch
575.	Salix fragilis	Pontania sp.	leaf
576.	Luffa acutangula	midge	flower & stem
577.	Vitis semioordata	Eriophyes sp.	leaf
578.	Argemone mexicana	Eriophyes sp.	leaf
579.	Memecylon unbellatum	thrips	leaf
580.	Strobilanthes integrifolia	midge	stem
581.	Bassia latifolia	midge	leaf
582.	Acacia catechu	Eriophyes sp.	leaf
583.	Leea sambuicna	midge	leaf
584.	Ficus infectoria	Hymenoptera	stem
585.	Pimpenella diversifolia	midge	flower
586.	Polygonum amplexicaule	midge	bud
587.	Impatiens micranthemum	midge	stem
588.	Corydalis cornuta	midge	ovary

• Nos. 530—563 refer to galls on exotic plants in my collection and not included in this work.

Gall No.	Plant	Gall maker	Part of plant bearing gall
589.	Polygonum alatum	fungus	stem & flower
590.	Populus nigra var. pyramidalis	aphid	leaf
591.	Ulmus laevigata	aphid	leaf
592.	Poplus ciliata	aphid	leaf
593.	Alnus nitida	Eriophyes sp.	leaf
594.	Lonicera parviflora	midge	leaf
595.	Gerardiana hetreophylla	fungus	terminal branch & leaf
596.	Quercus dilatata	cynipid	stem
•603.	Quercus semicarpifolia	Eriophyes sp.	leaf
604.	Salix fragilis	Eriophyes sp.	leaf
605.	Quercus semicarpifolia	Cynipid	bud
606.	Alnus nitida	midge	bud
607.	Rosa macrophylla	midge	leaf
•662.	Crotalaria saltiana	midge	stem
663.	Desmodium biarticulatum	midge	stem
664.	Prosopis spicigera	Eriophyes prosopidis	leaf
665.	Phaseolus radiatus	Alcidodes collaris	stem
666.	Cajanus cajan	Alcidodes collaris	stem
667.	Cyamposis tetragona	Alcidodes bubo	stem
668.	Indigofera arrecta	Alcidodes bubo	rtem
669.	Indigofera linifolia	Anatarctis plumigera	stem
670.	Tephrosia Candida	Stictodiplosis tephrosisae	flower
671.	Moringa pterygosperma	Stictodiplosis morinage	flower
672.	Dalbergia sissoo	Contarinia dalbergiae	flower
673.	Linum usitatissimum	Dasyneura lini	flower
674.	Ficus rumphii	Pauropsylla sp.	leaf
675.	Calycopteris floribunda	midge	gall No. 40
676.	unknown plant	Cecidothrips bursarum	bud
677.	Terminalia tomentosa	Trioza fletcheri	leaf
678.	Eugenia wightiana	Eriophyes cingulatus	bud
679.	Syzigium jambolanum	Mega trioza vitiensis	leaf
680.	Ficus arnotiana	unknown insect	stem
681.	Trichosanthes palmata	Lasiopterini	stem
682.	Melothria maderaspatana	midge	stem
683.	Ficeus glomerata	Psyllid	stem
684.	Gerbera kunzena	midge	bud
685.	Bassia longifolia	midge	leaf
686.	Mimusops hexandra	midge	stem
687.	Mimusops hexandra	midge	leaf
688.	Pilea umbrosa	midge	stem
689.	Hedera ngpalensis	midge	fruit
690.	Rosa macrophylla	Phragmidium subcorticum	stem
691.	Salvadora persica	midge	stem
692.	Hemidesmtts indicus (?)	Chalcid	ovary
693.	Podocarpus chinensis	bacteria	root
694.	unknown plant		
700.	Terminalia catappa	psyllid	stem
701.	Alstonia scholaris	Pauropsylla tuberculata	fruit
702.	Ficus infectoria	Trioza sp.	leaf

•Numbers 530 to 563, 597 to 602 and 608 to 661 are exotic galls in my collections

GENERAL INDEX

PLATE I

Fig. 1 and 4. Gall No. 453 **on** *Acacia suma* Ham.-Buchn. by unknown **midge.**

Fig. 2 and 3. **Gall** No. 200 **on** *Acadia catechu* **Willd.** by *Lobopteromyia bivalviae* (Rao)

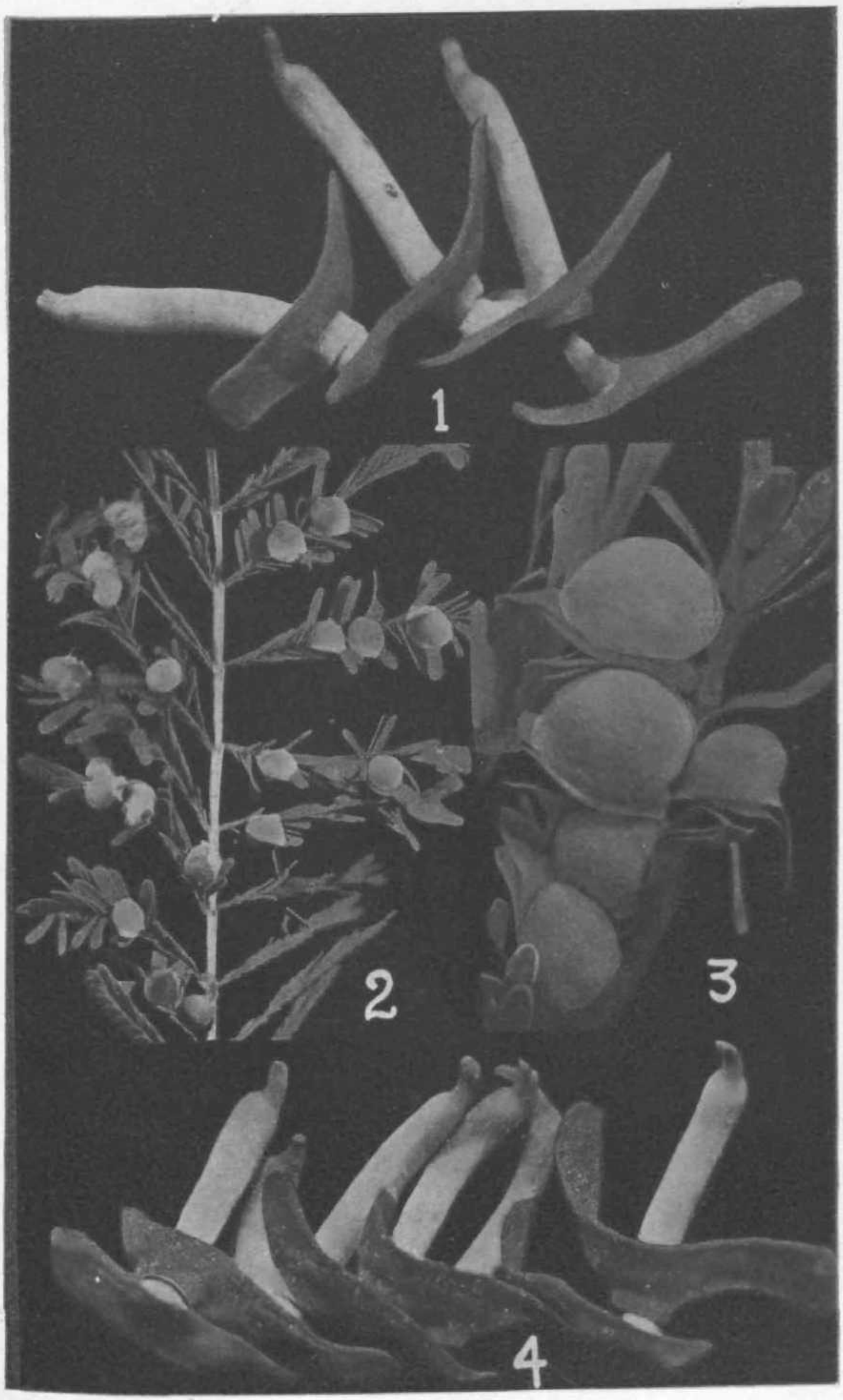

1
2
3
4

PLATE II

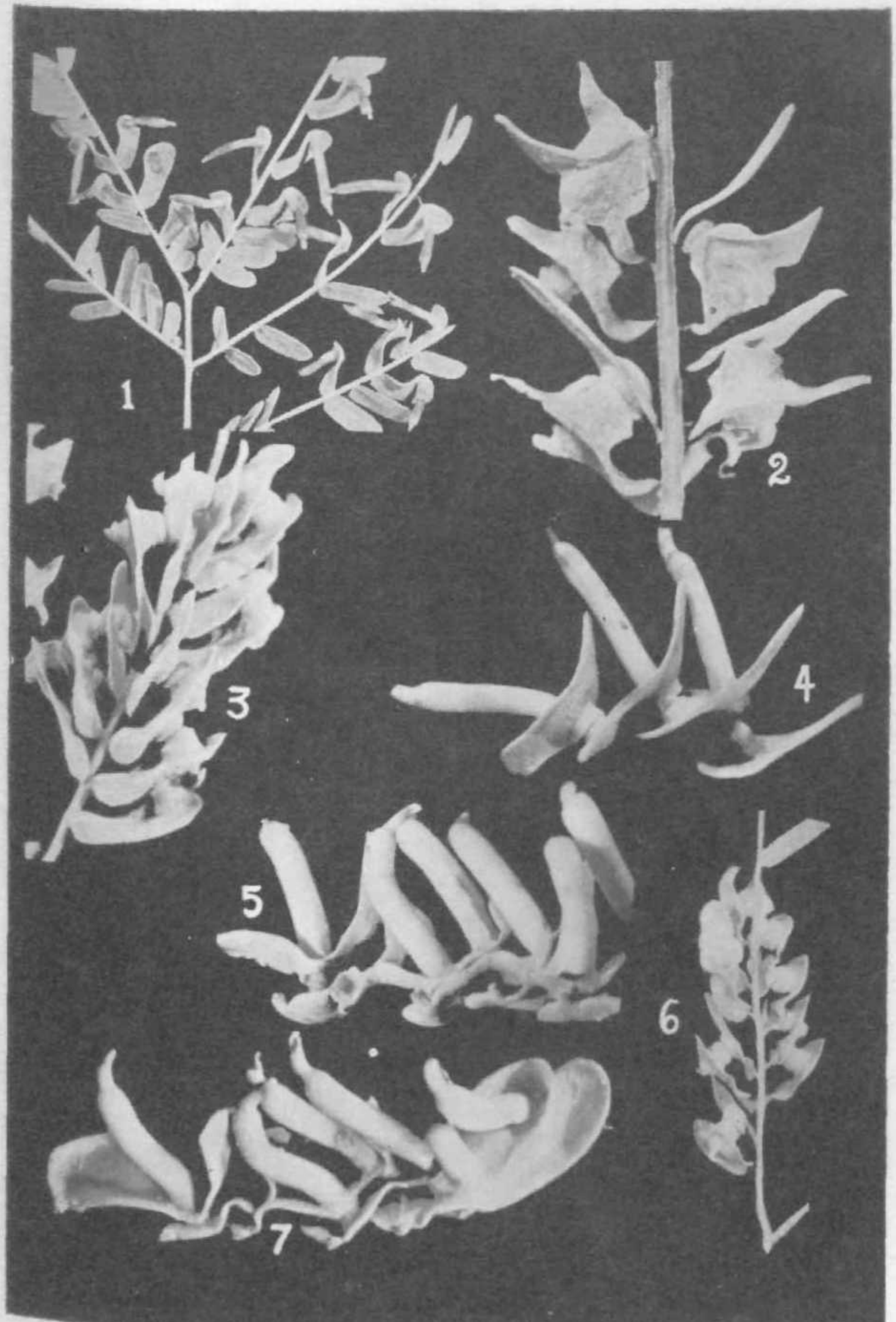
Gall No. 456 on *Acacia suma* Ham.-Buchn.,
by *Lobopteromyia ramachandrani* Mani

M. S, Mani : *Cccidotkeca indica.*

PLATE III

Fig. 1, 4, 5 and 7. Gall No. 453 on *Acacia suma* Ham.-Buchn. Note the series of cylinder and piston like outgrowths from the adjacent leaflets to form a chain of galls.

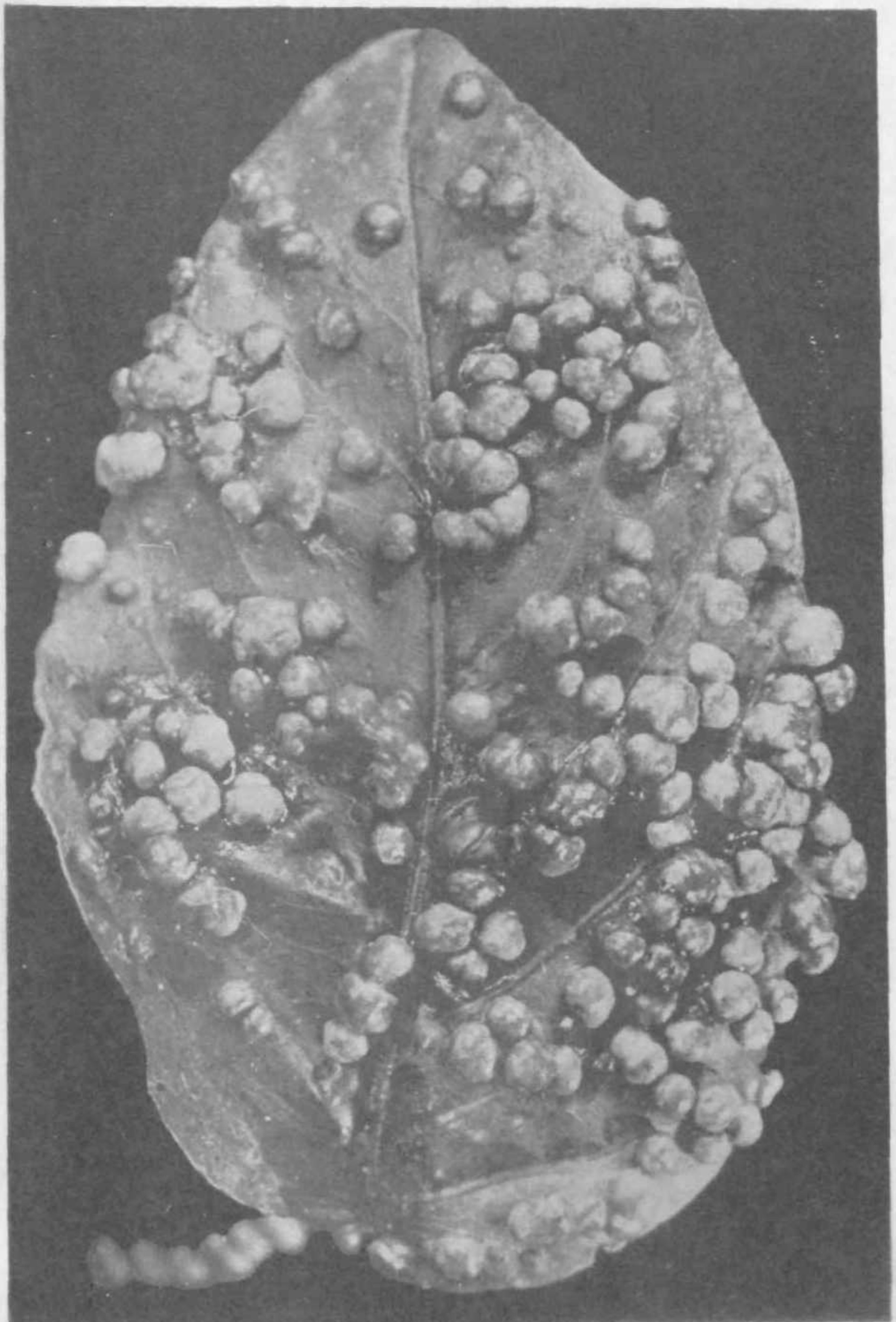
Fig. 2, 3 and 6. Gall No. 456 on *Acacia suma* Ham.-Buchn. by *Lobopteromyia ramachandrani* Mani.



M. S. Mani : *(Ucidothaca indica.*

PLATE IV

Gall No. 27 on *Impomaea staphylina* Roem. & Sch. by *Eriophyes gastrotrichus* Nalepa



M S. Mani : *Cecidotheca indica.*

PLATE V

Fig. 1. Gall No. 407 on *Artemisia vulgaris* Linn, by unknown Lepidoptera.

Fig. 2. Gall No. 445 on *Artemisia vulgaris* Linn, by midge.

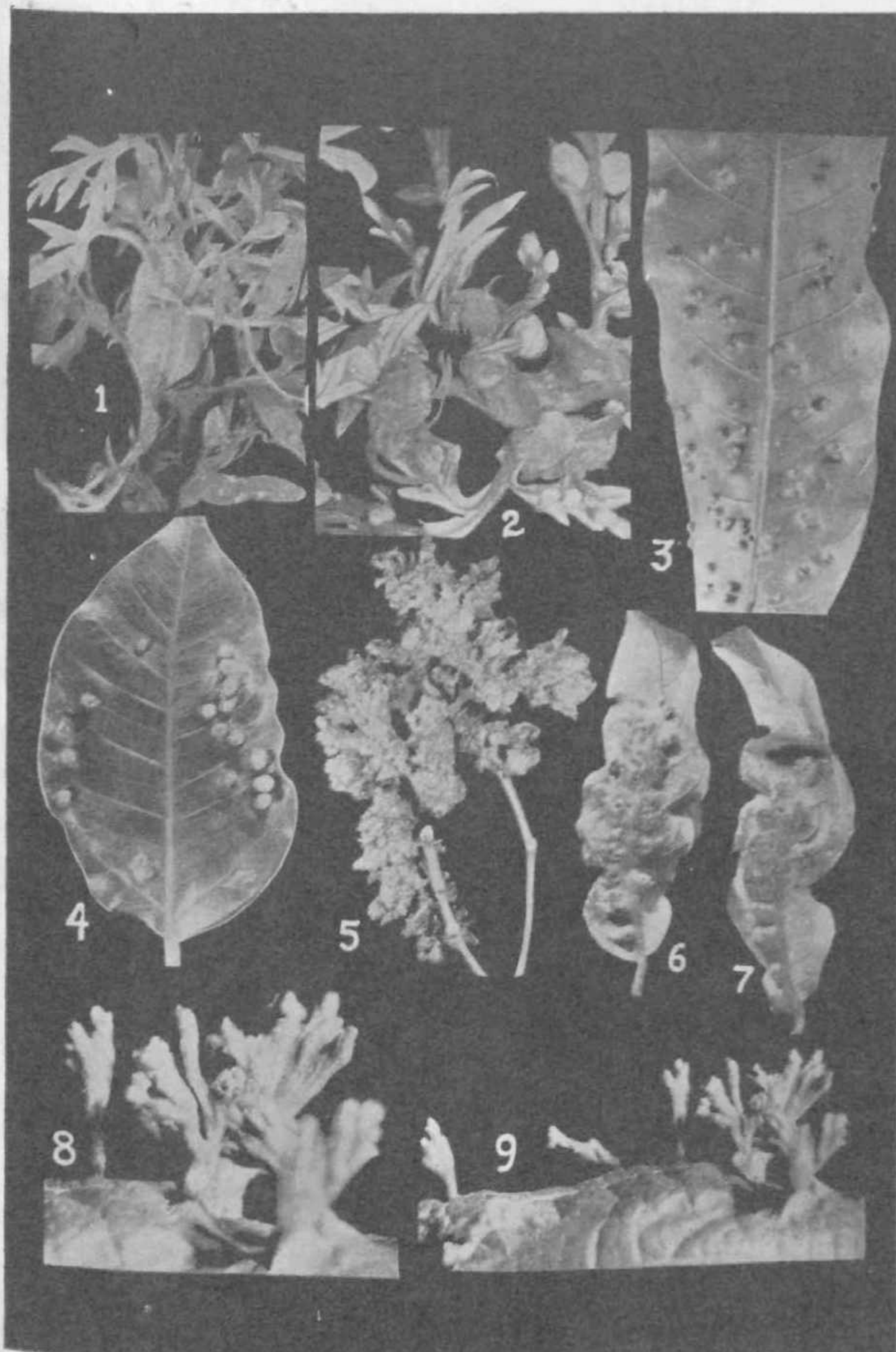
Fig. 3. Gall No. 406 on *Mangifera indica* Linn, by midge.

Fig. 4. Gall No. 702 on *Ficus infectoria* Roxb. by *Trioza* sp.

Fig. 5. Gall 409 on inflorescence of *Commiphora caudata* Engl. by *Eriophyes* sp.

Fig. 6 and 7. Gall No. 418 on *Salix daphnoides* Willars by midge.

Fig. 8 and 9. Gall No. 413 on *Grewia microcos* by *Eriophyes* sp.



M. S. Mani : *Cccidotheca indka.*

PLATE VI

Fig. 1. Gall No. 419 on *Strobilanthes dalhousianus* Clark by *Eriophyes* sp.

Fig. 2. Gall No. 427 on *Lecanthus wightii* Wedd. **by *Trioza* sp.**

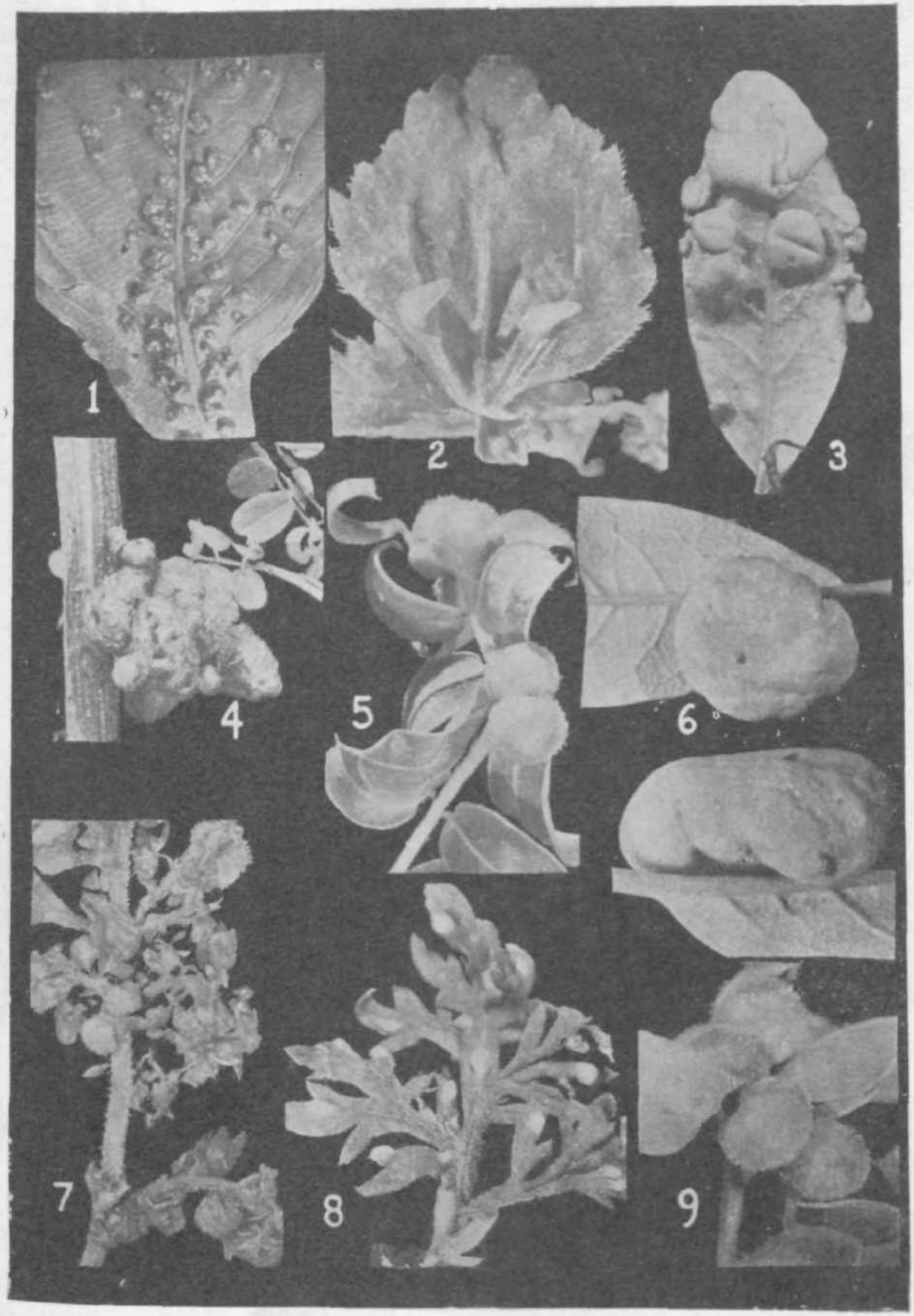
Fig. 3. and 6. Gall No. 428 on *Rhododendron arboreum* Sm. **by *Exobasidium* sp.**

Fig. 4. Gall No. 430 on *Indigofera dosua* Ham. by midge.

Fig. 5. and 9. Gall. No. 429 on *Indigofera dosua* Ham. by midge.

Fig. 7. Gall No. 444 on *Artemhia vulgaris* Linn, by aphid.

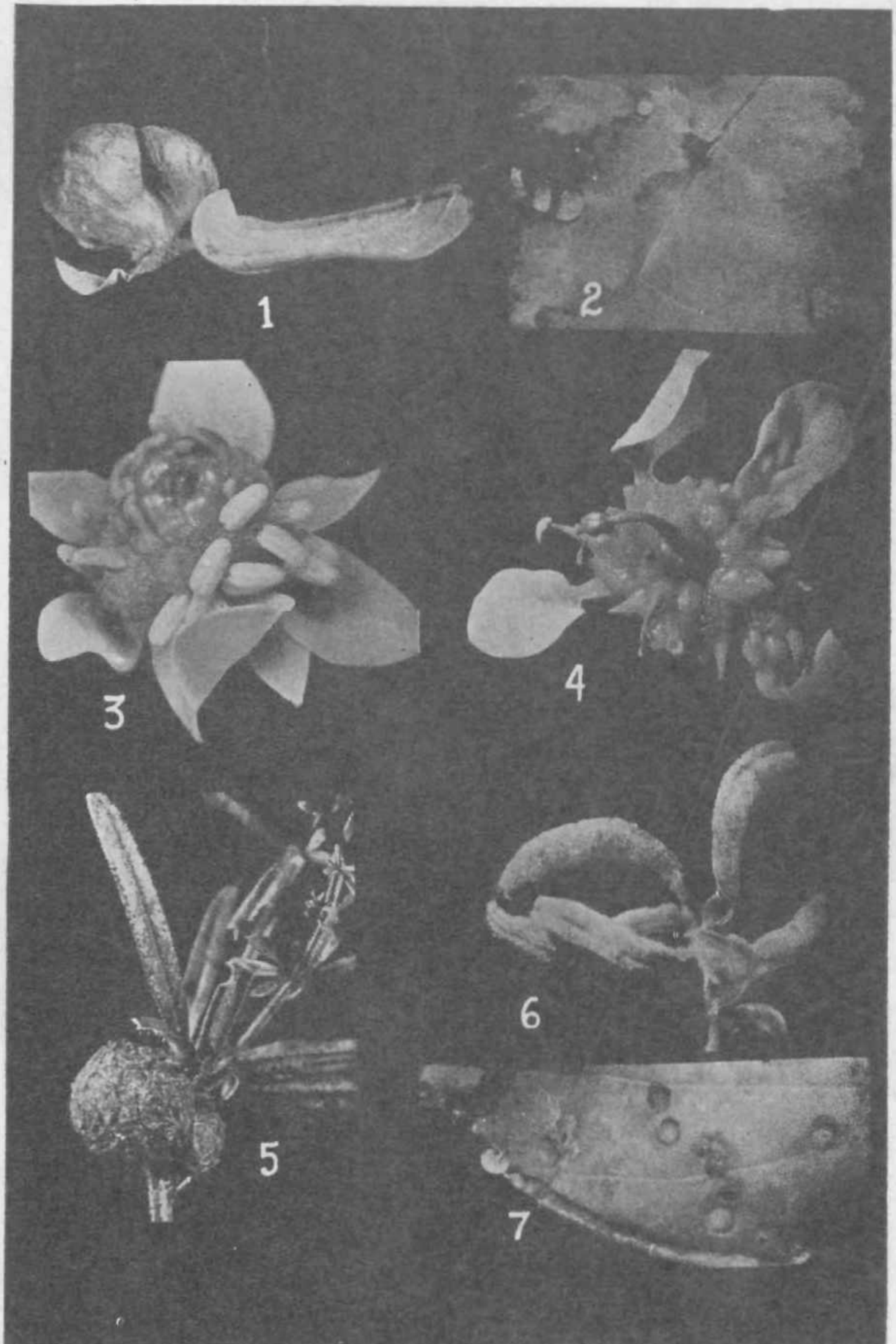
Fig. 8. Gall No. 443 on *Artemisia vulgaris* Linn, by *Eriophyes*



M. S. Mani : *Cecidot/i>,n indica.*

PLATE VII

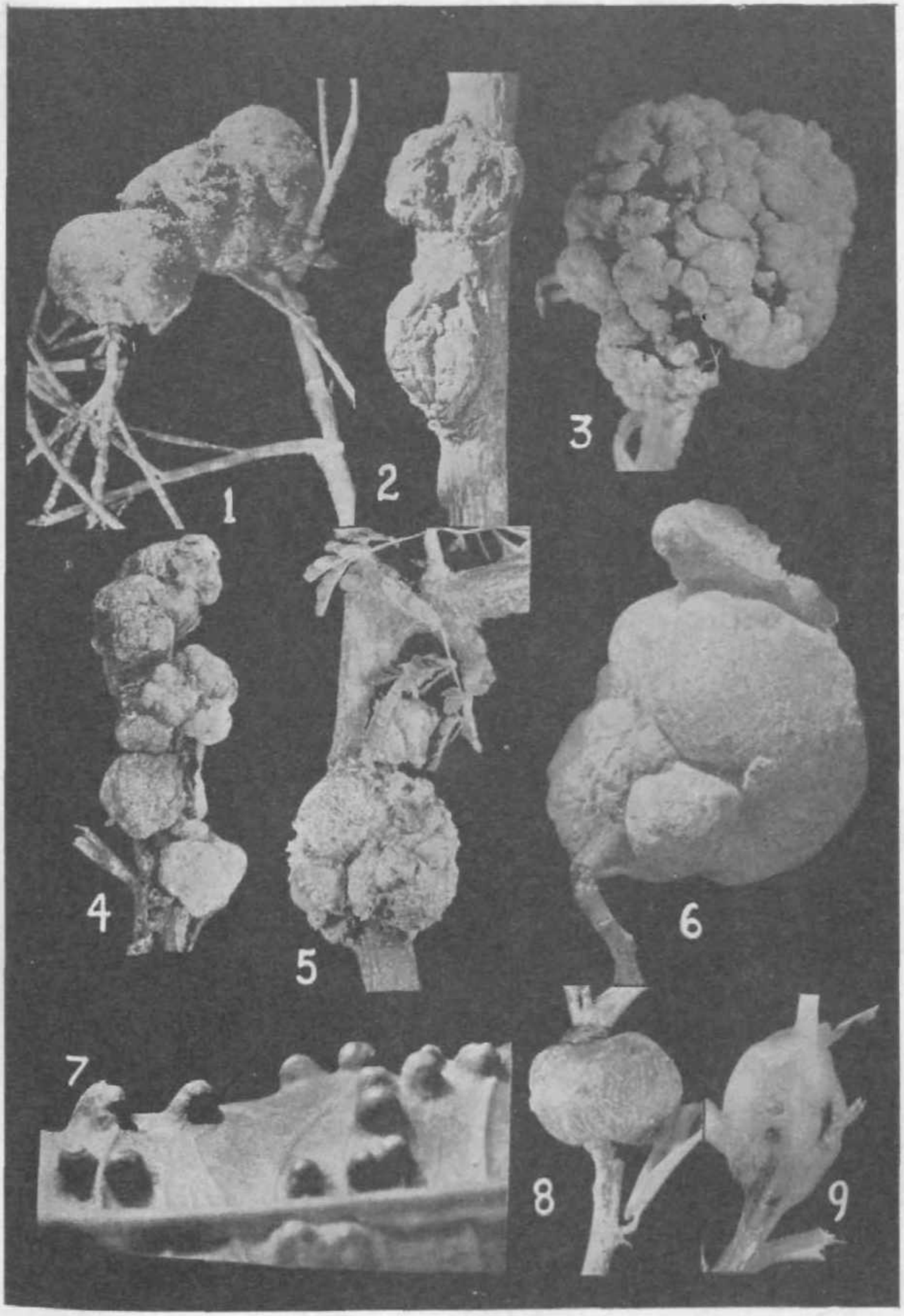
Fig. 1. Gall No. 327 on *Tcrminalia* sp. by Thrips.
Fig. 2. Gall No. 336 on *Piper nigrum* Linn, by midge.
Fig. 3 and 4. Gall No. 334 on *Crataeva religiosa* Forst. by *Aschistonyx crataevae* (Mani)
Fig. 5. Gall No. 434 on *Galium mollugo* Linn, by midge.
Fig. 6. Gall No. 337 on *Indigofera enneaphylla* by *Eriophyes* sp.
Fig. 7. Gall No. 49 (marginal roll) and Gall No. 336 (spherical) on *Piper nigrum* ; Gall No. 49 by *Gynaikothrips chavicae* Zimmerm.



M. S. Mani : *Cecidotheca indica.*

PLATE VIII

Fig. 1. Gall No. 364 on *Tamarix articulata* by *Eriophyes* sp.
Fig. 2. Gall No. 362 on *Bassia longifolia*
Fig. 3. Gall No. 359 on *Zinnia* sp. by *Phytomonas tumefaciens*
Fig. 4 and 5. Gall No. 404 on *Acacia* sp. by Bacteria.
Fig. 6. Gall No. 360 on *Acacia leucophloea* Willd. by *Uromycladium* sp.
Fig. 7. Gall No. 406 on *Mangifera indica* Linn.
Fig. 8 and 9. Gall No. 405 on *Capparis sepiaria* Linn, by Lepidoptera.



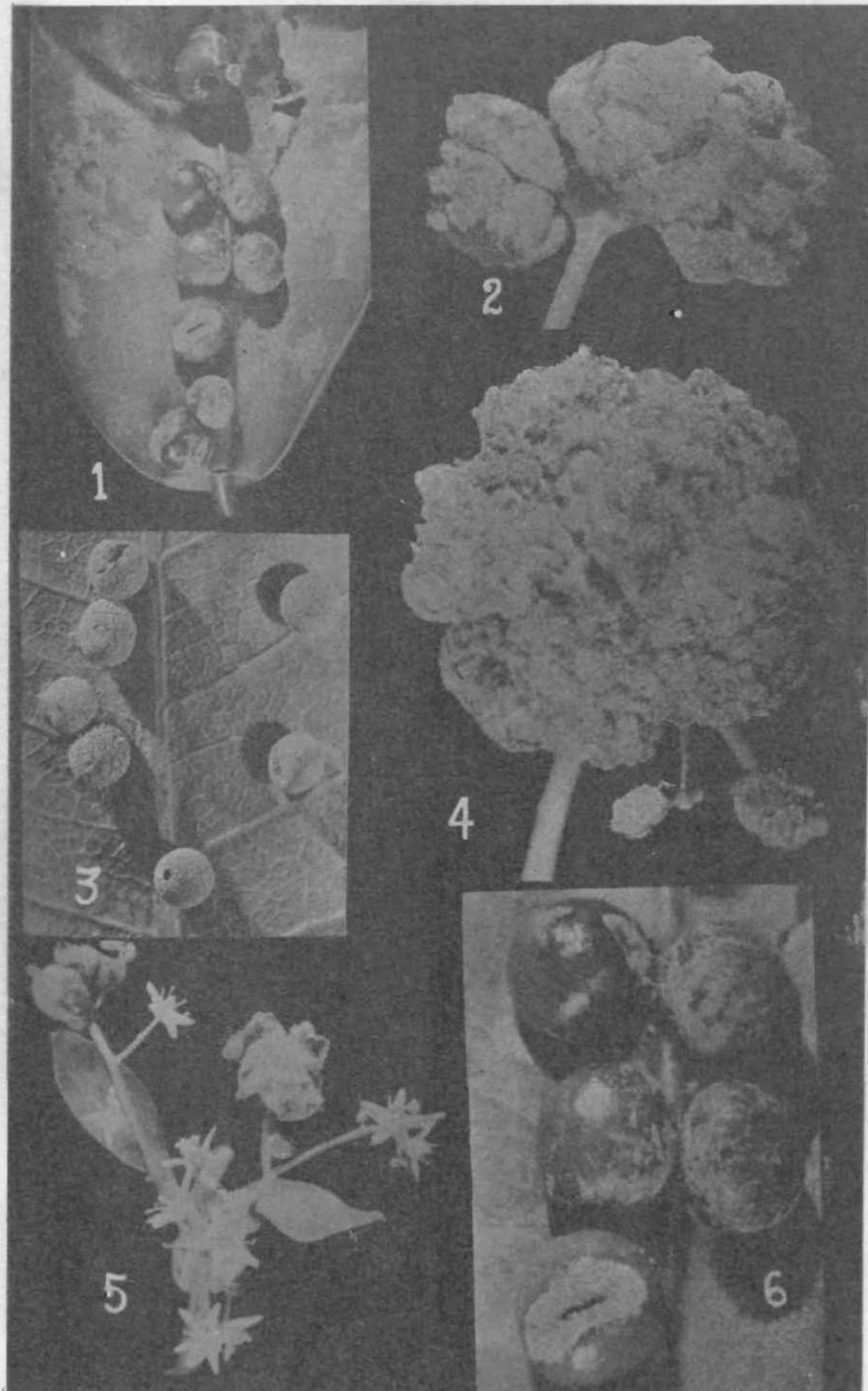
M. S. Mam : *Cecidothcca* ***indtca***

PLATE IX

Fig. 1 and 6. Gall No. 316 on *Memecylon edule* Roxb. by midge.

Fig. 2, 4 and 5. Gall No. 318 on *Ehretia laevis* by *Eriophyes* sp.

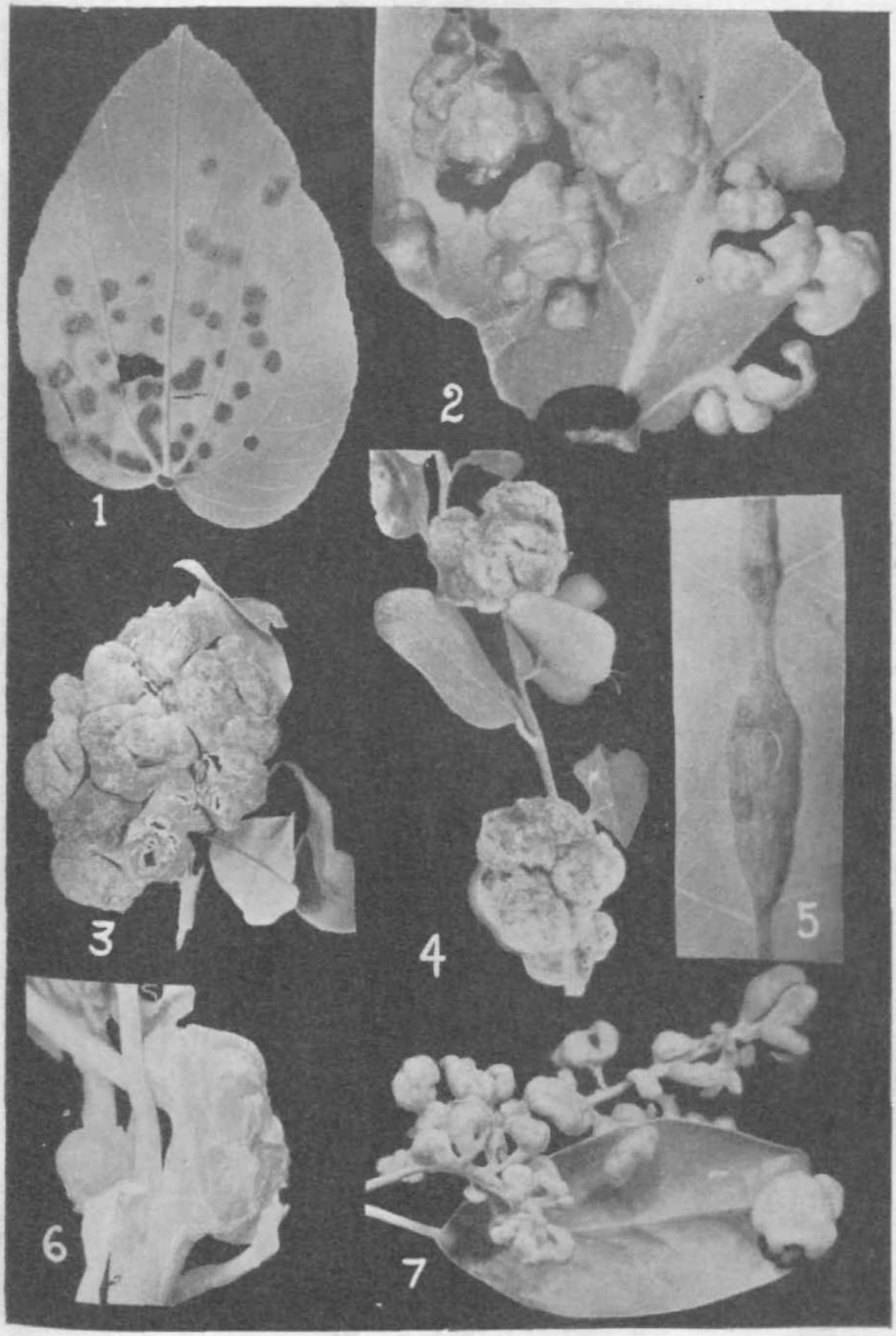
Fig. 3. Gall No. 325 on *Mangifera indica* Linn, by *Amradiplosis amraemyia* (Rao).



M. S. Mani : *L'ccidothcca iudica.*

PLATE X

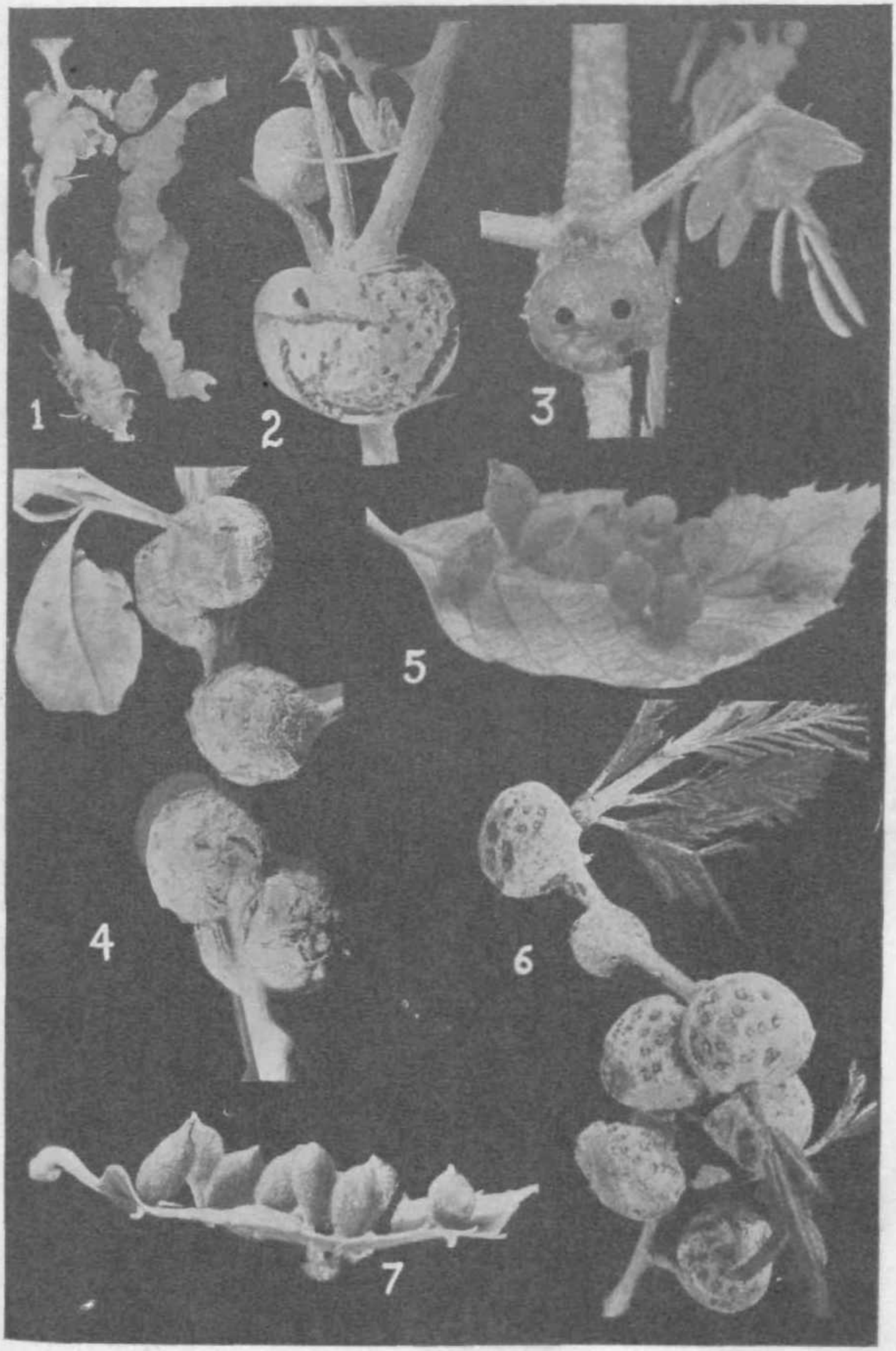
Fig. 1. Gall No. 338 on *Melhania futteporensis* Munro by midge.
Fig. 2. Gall No. 339 on *Hydnocarpas wigktiana* by *Ericphyes* sp.
Fig. 3. Gall No. 354 on *Vaccinum leschenaultii* Wt. by aphid.
Fig. 4. Gall No. 349 on *Cocculus kirsutus* Diels. by *Schizomyia cocculi* Mani.
Fig. 5. Gall No. 352 on *Bassia longifolia* by midge.
Fig. 6. Gall No. 357 on *Brassica juncea* by bacteria.
Fig. 7. Gall No. 356 on *Salvadora persica* Linn, by *Eriophyes* sp.



M. S. Maul : *Cctidotfuca indica.*

PLATE XI

Fig. 1. Gall No. 288 on *Hibiscus esculentus* Linn, by *Heterodera marioni.*
Fig. 2. Gall No. 274 on *Prosopis juliflora* by Chalcid,
Fig. 3. Gall No. 273 on *Acacia leucophloea* Willd.
Fig. 4. Gall No. 361 on *Citrus* sp. by *Sphaeropsis tumefaciens.*
Fig. 5 and 7. Gall No. 293 on *Quercus incana* by midgo.
Fig. 6. Gall No. 271 on *Acacia leucophloea* Willd. by Chalcid.



M. S, ManJ : *Cffidofhrca indua.*

PLATE XII

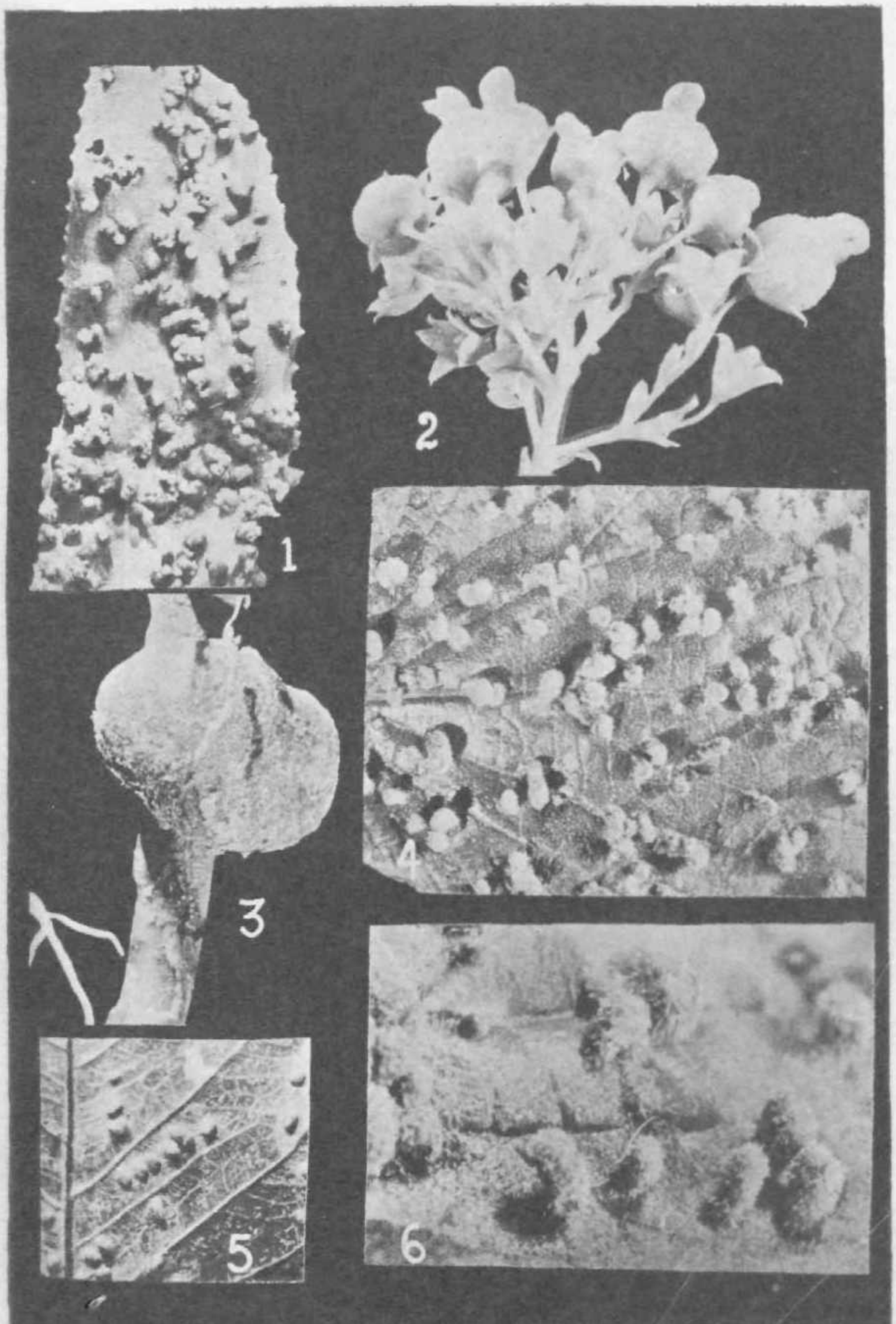
Fig. 1. Gall No. 295 on *Salix hastata* Linn, by *Eriophyes* sp.

Fig. 2. Gall No. 307 on *Clerodendron phlomides* Linn, by *Paracopium cingalense*

Fig. 3. Gall No. 306 on *Aeschynanthes pcrotetti* by *Prolasioptera aeschynantheS'perotetti* Mani

Fig. 4 and 6. Gall No. 296 on *Viburnum cotinifolium* Don. by *Eriophyes* sp.

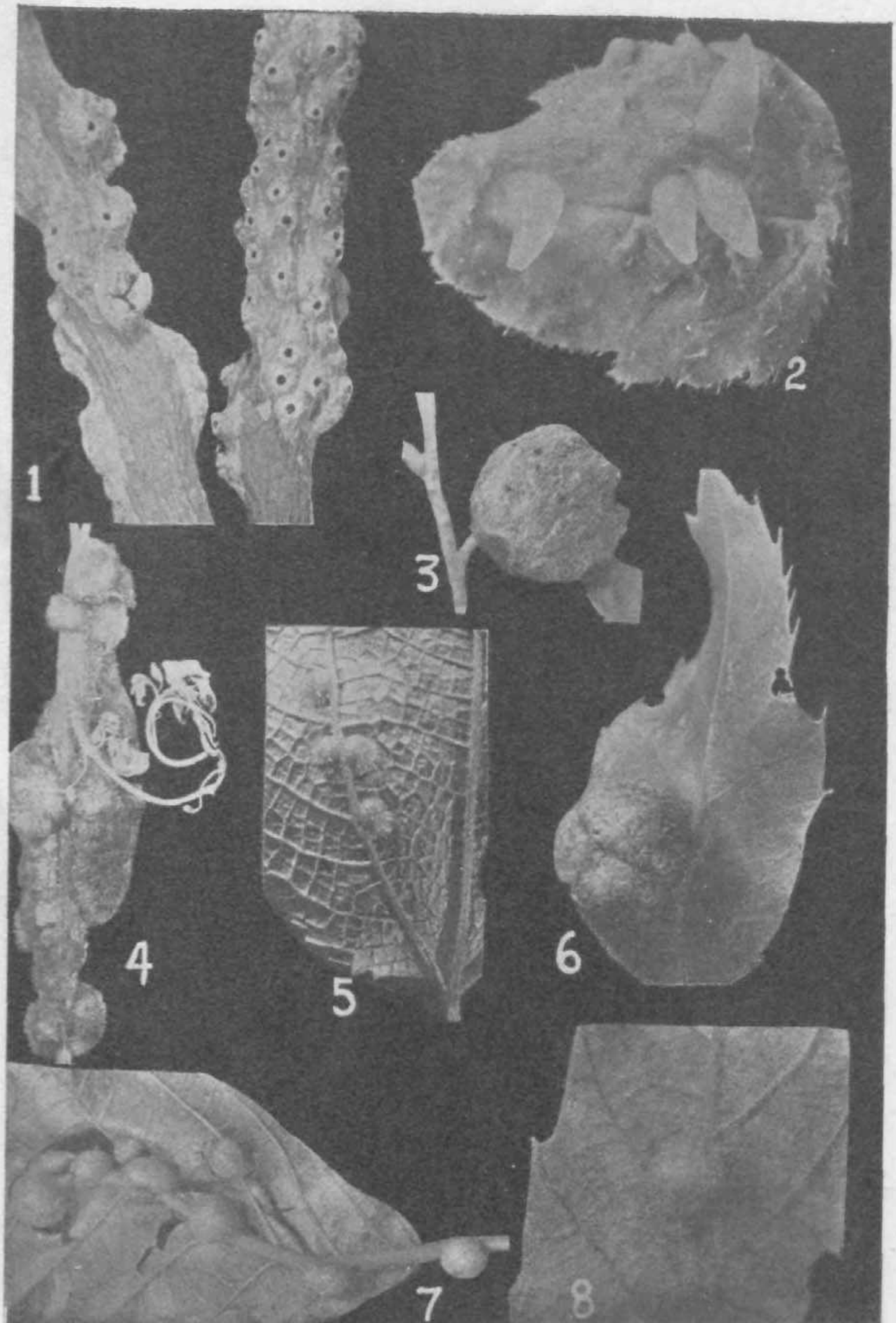
Fig. 5. Gall No. 323 on *Ficus religiosa* Linn, by *Trioza* sp.



M. S. Mani : *Cecidoiheca iiidica.*

PLATE XIII

Fig. 1. Gall No. 197 on *Mangifera indica* Linn, by *Rhabdophaga mangiferae* Mani
Fig. 2. Gall No. 427 on *Lecanthus wightii* Wedd. by *Trioza.*
Fig. 3. Gall No. 421 on *Quercus incana* by Cynipid.
Fig. 4. Gall No. 457 on *Indigo/era pulchella* Roxb. by midge.
Fig. 5. Gall No. 446 on *Boehmeria platyphylla* Don. by midge.
Fig. 6. Gall No. 450 on *Quercus dilatata* by cynipid.
Fig. 7. Gall No. 198 on *Odina wodier* Roxb. by *Odinadiplosis odinae* Mani.
Fig. 8. Gall No. 449 on *Quercus incana* by cynipid.



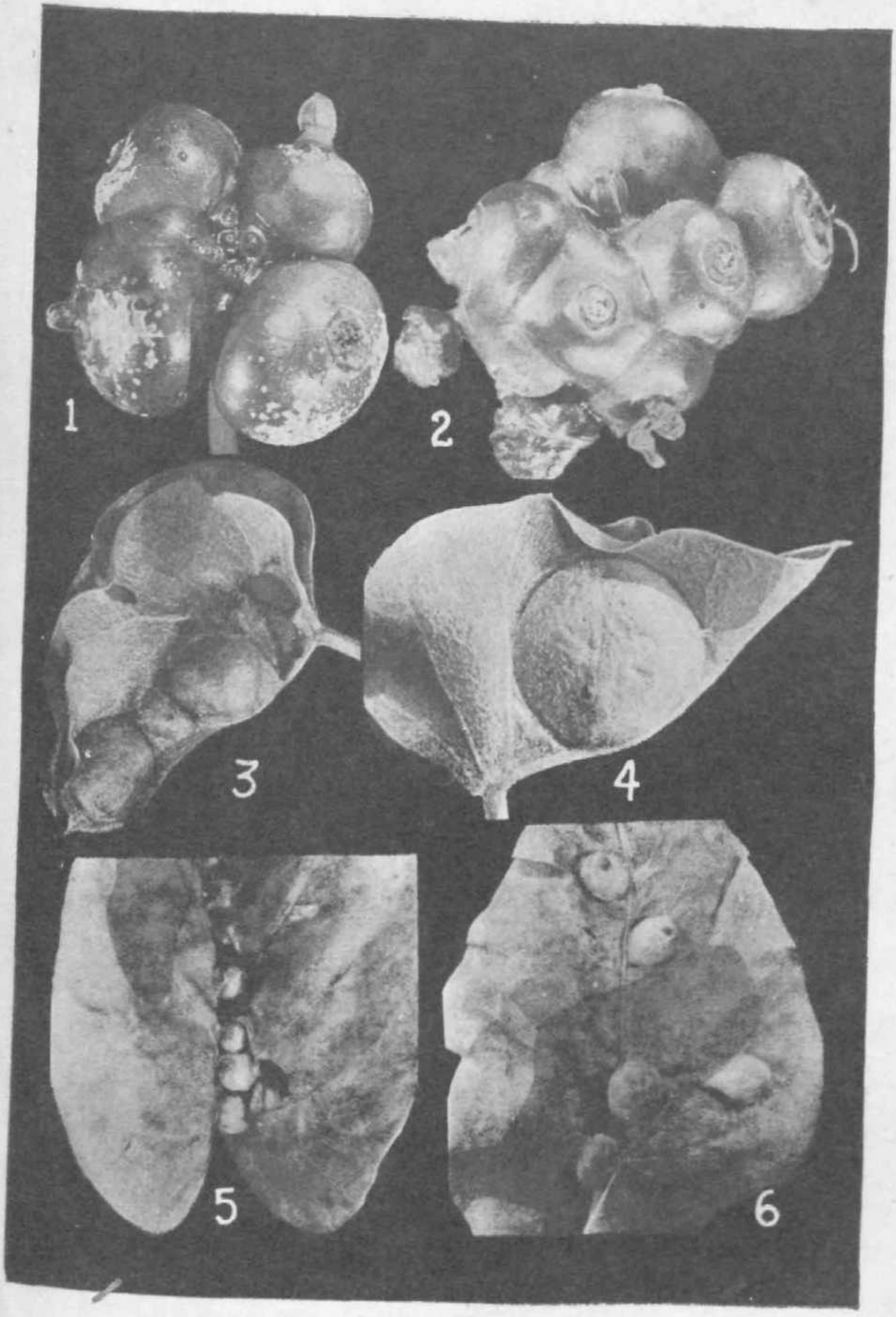
M. S. Mani : *Cecidotheca indica.*

PLATE XIV

Fig. 1 and 2. Gall No. 228 on *Morinda tincloria* Roxb. by *Asphondylia morindae* Mani.

Fig. 3 and 4. Gall No. 247 on *Rivea hypocrateriformis* Choisy by *Asphondylia riveae* Mani.

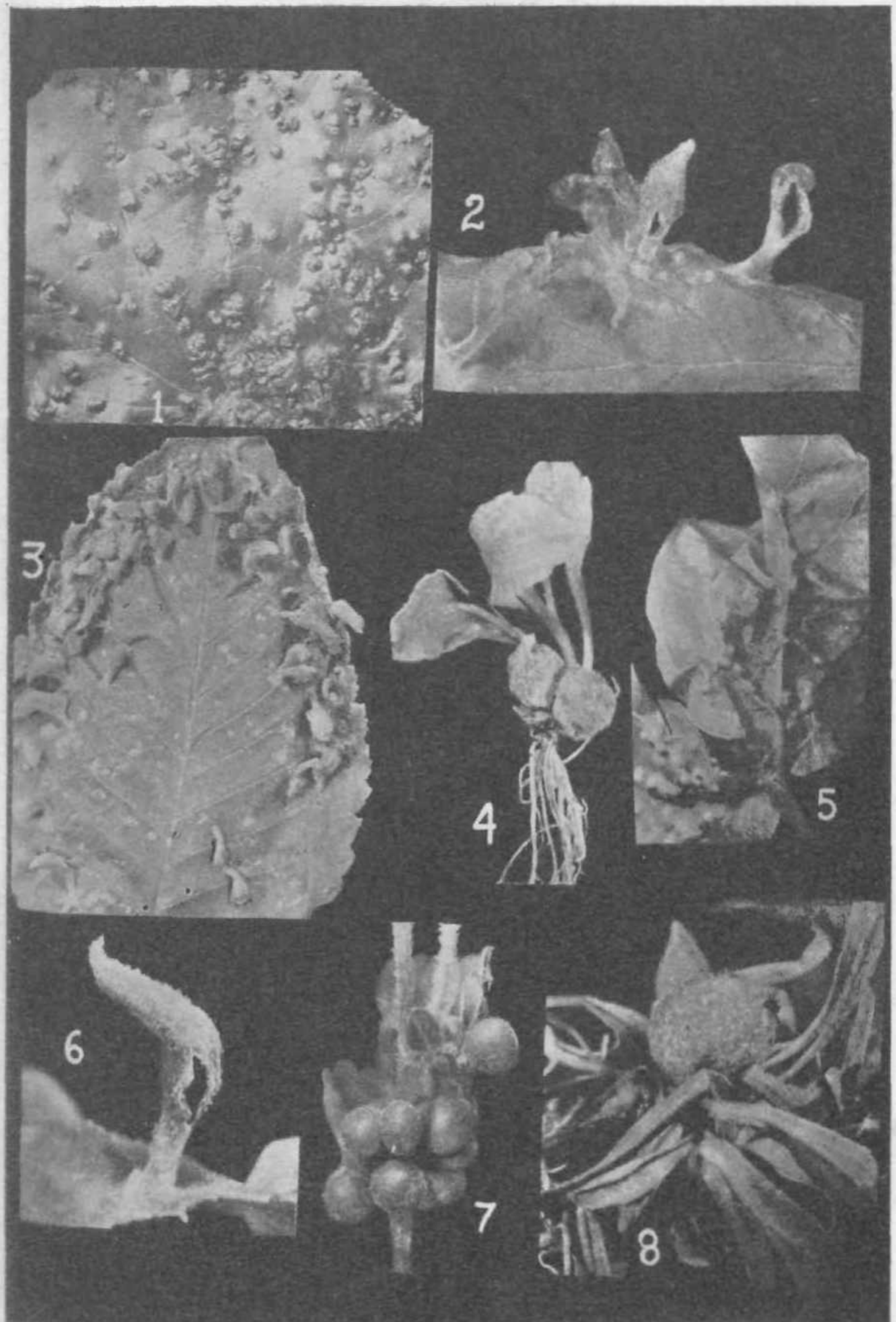
Fig. 5 and 6. Gall No. 246 on *Impomea staphylina* Rocm. & Sch. by *Asphondylia impomaeae* Felt.



M. S. Mani : *Cecidolheca indica.*

PLATE XV

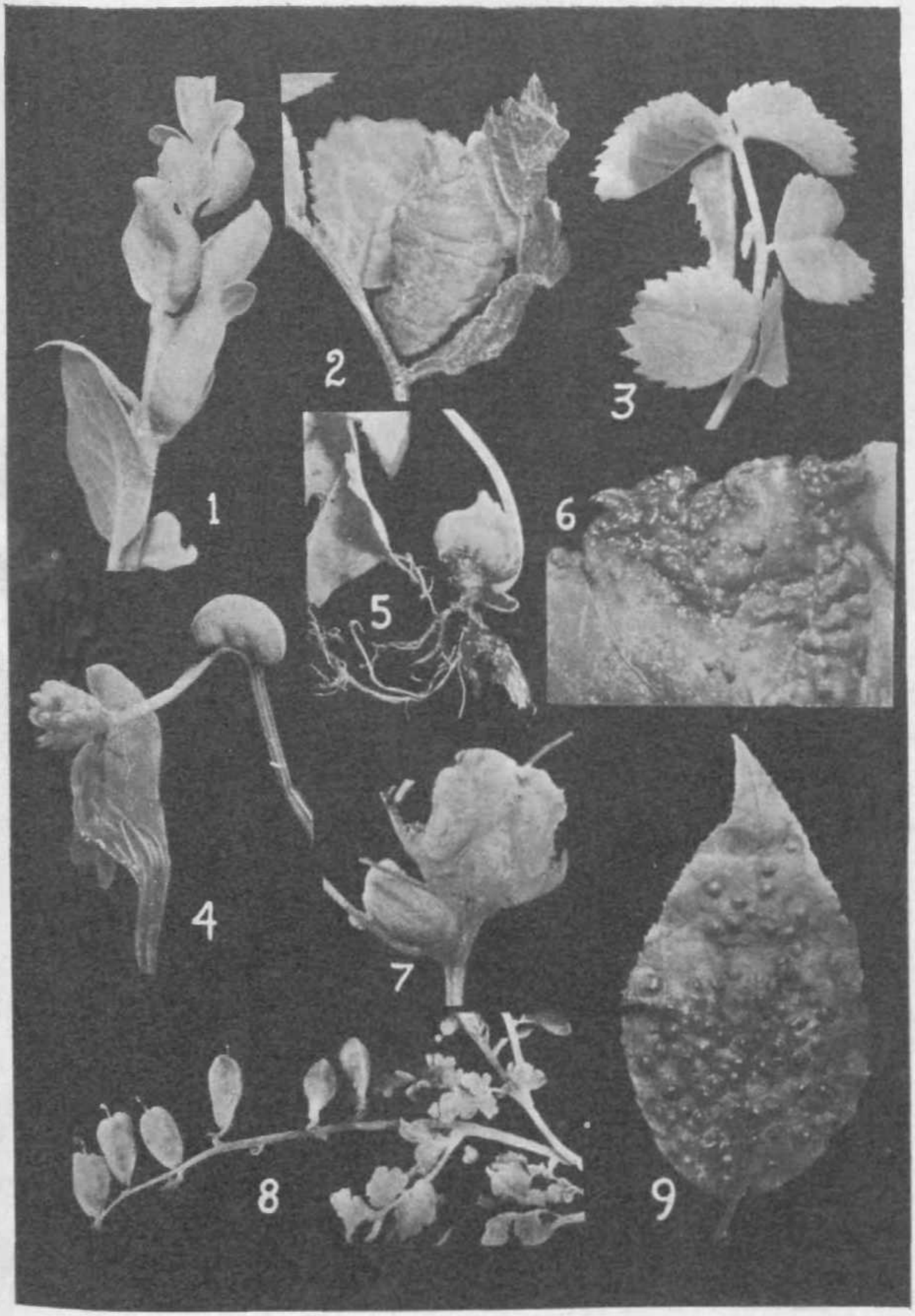
Fig. 1. Gall No. 512 on *Althea rosea* by *Eriophyes* sp.
Fig. 2, 3 and 6. Gall No. 493 on *Ulmus wallichiana* Planch.
and 8 by aphid.
Fig. 4. Gall No. 514 on *Erigeron* by midge.
Fig. 7. Gall No. 429 on *Indigo/era dosua* Ham. by midge.
Fig. 5. Gall No. 201 on *Pongamia glabra* Vent, by *Myricomyia pongamial* Mani.



M. S. Mani : *Cecidutkeca indica.*

PLATE XVI

Fig. **1.** Gall No. 594 on *Lonicera parviflora* by midge.
Fig. 2. Gall No. 591 on *Ulmus laevigata* Royle by aphid.
Fig. 3. Gall No. 607 on *Rosa mccrophylla* by midge.
Fig. 4. Gall No. 589 on *Polygonum alalum* Ham. by fungus.
Fig. 5. Gall No. 586 on *Polygonum cmplexicaule* by midge.
Fig. 6. Gall No. 593 on *Alnus nitida* End. by *Eriophyes* sp.
Fig. 7. Gall No. 513 on *Indigofera pulchella* Roxb. by midge.
Fig. 8. Gall No. 588 on *Corydalis cornuta* Royle by midge.
Fig. 9. Gall No. 518 on leaf of an unknown plant.



M. S. Mani : *Cecidotheca indica.*

PLATE XVII

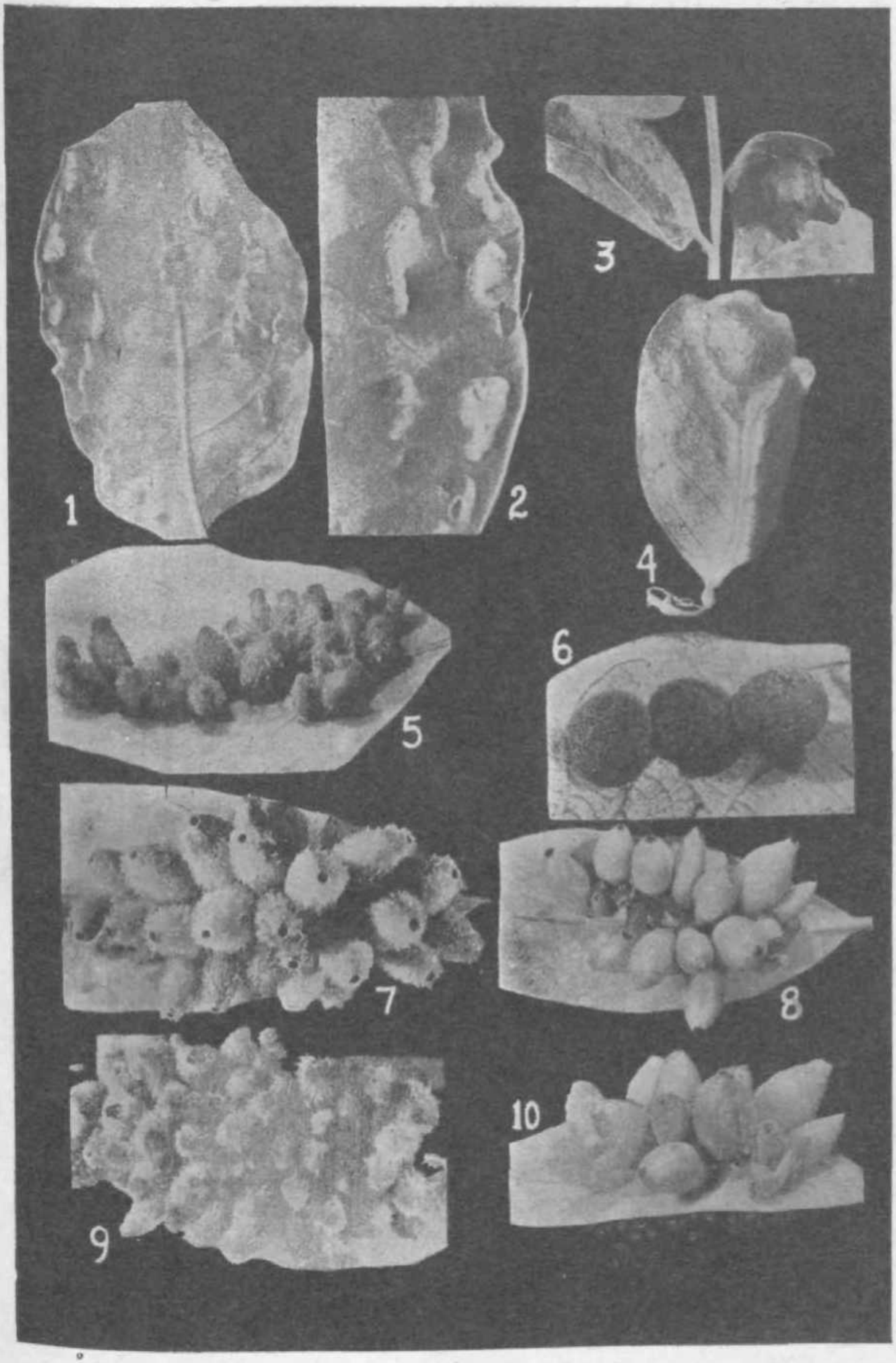
Fig. 1 and 2. Gall No. 473 on unknown plant

Fig. 3 and 4. Gall No. 474 on unknown plant

Fig. 5, 7 and 9. Gall No. 479 on *Machilus odoratissimus* Nees by

Fig. 6. Gall No. 475 on *Ficus* sp.

Fig. 8 and 10. Gall No. 481 on *Machilus odoratissimus* Nees by midge.



M. S. Mani : *Cecidotheca indica.*

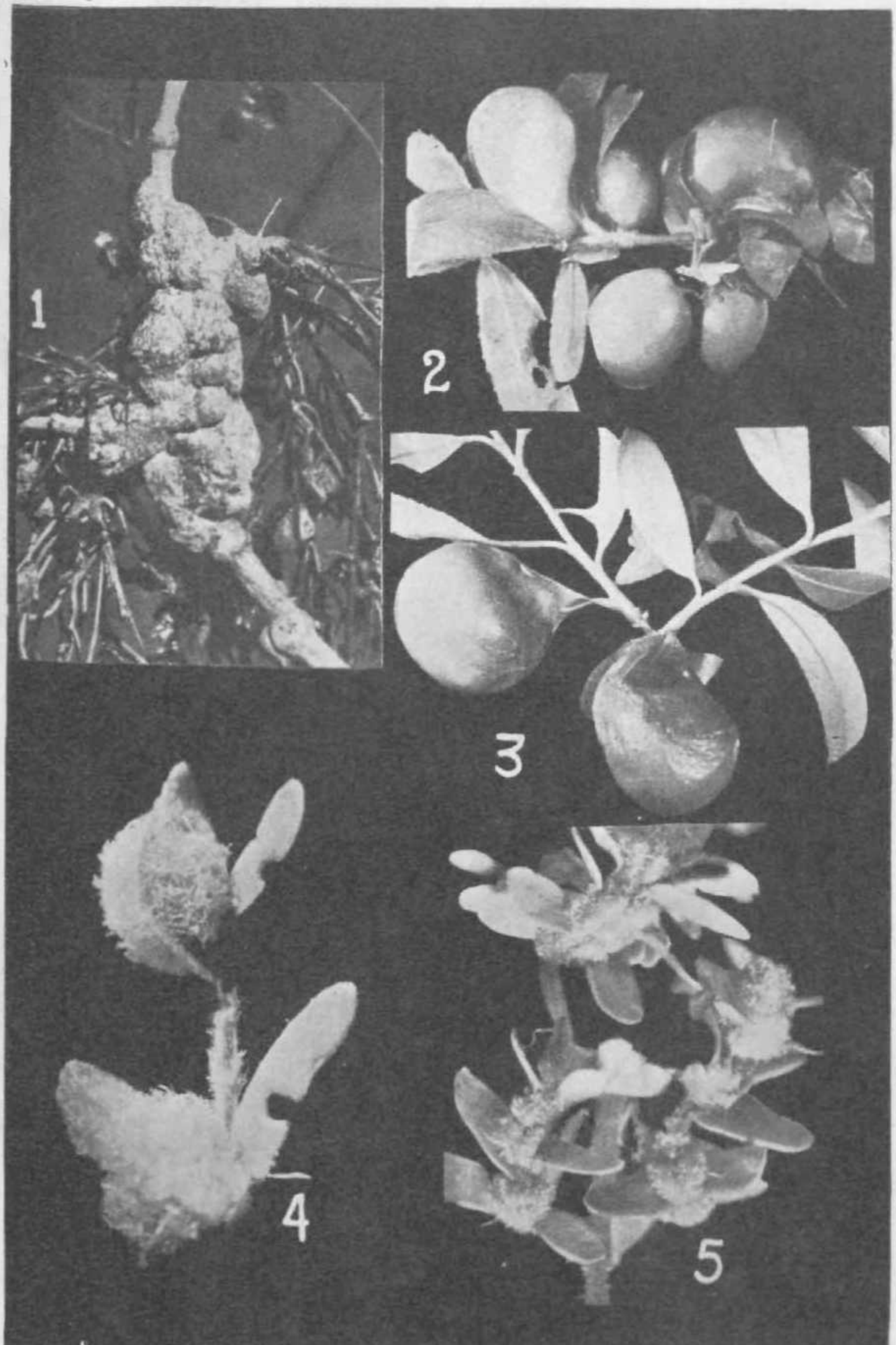
PLATE XVIII

Fig, 1. Gall No. 363 on *Coccínia indica* Naud. by fungus.

Fig. 2. and 3. Gall No. 574 on *Salix fragilis* by *Pontania* sp.

Fig. 4. Gall No. 206 on *Acacia leucophloca* Willd. by *Asphondylia irkhoceci-darum* Mani.

Fig. 5. Gall No. 14 on *Acacia Uucophloea* Willd. by *Eriophyes* sp.



M. S. Mani : *Cec'uhlheca indica.*

PLATE XX

Fig. 1• 482 on *Machilus odoratissima* Nees by Psyllid.

Fig. 2. Gall No. 487 on *Indigofera gerardiana* by midge.

Fig. 3. Gall No. 486 on *Indigofera gerardiana* by *Oxasphondylia echinata* Mani.

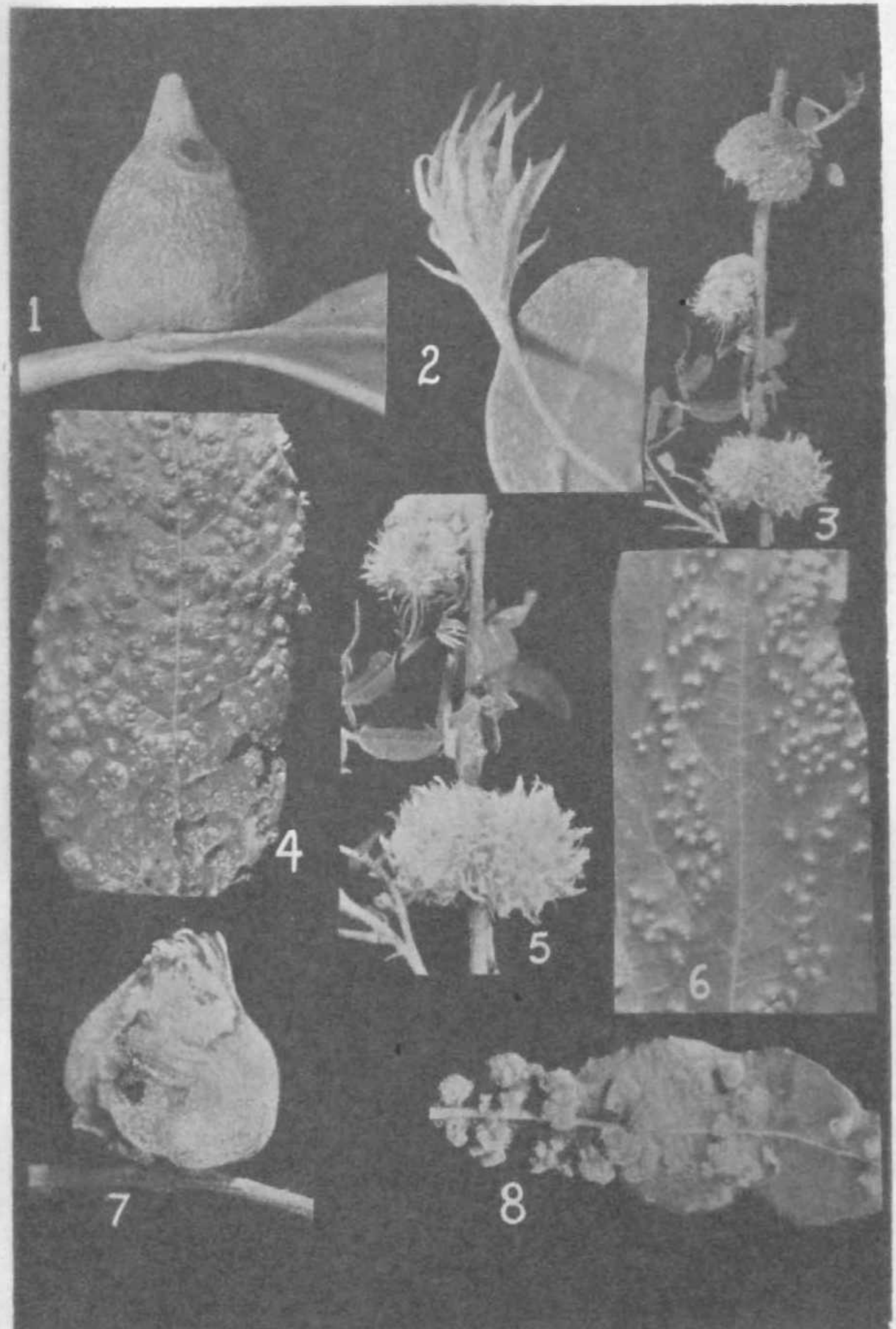
Fig. 4 Gall No. 480 on *Ficus scandens* by *Eriophyes* sp.

Fig. 5. Gall No. 486 on *Indigofera gerardiana* by *Oxasphondylia echinata* Mani.

Fig. 6. Gall No. 495 on *Machilus odoratissima* Nees by Aleurodid.

Fig. 7. Gall No. 490 on *Indigofera gerardiana* by *Oxasphondylia floricola* Mani.

Fig. 8. Gall No. 492 on *Salix elegans* by *Eriophyes* sp.



M. S. Mani : *Cecidotheca indica.*

PLATE XXI

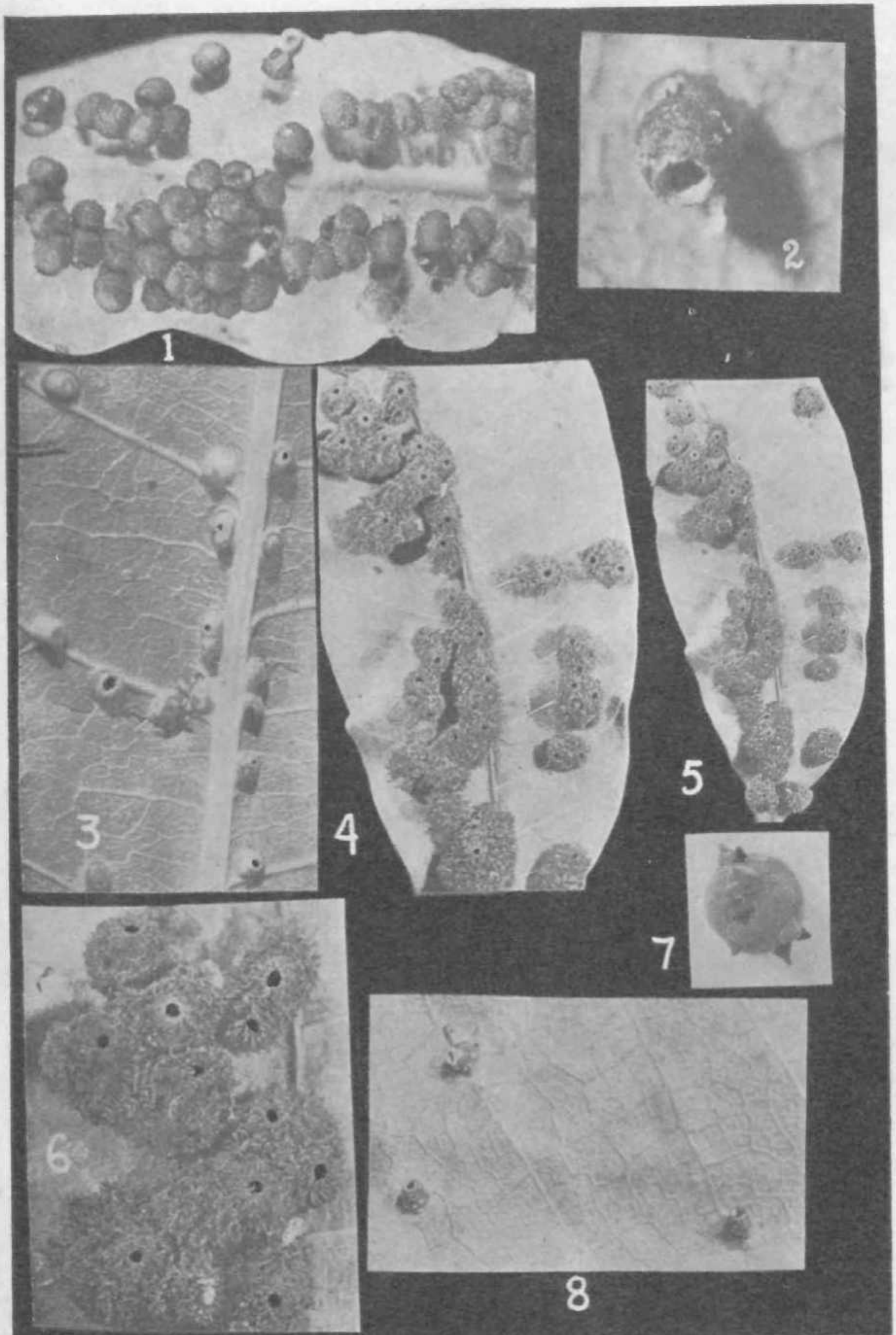
Fig. 1 Gall No. 190 on *Mangifera indica* Linn, by *Alosomyia tenuispatha* (Kieff.)

Fig. 2 and 8. Gall No. 191 on *Mangifera indica* Linn, by midge.

Fig. 3. Gall No. 194 on *Mangifera indica* Linn, by midge.

Fig. 4, 5 and 6. Gall No. 196 on *Mangifera indica* Linn, by *Amradipliosis* ***echinogalliperda*** **Mani.**

Fig. 7. Gall No. 187 on *Zizyphus xylopyra* by midge.



M. S. Mani : *Cecidotheca indtca.*

PLATE XXII

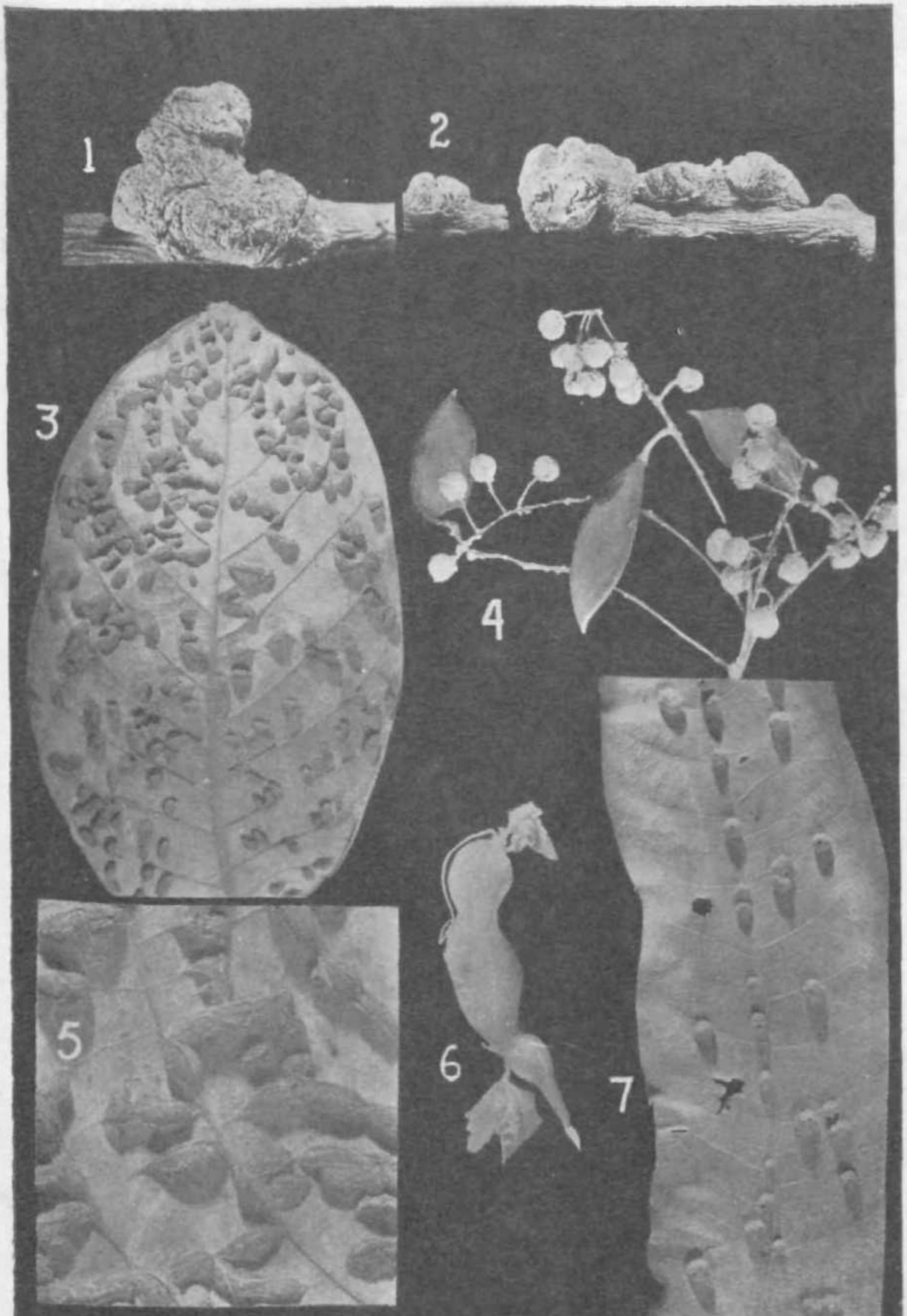
Fig. 1 and 2. Gall No. 213 on *Pyrus pashia by* midge.

Fig. 3 and 5. Gall No. 321 on *Bassia latifolia* by chalcid.

Fig. 4. Gall No. 202 on *Pongamia glabra* Vent, by *Asphondylia pongamiae* Felt.

Fig. 6 Gall No. 224 on *Melothria madaraspatana* by midge.

Fig. 7. Gall No. 325 on *Mangifera indica* Linn, by *Amradiplosis amraemyia* (Rao)



M. S. Matii : *Cecidotheca indica.*

PLATE XXIII

Fig. 1 and 4. Gall No. 14 on *Acacia leucophloea* Willd. by *Eriophyes acaciae JValepa.*

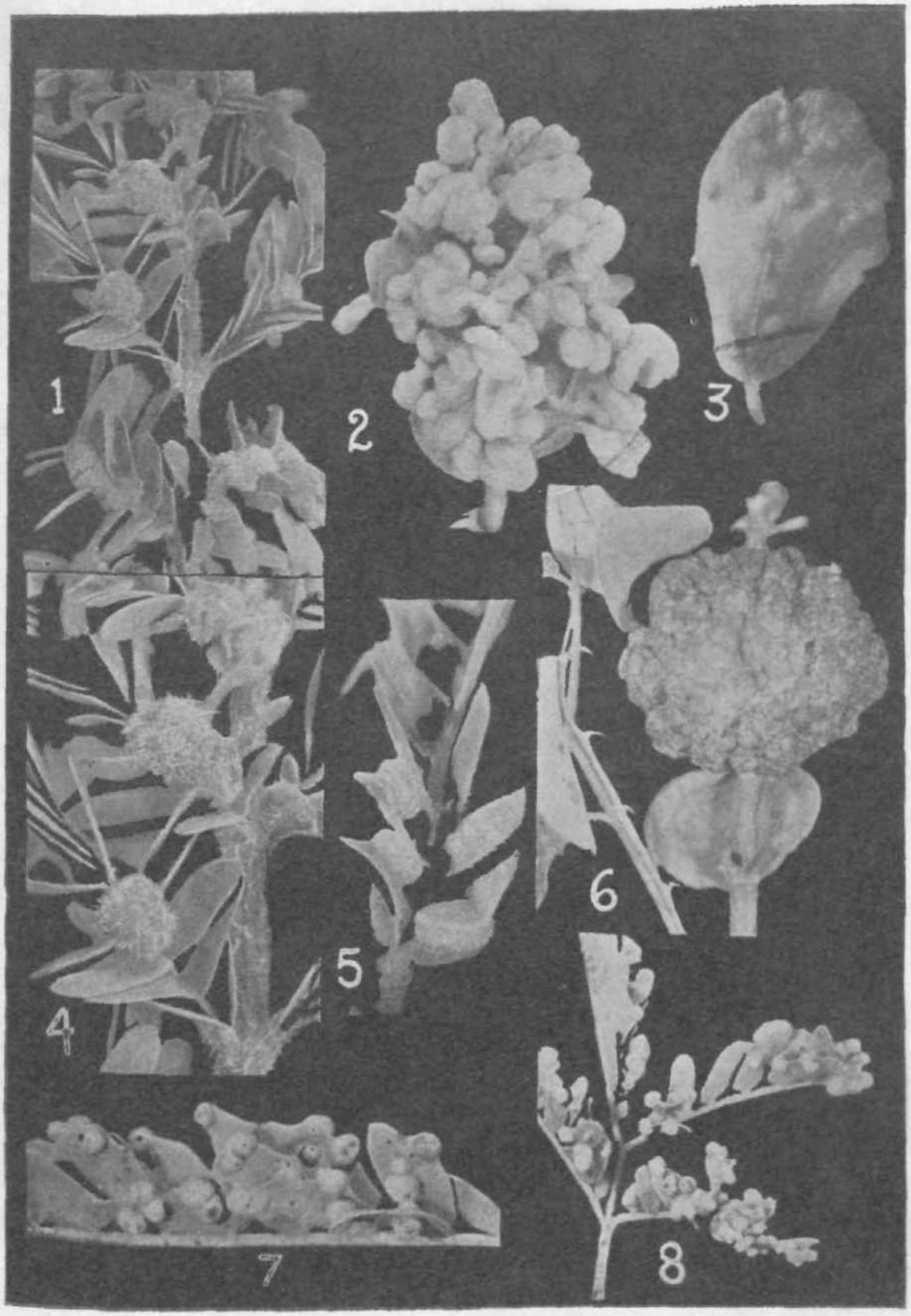
Fig. 2. Gall No. 17 on *Pongamia glabra* Vent, by *Eriophyes cheriani* Mas see.

Fig. 3. Gall No. 6 on *Hibiscus micrantkus* Linn, by *Eriophyes hibisci* Nalepa.

Fig. 5 Gall No. 16 on *Dichrostachys cinerea by Eriophyes dichrostachia* Tucker.

Fig. 6. Gall No. 11 on *Z^zyphusjujuba* Lamarck by *Eriophyes cernuus* Massee.

Fig. 7 and 8. Gall No. 18 on *Prosopis juliflora* Linn, by *Eriophyes prosopidis* Saksena.



M. S. Mani : *Ceddotheca indka.*

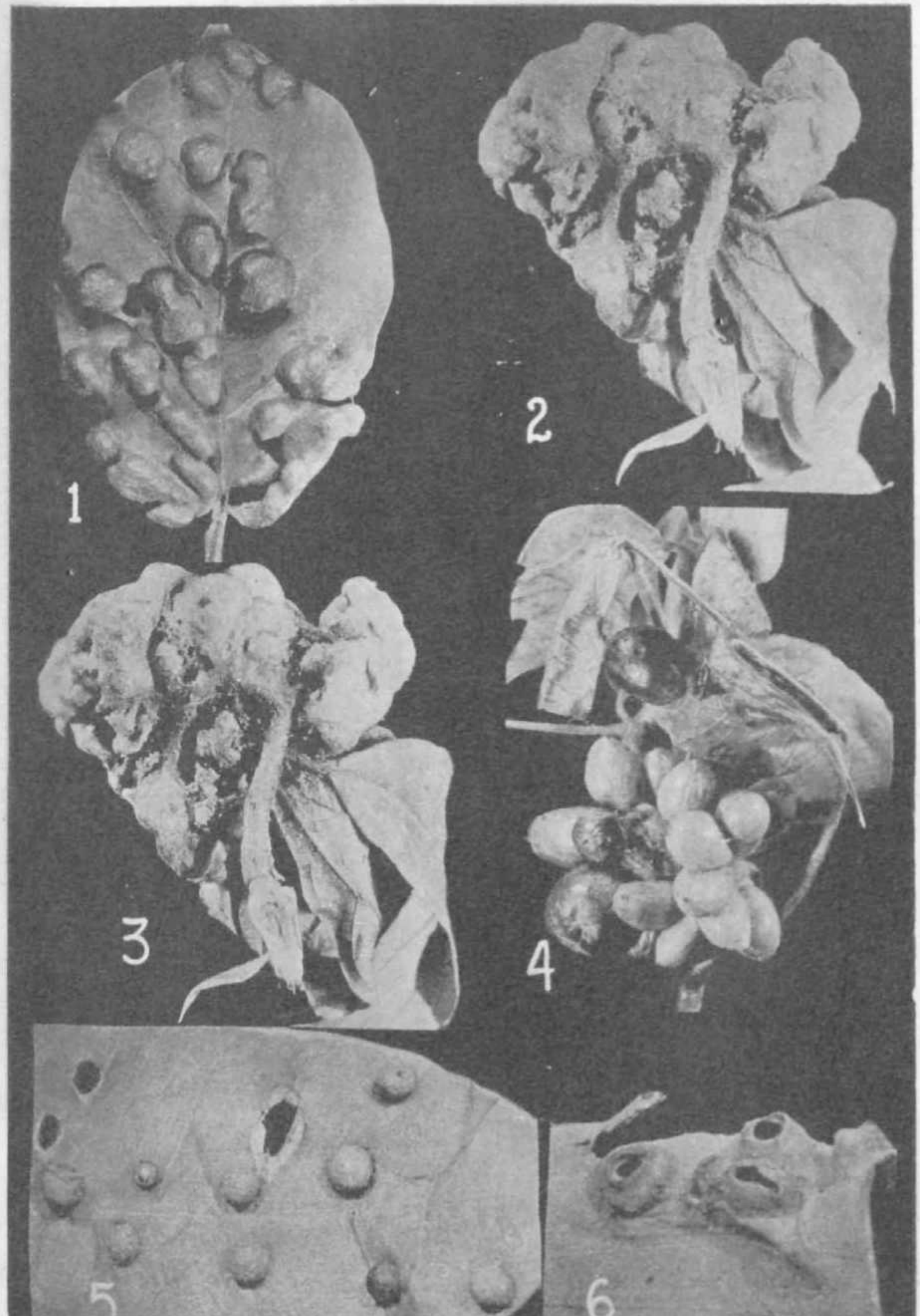
PLATE XXIV

Fig. 1. Gall No. 37 on *Holoptelea integrifolia* Planch, by *Eriophyes* sp.

Fig. 2 and 3. Gall No. 40 on *Calycopteris floribunda* Lamarck by *Austrothrips cochinchinensis* Karny.

Fig. 5 and 6. Gall No. 73 on *Alstonia scholaris* R. Br. by *Pauropsylla tubercula ta* (Crawf.)

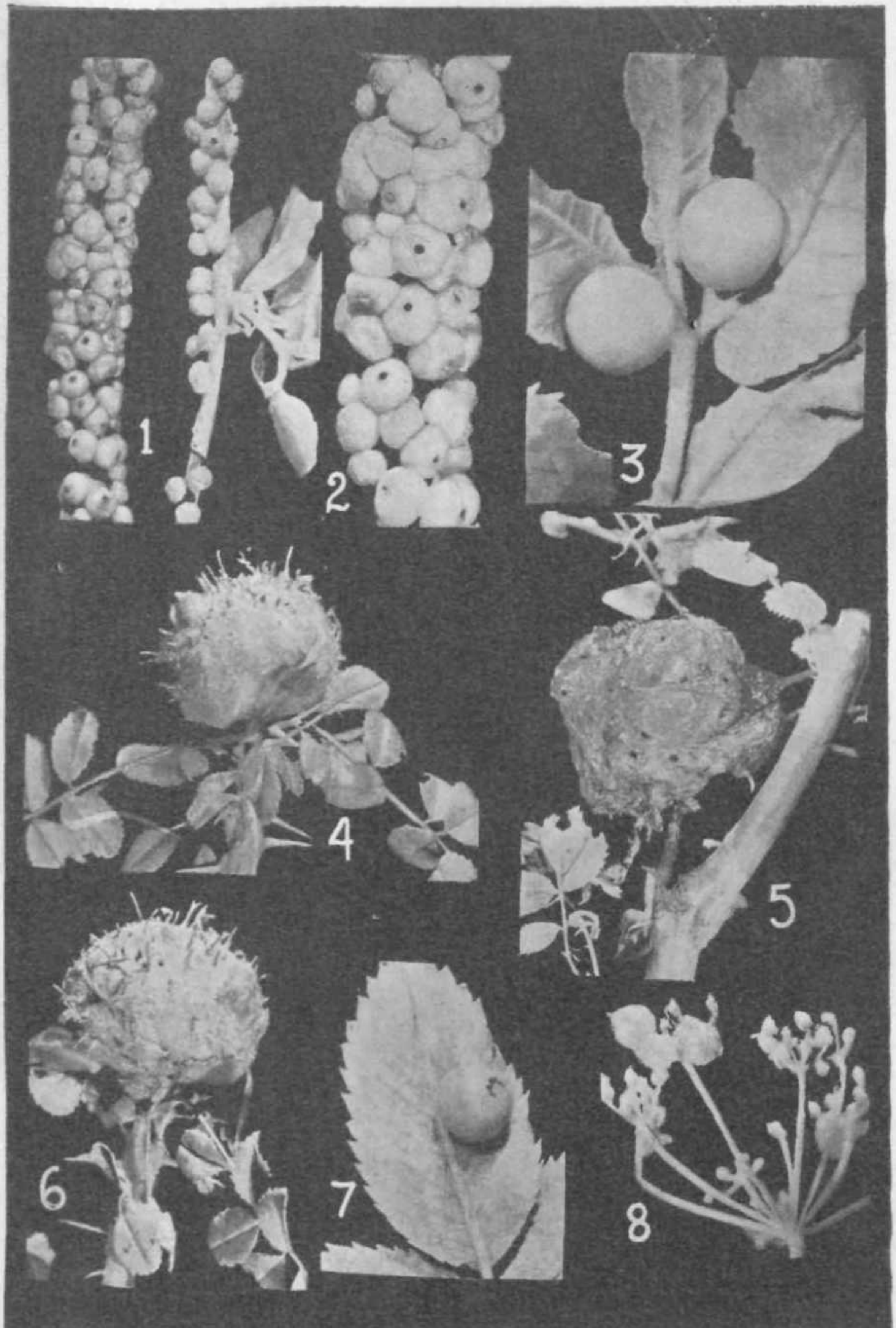
Fig. 4. Gall No. 55 on *Geruga pinnata* Roxb. by *Phacopteron leniiginosum* **(Buckton)**



M. S. Mani : *Cecidolk-ca indica.*

PLATE XXV

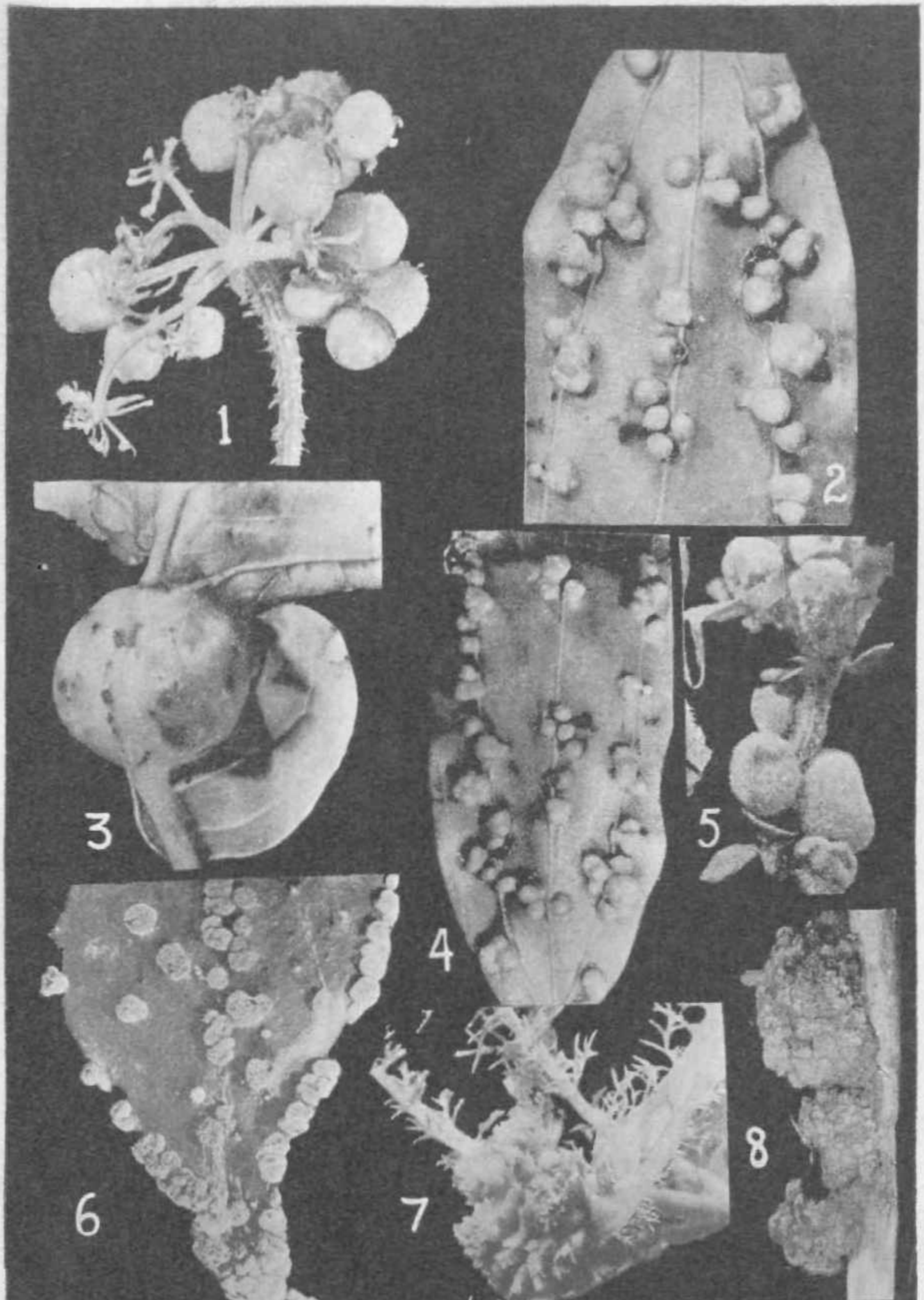
Fig. 1 and 2. Gall No. 500 on *Sabia campanulata* Wall, by *Acroectasis campanulata* Mani.
Fig. 4, 5 and 6. Gall No. 497 on *Rosa macrophylla* Lindl. by cynipid.
Fig. 3 and 7. Gall No. 499 on *Rosa macrophylla* Lindl. by cynipid.
Fig. 8. Gall No. 585 on *Pimpenella diversifolia* DC by midge.



M. S. Mani : *Cecidotfcca indica.*

PLATE XXVI

Fig- 1. Gall No. 515 on *Hieracleum canescens* Lindl. by midge.
Fig. 2 and 4. Gall No. 510 on *Cinnamomum* sp.
Fig. 3. Gall No. 511 on *Ficus* sp.
Fig. 5. Gall No. 445 on *Artemisia vulgaris* by midge.
Fig. 6. Gall No. 507 on *Avicinia officnalis* by *Eriophyes* sp.
Fig. 7. Gall No. 505 on *Achillea millefolium* Linn, by *Rhopalomyia* sp.
Fig. 8. Gall No. 506 on *Cyathula tomentosa* Moq. by *Eriophyes* sp.



M. S. Mani : *Cecidotheca indica.*

PLATE XXVIII

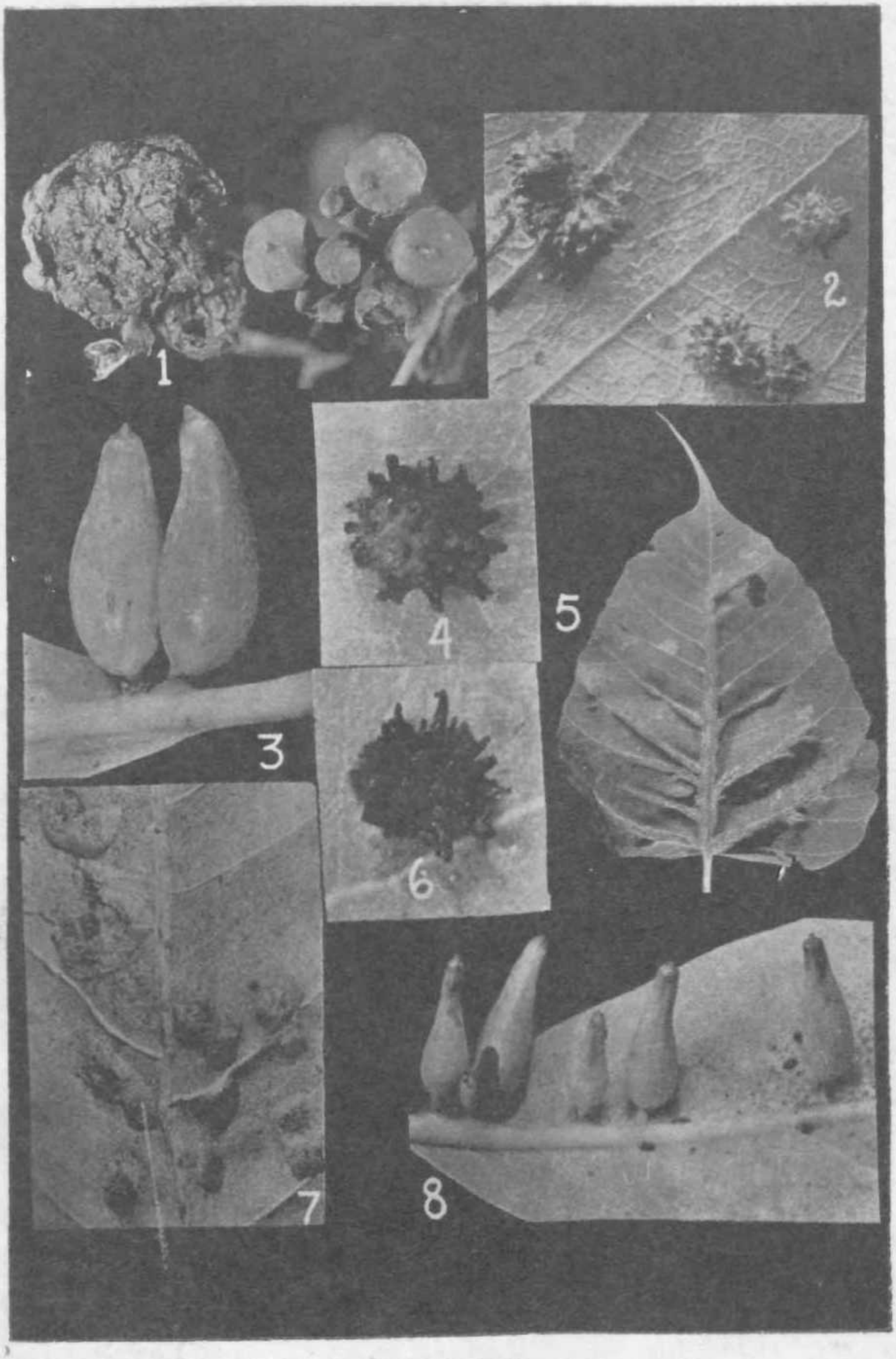
Fig. 1. Gall No. 245 on *Ipomea sepiaria* by midge.

Fig. 2, 4 and 6. Gall No. 263 on *Ficus bengalensis* Linn, by chalcid.

Fig. 3 and 8. Gall No. 260 on *Machilus gamblei* King by *Daphnephila haasi* Kieff.

Fig. 7. Gall No. 264 on *Ficus glomerala* Roxb. by *Dyodiplosis fid* Rao.

Fig. 5. Gall No. 267 on *Ficus religiosa* Linn, by *Pipaldiplosis pipaldiplosis* Mani.



M. S. Mani : *Cecidotheca tndka.*

PLATE XXIX

Fig. 1. Gall No. 19 on *Prosopis juliflora* Linn, by *Eriophyes prosopidis* Saksena.

Fig. 2. Gall No. 22 on *Randia dumetorum* Lamarck by *Eriophyes* sp.

Fig. 3. Gall No. 26 on *Ipomeapestigridis* Linn, by *Eriophyes sp.*

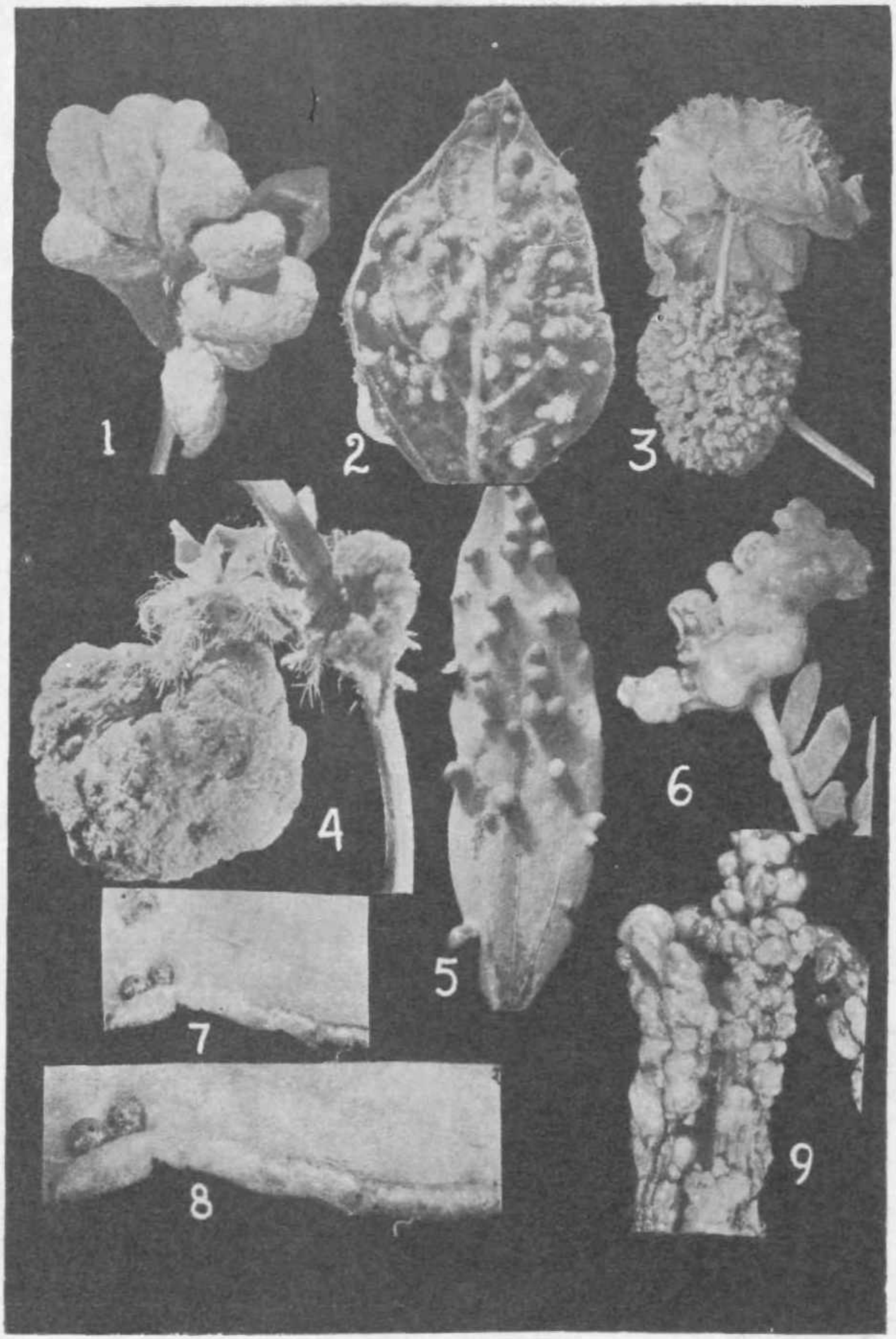
Fig. 4. Gall No. 25 on *Ipomea scindica* by *Eriophyes* sp.

Fig. 5. Gall No. 30 on *Cinnamomum zeylanicum* Breyn. by *Eriophyes doctersi* Nalepa

Fig. 6. Gall No. 18 on *Prosopis juliflora* Linn, by *Eriophyes prosopidis* Saksena.

Fig. 7 and 9, Gall No. 27 on *Ipomea staphylina* Roem. Sch. by *Eriophyes gastrotrichus* Nalepa

Fig. 8. Gall No. 336 and No. 49 on *Piper nigrum ;*
Gall No. 49 by *Gynaikothrips chavicae* Zimmerm .
(Marginal leaf-roll gall).



M. S. Mani : *Cecidolheca xndica.*

PLATE XXX

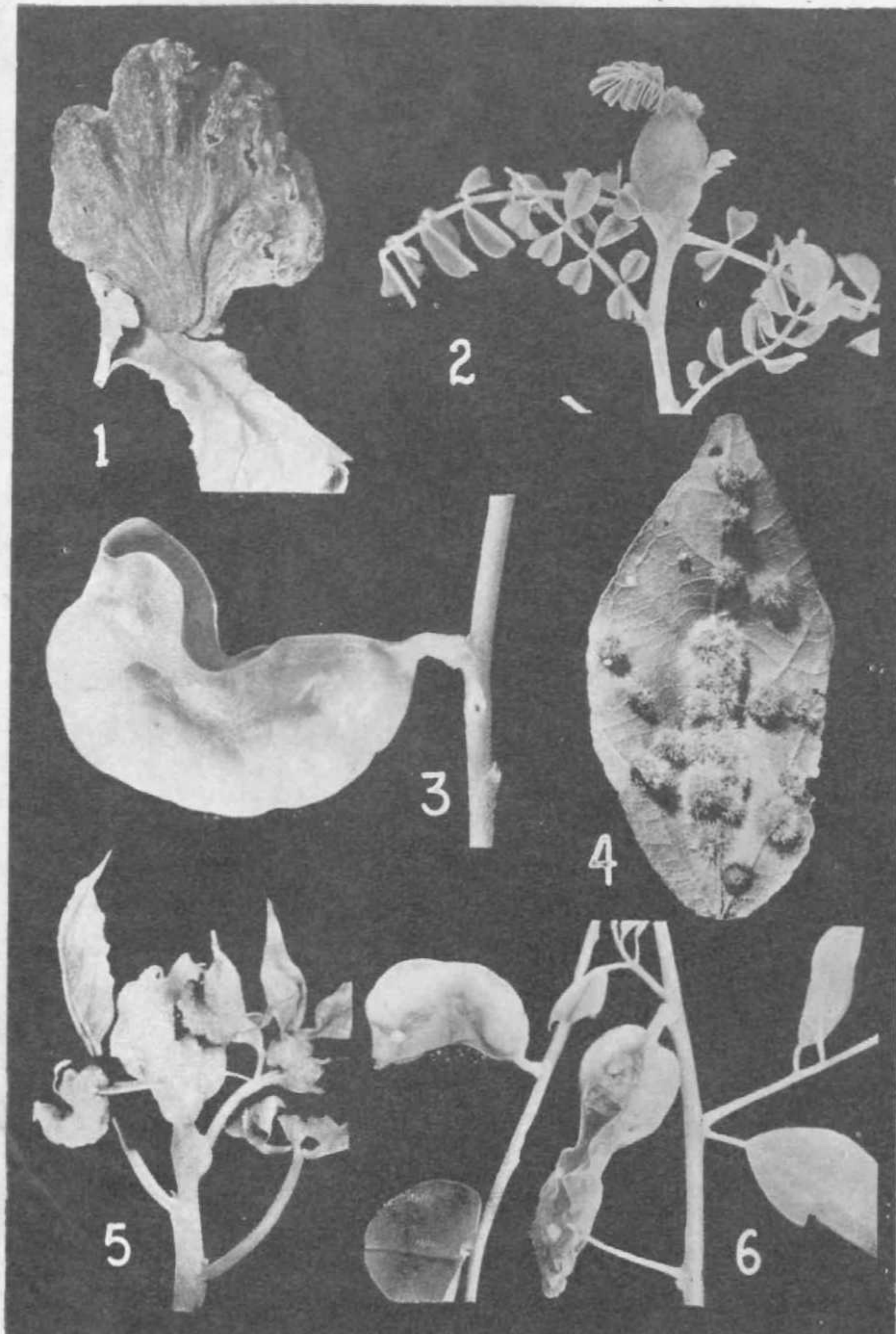
Fig. 1 Gall No. 121 on *Populus alba* by *Eriosoma taskhiti*

Fig. 2 Gall No. 160 on *Tephrosia purpurea* Pers. by *Dactylethra Candida* Staint.

Fig. 3 and 6. Gall No. 173 on *Maerua arenaria* Hook. & Thorn, by *Schizomyia arenariae* Felt

Fig. 4. Gall No. 182 on *Grewia (Eugrewia) orientalis* by midge.

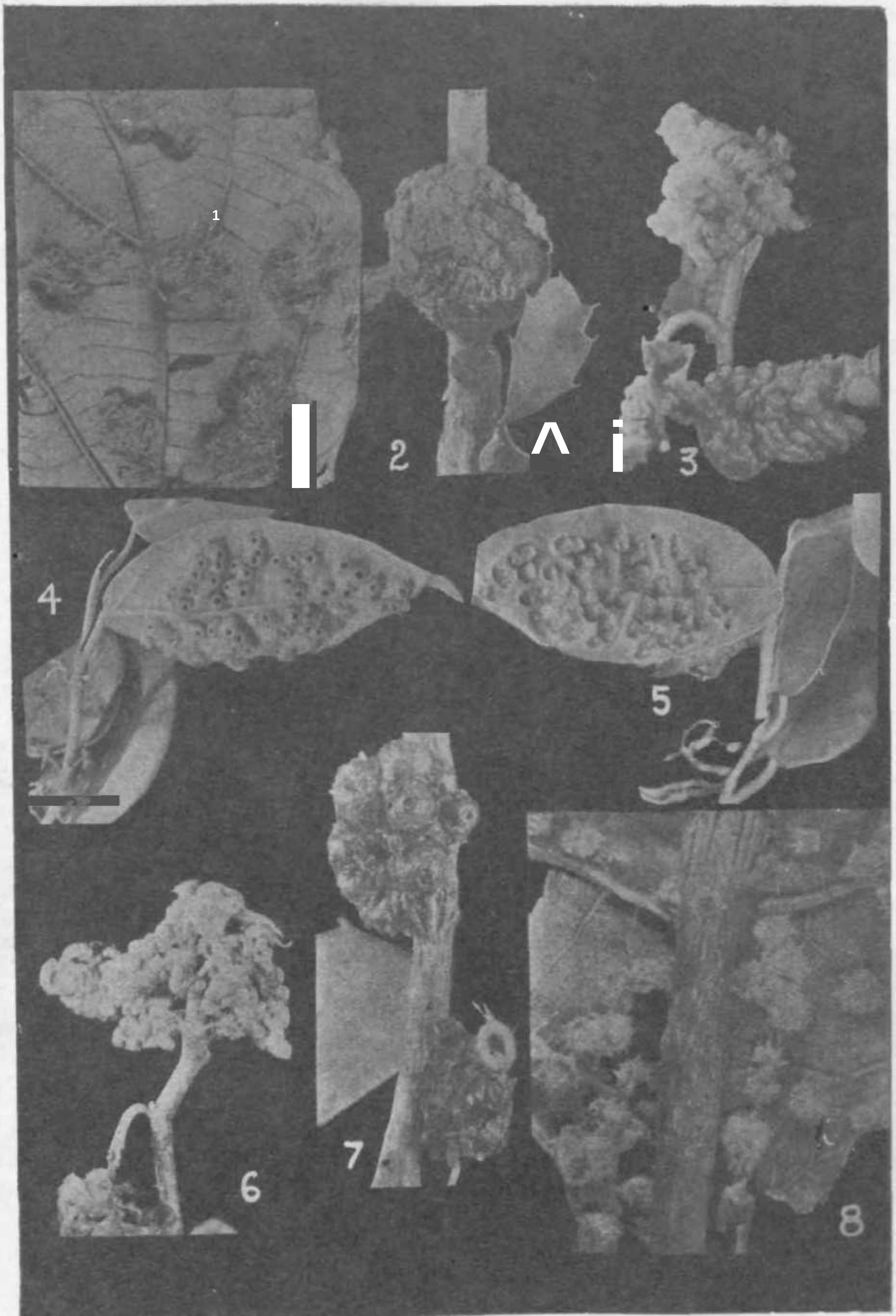
Fig. 5. Gall No. 171 on *Crataeva religiosa* Forst. by *Aschistonyx cratevae* (Mani).



M. S. Mani : ***Ctcidothsca*** *indica.*

PLATE XXXI

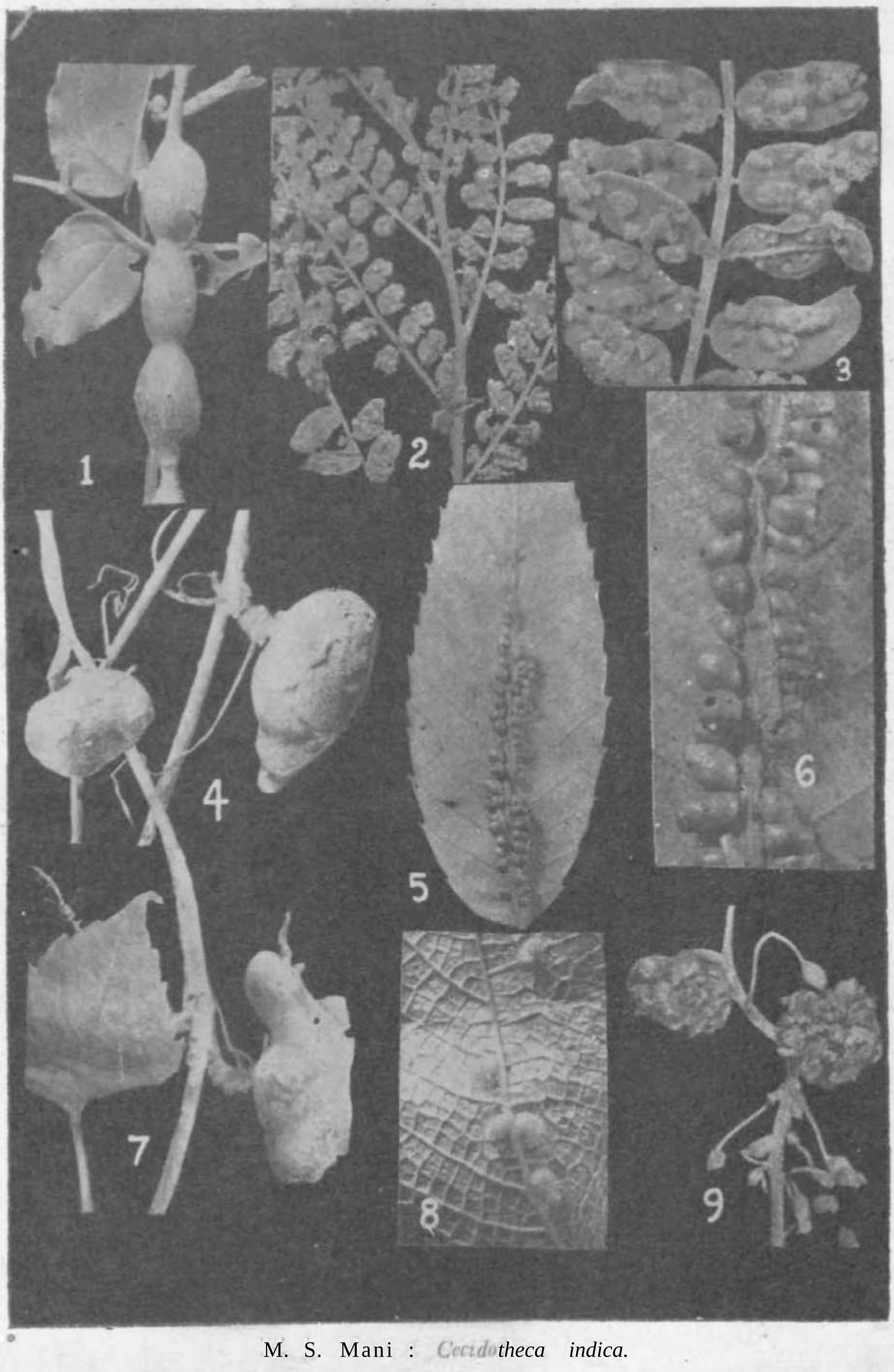
Fig. 1 and 8. Gall No. 414 on *Tectona grandis* Linn, by midge
Fig. 2. Gall No. 425 on *Berberis lycium* by fungus
Fig. 3 and 6. Gall No. 422 *onZPrunus cerasoides* D.Don by *Schizoneura* sp.
Fig. 4 and 5. Gall No. 426 on *Ficus foveolata* Wall, by midge.
Fig. 7 Gall No. 420 on *Berberis lycium* by Trypetid.



M. S. Mani : *Cecidotheca tndica.*

PLATE XXXII

Fig. 1. Gall No. 439 on *Jasminum dispermum* by midge.
Fig. 2 and 3. Gall No. 431 on *Indigofera dosua* by *Eriophyes* sp.
Fig. 4 and 7. Gall No. 432 on *Vitis semicordata* Wall, bv midge.
Fig. 5 and 6. Gall No. 433 on *Quercus incana* by Cynipid.
Fig. 8. Gall No. 446 on *Boehmeria platyphylla* D.Don by midge,
Fig. 9. Gall No. 455 on *Artemisia[pulgaris* by *Eriophyes* sp.



M. S. Mani : *Cecidotheca indica.*

CONDENSATION OF MALON-O-, M—AND P-CHLORANILIG ACIDS WITH ALDEHYDES—PART IV—WITH O—AND P-CHLORO, 2:4—DICHLORO AND 3:4—DICHLORO-BENZALDEHYDES

By M. V. GEORGE ani P. I. ITTVERAH, *Chemistry Department, St. John's College, Agra.*

Perkin's method was first applied to the condensation of c-, *m*- and j&-chlorobenzaldehydes by Meyer and Beer (2) and by Meyer, Beer and Lasch [3]. Their observations have been confirmed by Lock and Bayer [1] who have made a study of the influence of groups on the yields obtained during Per kin's reaction under standardised conditions. They observed that the presence of haloid groups influenced the formation of better yields of the corresponding cinnamic acids. Stuart in 1888 obtained o-chloro-benzalmalonic acid by heating 0-chlorobenzaldehyde, malonic acid and glacial acetic acid (6). The three mono-chlorobenzaldehydes and m-bromo-trenzaldehyde have been condensed with malonic acid in the presence of organic bases like pyridine or piperidine by Pandya and Pandya [4] and they obtained quantitative yields of the co. responding haloid cinnairic acids or the haloid benz^lidene malonic acid. They also condensed 0-aud *p*-chlorobenzaldehyde and m-bromobenzaldehyde with malonanilic acid [5] and yields ranging between 74 and 100% of the products were obtained.

This paper deals with the condensation of malon o-, *m*- and ^-chloranilic acids with *o*-9 *m*- and /r-chloro, 2:4-dichlo.o and 3:4 dichlorobenzaldehydes.

The reaction between an aldehyde and malonchloranilic acid, under ordinary conditions may give three products which are shown below :—

a. R—GH (OH). CH< .GO.NH.C_6H_4. Cl

b. R—CH=C ^CO. NH. C_6H_4cl / ^COOH

C. R — CH=CH— CO.NH C_6H_4. cl

where R=—C_6H_4.C1 or —C_6H_3. cl_2

The aldol [a] might be taken as the intermediate, though in these condensations it was never isolated. Products [b] and [c] were stable and could be obtained without difficutly. Various condensations were tried using different condensing agents like acetic acid and traces of organic bases. In the absence of any condensing agent the products formed were of type (b) whereas when a trace of organic base was used, the products were mainly if not wholly of the type (c).

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o-Chlorobenzaldehyde when condensed with malon-o-chloranilic acid gave 92.1% yield of o-chlorobenzylidene-malone-o-chloranilic acid and 98.68% of 0-chloro-cinnam-0-chloranilide, p-Chlorobenzaldehyde gave 88.94% of ^-chloro-benzylidene-malon-o-chloranilic acid and 91.4% of/-chloro-cinnam-0-chloranilide. Similarly the yields of the products obtained by condensing the above aldehydes with malon-m-and ^-chloranilic acids were also over 90% revealing thereby the high activity of these aldehydes.

2:4—Dichloro and 3:4-dichlorobenzaldehydes were also condensed and they also have given excellent yields of the corresponding products. These observations also support the view that haloid benzaldehydes are reactive.

It may also be mentioned here that pyridine or piperidine in traces, or the acetate of any of these bases in traces were found lo be the most efficient catalysts in these reactions. [Refer Tables II, III, IV and VJ.

EXPERIMENTAL

The general procedure has been to mix equimolecular quantities of the acid and the aldehyde in a small round bottomed flask and to heat at 100°G for four hours. When glacial acetic acid was used as a condensing agent, one molecular proportion of it was added, whereas organic bases were used only in traces [0.15 mol]. After heating for the required length of time the contents of the flask were extracted with a strong solution of sodium bicarbonate. The acid products were dissolved by the alkali. The non-acid residue left w?s filtered and purified by recrystallisation from alcohol. The alkali extract was acidified with hydrochloric acid and the precipitated acids purified by crystallisation from a suitable organic solvent like alcohol or acetone.

All the products were white crystalline solids and the acid products melted with decomposition. The products obtained were analysed and their properties studied. They are shown in Table I.

Tables II, III, IV and V show the yields of products and the experimental conditions observed in the different condensations.

* **Table I**

No.	Name	Mol. Form.	M.p. °C	Eq. Weight		Ghlorine%	
				Found	Gale.	Found	Calc.
1	**o-Chlorobenzylidene-malon-o-X**	$C_{18}H_{U}O_{8}NCl_{2}$	192	337.9	336.1	20.6	21.13
2	o-Chlorocinnam-0-Y	$C_{,5}H_{n}ONCl_{2}$	171			24.4	24.28
3	o-Chlorobenzylidene-malon-m-X	$^{c}18^{H}ll0_{3}NCl_{a}$	212	336.7	336.1	21.1	21.13
4	o-Chlorocinnam-m-Y	$^{C}15^{H}11°NC1_{2}$	154			24 2	24.28
5	o-Chlorobenzylidene malon-/-X	$^{C}16HllO_{3}NCl_{2}$	198	337.2	336.1	21.3	21.13
6	0-Chlorocinnam-/»-Y	$Cj_{6}H_{u}ONCl_{2}$	214			24.0	24.28
7	^-Chlorobenzylidene-malon-0-X	$^{C}16^{H}11°3^{Ncl}2$	197	339.1	336.1	21.1	21.13
3	/>-Chloiocinnam-0-Y	$C_{15}H_{u}ONCl_{2}$	193			24.3	24.28
9	^-Chlorobenzylidcne-malon-m-X	$C_{16}H_{u}O_{3}NCl_{2}$	205	337.1	336.1	20.9	21.13
10	^-Chlorocinnam-m-X	$C_{15}H_{n}ONCl_{2}$	181			24.2	24.28
11	jft-Chlorobenzylidcne-malon-/>-X	$Cl_{6}H_{u}O_{3}Nclj$	216	**336.2**	336.1	21.3	21.13
12	o- Chlorocinnam-^-Y	$C_{15}H_{n}ONCl_{2}$	207			24 1	24.28
13	2:4-Dichlorobenzyli-dcne-malon-o-X	$Cl_{6}H_{,o}0_{3}Ncl_{8}$	206	**370.7**	370.6	28.8	28.74
14	2:4-Dichlorocinnam-*o-Y*	$C_{15}H_{10}ONCl_{3}$	178			32.0	32.58
15	**3:4-Dichlorobenzyli-denc-malon-o-X**	$Cl6^{H}10°3^{N}cl_{3}$	198	**370.5**	370.6	28.9	28.74
16	**3:4-Dichlorocinnam-0-Y**	$Ci_{5}H_{10}ONCl_{3}$	152			32.7	32.58
17	3:4-Dichlorobenzyli-dene-malon-m-X	$^{C}1«^{H}1O°3^{NCl}3$	250	**371.0**	370.6	28.8	28.74
18	3:4-Dichlorocinnam-**m-Y**	$C_{16}Hi_{0}ONCl,$	180			32.6	32.58
19	3:4-Dichlorobenzyl-idene-malon-/»-X	$Ci«H_{10}O_{3}NCl_{3}$	222	**370.5**	370.6	28.9	28.74
20	3:4-Dichlorocinnam-*p-Y*	$Cl5^{H}10^{ONcl}3$	215			32.4	32.58

X stands for -chloranilic acid and Y stands for -chloranilide.

Table II

With o - Chlorobenzaldehyde

No.	Acid	Condensing agent.	Mol. prop.	Yield%	
				Acid	Chloranilide
1.	Malon-o-chloranilic acid >	Nil	1:1	76.2	0
2.	99	Acetic acid	1:1:1	92.1	0
3.	99	Pyridine	1:1:0:15	0	95
4.	9)	Piperidine	99	0	99
5.	99	2:4-Lutidine	99	0	66
6.	f ,	Collidine	99	0	73
7.	99	Triethanol-amine	99	0	58.5
8.	99	Pyridine acetate	99	0	99
9.	99	Piperidine acetate	99	0	99
10.	Malon-w-chloranilic acid	Nil	1:1	76.3	0
11.	))	Acetic acid	1:1:1	89	0
12.	99	Pyridine	1:1:0:15	0	80.5
13-	9)	Piperidine	99	0	80.5
14.	99	2:4-Lutidine	99	0	58.5
15.	99	Collidine	99	0	55
16.	99	Triethanol-amine	99	0	44
17.	99	Pyridine acetate	99	0	90
18.	99	Piperidine acetate	99	0	90
19.	Malon-^-chloranilic acid	Nil	1:1	70	0
20.	,,•	Acetic acid	1:1:1	92	0
21.	>*	Pyridine	1:1:0:15	0	91.5
22.	99	Piperidine	99	0	88
23.	99	2:4-Lutidine	99	0	80.4
24.	99	Collidine	99	0	66
25.	99	Triethanol-amine	99	0	66
26.	•9	Pyridine acetate	99	0	97
27.	>9	Piperidine acetate	99	0	97

In all cases the temperature maintained was 100° and time 4 hours.

Table III

With p - Chlorobenzaldehyde.

No.	Acid	Condensing agent.	Mol. prop.	Yield % Acid	Yield % Chloranilide.
1.	Malon-o-chloranilic acid	Nil	1:1	70	0
2.	jj	Acetic acid	1:1:1	89	0
3.	99	Pyridine	1:1:0.15	0	90
4-	99	Piperidine	9j	0	88
5.	99	2:4-Lutidine	99	0	55
6.	99	Collidine	*9	0	69
7.	99	Triethanolamine	99	0	44
8.	99	Pyridine acetate	J5	0	91
9.	99	Piperidine acetate	99	0	91
10.	Malon-m-chloranilic acid.	Nil	1:1	82	0
11.	j 7	Acetic acid	1:1:1	89	0
12.	99	Pyridine	1:1:0.15	0	84
13.	99	Piperidine	99	0	88
14.	)1	2:4-Lutidine	99	0	66
15.	•9	Triethanol-amine	•9	0	59
16.	99	Collidine	99	0	73
17.	J9	Pyridine acetate	9'	0	91
18.	9)	Piperidine acetate	99	0	90
19.	Malon-jfr-chloranilic acid.	Nil	1:1	73	0
20.	99	Acetic acid	1:1:1	89	0
21.	99	Pyridine	1:1:0.15	0	95
22.	>9	Piperidine	99	0	88
23.	99	2:4-Lutidine	99	0	84
24.	)9	Collidine	99	0	69
25.	9)	Triethanolamine	\,,	0	69
26.	99	Pyridine acetate	99	0	99
27.	»9	Piperidine acetate	99	0	99

In all cases the temperature maintained was 100o and time 4 hours.

Table IV

With 3\4—Dichlorobenzddehyde

No.	Acid	Condensing agent	Mol. prop.	Yield 1% Acid	Yield 1% Chloranilide
1.	Malon-o-chloranilic acid.	Nil	1:1	87	0
2.	5l	Acetic acid	1:1:1	95	0
3.	99	Pyridine	1:1:0:15	0	88
4.	99	Piperidine	*>	0	92
5.	99	2:4-Lutidine	) j	0	85
6.	j .	Collidine	9,	0	**52**
7.	}9	Triethanol-amine	)9	0	46
8.	9J	Pyridine acteate	99	0	95
9.	99	Piperidine acetate	9)	0	97
10.	Malon-m-chloranilic acid.	Nil	1:1	81	0
11.	;J	Acetic acid	1:1:1	95	0
12.	‹>	Pyridine	1:1:0:15	0	88
13.	99	Piperidine	99	0	90
14.	99	2:4-Lutidine	j J	0	78
15.	o	Collidine	,,	0	65
16.	)L	Triethanol-amine	9)	0	52
17.	99	Pyridine acetate	))	0	92
18.	99	Piperidine acetate	99	0	95
19.	Malon-^-ch'oranilic acid.	Nil	1:1	81	0
20.	,,	Acetic acid	1:1:1	97	0
21.	99	Pyridine	1:1:0.15	0	92
22.	59	Piperidine	99	0	92
23.	9,	2:4-Lulidine	i),	0	82
24.	' # 9)	Collidine	j« * 9	0	59
25.	,,	Triethanol-amine	j)	0	56
26.	,,	Pyridine acetate	‹>	0	95
27.	»9	Piperidine acetate	>>	0	96

In all cases the temperature maintained was 100o and time 4 hours.

Table V

With 2\4—DichlorobenzaIdehyde

No.	Acid	Condensing agent	Mol. prop	Yield 1%	
				Acid	Chloranilide.
1.	Malon-<?-chloranilic Acid	Nil	1:1	86.5	0
2.	,,	Acetic acid	1:1:1	99.3	0
3.	99	Pyridine	1:1:0.15	0	91.6
4.	99	Piperidine	,,	0	95
5.	,,	2:4-Lutidine	,,	0	78.5
6.	,,	Collidine	,,	0	65
7.	,,	Triethanol-amine	,,	0	52
8.	99	Pyridine acetate	,,	0	98
9.	,,	Piperidine acetate	,,	0	98

In all cases the temperature maintained was 100° and time 4 hours.

SUMMARY

Malon-0-, m-and *p*- chloranilic acids were condensed with 0-chloro, />-chloro, 2:4-dichloro and 3:4-dichlorobenzaldehydes. Condensing agents like glacial acetic acid and traces of various organic bases were used. A trace of pyridine or piperidine was found to be the most efficient catalyst in these condensasions. Two products were obtained from the condensation of each aldehyde, (a) the corresponding benzylidene malon chloranilic acid and (b) the corresponding cinnamchloranilide. The yields in all cases were almost quantitative.

REFERENCES

1. Lock and Bayer. 1939. Ber., 72:1064.
2. Meyer and Beer. 1913. Monat., 34:651.
3. Meyer, Beer and Lasch. 1913. *Ibid.* 34:1654.
4. Pandya, K. C. and MissPandya. 1943. Proc. Indian Acad Sci., 73:112.
5. Pandya, K. C. and Miss Pandya. 1943. *Ibid.,* 7:17.
6. Stuart, C.M. 1888. Ber.*53*:144.

PAPYROGRAPHIC EXAMINATION OF SOLUBLE CARBOHYDRATES IN SIXTEEN VARIETIES OF APPLES CULTIVATED IN KUMAON REGION

By S. C. GUPTA, M. SC, Ph. D. and D. R. GUPTA, M. SC.; *Th. D.S.B. Government College, Naini Tal.*

INTRODUCTION

A large number of varieties of apples are widely cultivated in Kumaon region, some of them are very sweet while many others are with sour taste. The present investigations were undertaken in order to examine whether the sugars in different varieties of apples were the same or different.

EXPERIMENTAL

Sixteen varieties of 'edible ripe' apples with different tastes were obtained in the month of September. Juices were extracted by crushing small pieces of apples in glass mortar and clearing the extracts by centrifuging for 10 minutes at 4,000 r. p. m. Only 0.004 ml. of juice was spotted on Whatman No. 1 filter paper (larger quantities of the fruit juices often resulted in streaking of the spots). Chromatograms were developed for 24 hours at room temperature (18°-21° C) by descending technique of paper chromatography.

The upper layer of n-butanol-acetic acid-water (4 : 1 : 5, v/v) was used as solvent phase. After development the chromatograms were air dried, sprayed with benzidine reagent (0.5gm. benzidine, 10 ml. acetic acid, 10 ml. 45 % trichloroacetic acid and 100 ml. 95 % ethanol), again air dried and the spots of sugars were located by heating the chromatograms at 90°C for 5 minutes.

Though Rf values of different sugars were determined, yet to avoid any error due to variation in room temperature, a number of sugars were also spotted on the same chromatogram along with the fruit juices.

The Rf values of differnt sugars are shown in table **I**

Table I

R_f values of sugars at 18°- **21°** C.

Name of sugar	Rf **value**
Raffinose	0.026
Maltose	0.072
Sucrose	0.12
Glucose	0.18
Fructose	**0.24**
Xylose	**0.30**
Ribose	**0.33**

The names of different varieties of apples which were examined and sugars found in each of them are shown in table II.

Table II

Sugars present in different varieties of apples

S. No.	Name of apple variety	Sugars
1.	Blim orange pippin	Sucrose, glucose & fructose
2.	Buckingham	-do-
3.	Court land	-do-
4.	Delicious	-do-
5.	Esopus spitzenberg	-do-
6.	Gano	-do-
7.	Jonathan	-do-
8.	King Davis	-do-
9.	King of pippin	-do-
10.	King of tomkins county	-do-
11.	Norfolk	-do-
12.	Red Rome beauty	-do-
13.	Rymer	-do-
14.	Syke's house russet	-do-
15.	Winter banana	-do-
16.	Yellow newton pippin	-do-

SUMMARY AND CONCLUSIONS

Juices of sixteen varieties of apples, commonly cultivated in Kumaon region, showed the presence of sucrose, glucose, and fructose irrespective of their taste.

A STUDY ON CERTAIN MICROORGANISMS IN POULTRY WITH SPECIAL REFERENCE TO THE OCCURRENCE OF *SALMONELLA, PLEUROPNEUMONIA-LIKE ORGANISMS* AND *CANDIDA* IN INDIAN CONDITIONS* -

By R. C. PATHAK, *Department of Pathology and Bacteriology, U. P. College of Veterinary Science and Animal Husbandry, Mathura, U. P. [India).*

The study was undertaken to investigate the incidence of some of those infectious agents in the fowl, which apart from their disease significance to the poultry husbandry, have either public health importance or about which little information is available in India. As such the opportunity of having the material from the birds of the College Poultry Farm was utilized as far as possible, to study the occurrence of *Salmonella, Pleuropneumonia-like organisms* and *Candida* in fowls in Indian conditions.

Bacteriological examination carried out in this study on the carcases of fowls submitted by the College Poultry Farm, for routine post-mortem examination, to the Department of Pathology and Bacteriology of U. P. College of Veterinary Science and Animal Husbandry, Mathura, during the session 1958-59, resulted in the isolation of two Salmonella serotypes *viz. S. dublin* and *S. enteritidis* which are of rare and unusual occurrence in poultry.

The findings on the study of the members of the family *Enterobacteriaceae* in relation to the yolk flora in chicks, autopsied showing unabsorbed yolk sac revealed that the main types of bacteria contaminating the yolk are of the types usually present in the alimentary tract of the birds. The general cleanliness and disinfection of the surroundings and the equipment with which baby chicks come in contact in early days of their life can, possibly , check the high mortality due to yolk sac contamination.

Pleuropneumonia-like organisms *{PPLO)* could be isolated from the trachea and air sacs of the fowls autopsied, showing typical lesions like that of the so called chronic respiratory disease *(CRD)*. *PPLO* were also isolated from the adult fowls of the breeding stock maintained at four different Government Poultry Farms of the country. This finding shows that *PPLO* are widely prevalent in India.

Evidence that *PPLO* are egg transmitted, has been presented on the basis of the findings, that *PPLO* could be isolated from the breeding stock, their progeny chicks and some of the embryos in their hatching eggs.

The liquid carbohydrate medium containing 20% sterile horse serum used in this study appears to be a suitable medium, for the primary isolation of avian *PPLO* and has been found to be a simple, economic and efficient

•This is an abstract of the thesis submitted for the degree of M.V.Sc. in Advanced Bacteriology of the Agra University by ihe Author.

medium in the rapid isolation of *PPLO* in field conditions with a little laboratory establishment.

Results of the study of the characters of the *PPLO* isolated in this investigation indicate that :

(i) the sugar fermentation reactions of the avian *PPLO* are quite variable.

(ii) there are two types of *PPLO* found in poultry, one rapidly growing, giving bigger colonies and the other slow growing, giving smaller colonies.

(iii) according to serology two types of avian *PPLO* are recognised HA + and *HA*-.

The most prominent pathological findings in the dead birds, which gave isolation of *PPLO* from the trachea and air sacs, included catarrhal exudate in the trachea and nasal sinuses and slight to extensive deposits of cheesy material in the air sacs. Tracheal mucosa showed tubular mucous glands, hyperplasia and lymphofollicular infiltration. Exudation, lymphofollicular infiltration and localised aggregations of large mononuclear cells were obser* ved as typical tissue reactions of lungs and air sacs.

The attempt to study the incidence of *Candida* in the crops of fowls routinely autopsied resulted in the isolations of five species of Candida *viz. C. albicans,* C. *tropicalis, C. krusei, C. parakrusei* and C. *stellatoidea.* The isolation of *C. tropical%s*$_9$ *C. parakrusei* and C. *stellatoidea* from the fowls in this study probably is being reported for the first time. There were isolated two strains of *Candida* which did not conform to any of the common species of Candida encountered in man.

The results of the study indicate that the incidence of *C. albicans* is higher in older birds. The affected crops revealed erosion and disruption of the lining of epithelium with invasion of the hyphae of the fungus deep into **stratum** corneum*

STUDIES ON STAPHYLOGOCGI WITH PARTICULAR REFERENCE TO STRAINS FROM BOVINE UDDER*

By BRAHMA SINGH MALIK, *Department of Pathology and Bacteriology, U.P. College of Veterinary Science and Animal Husbandry, Mathura, U~P. (India).*

Two hundred and sixty-one strains of Staphylococci comprising 167 from bovine normal and abnormal milk samples, 10 from caprine mastitis cases, 1 from a case of ovine abscess, 80 from milkers acting as normal carriers and 3 from Pathological lesions in human beings were studied. Of these 139 strains were isolated at Mathura, 15 were obtained from Lucknow, 29 were received from Madras and rest 9 were supplied from Calcutta. These strains were subjected to various *invitro* and *invivo* tests, adjudged as criteria, by earlier workers in establishing the pathogenicity of this organism. Phage typing and serological classification which are new avenues in the field of Staphylococcal research in India were attempted. Drug sensitivity trials using penicillin were also carried out.

Fibrinolysin test, phosphatase activity, gelatin liquefaction and sugar fermentation reactions were inconclusive to establish any definite correlation within themselves or with other important *invitro* characters like coagulase production, haemolysin production and pigment production.

Regarding coagulase test rabbit plasma was found to be the>most suitable while plasmas from horse, sheep, goat and cow and finally buffalo gave comparable results in the sequence mentioned. Plate technique of coagulase test gave results nearly equal to tube test and possessed several advantages. The results with slide technique were inconclusive.

On the basis of Pathogenicity trials, it was found that about two-third of alpha-toxigenic strains were lethal to mice by virtue of their toxins while about one-third of alpha-beta toxigenic strains were lethal by culture virulence test.

No absolute correlation was observed among golden yellow pigment, coagulase and haemolysin production ; although 91*7% of coagulase positive and 93-6% of haemolytic strains were golden yellow in colour. Among bovine strains 93'7% of coagulase positive strains were haemolytic and 95*7% of haemolytic strains were coagulase positive.

It appears that coagulase production coupled with haemolysin (alpha and/or beta) is strongly indicative of pathogenicity. However, absence of any^ one of these does not altogether exclude the possibility of occasional strains* being pathogenic.

•This is an abstract of the thesis submitted for the degree of M. V. Sc. in Advanced Bacteriology of the Agra University.

Majority of the strains included in this study were penicillin sensitive (11% showed resistance to penicillin concentration varying from 0*5-50 units per ml.).

Sixty-three coagulase positive and 17 coagulase negative strains were subjected to phage typing with the help of 10 standard phages, (6,42 D, 42 E, 42 F, 44, 52, 78, 105, 107 & 111). Out of 44 coagulase positive bovine strains over 86% were classified into 4 phage types. It is interesting to note that all the typable strains were susceptible to phage 42F. None of the other strains excepting 2 human ones could be typed.

All the 44 coagulase positive bovine strains as mentioned above were serologically tested by slide agglutination test with the help of 5 group factor sera (ac, a, b, c, and e) and 3 specific factor sera (h, i and k) prepared against Oeding's (1952) type strains. About 71% of the strains were divided into ** different serological groups. Among typable strains 45'2% belonged to serological group 1 (a b e) ; 9*7% to group 2 (a b) ; 25*8 % to group 3 (a b c) and 19'3% to group 4 (a b c e). The comparison of phage typing and serological typing revealed little correlation.

•Oeding, P. (1952). Acta. Path. Microbiol. Scand. Suppl. 93,356.

A NOTE ON AN ABNORMAL INFLORESCENCE OF ZEA MAYS L.

By **R. L. PALIWAL, M. SC, Ph. D. and A. K. KOUL, M. SC,** ***Department of Botany> B. R. College, Agra.***

Corn is unique for not only bearing specialized typr of rrale and female inflorescences but also for the plasticity the two types of iafloiescences show during development. This plasticity is in some way responsible for the occurrence of several types of anomalies. The production of fasciated and furcated ears, ears branched irregularly at the base, and ears showing a good lot of irregularity in rows of grains (Reeves & Stansel 1940, Reeves 1950, Sprague 1955 Tondon 1955) are already on record. The present anomaly, however, is unlike any recorded so far.

The inflorescence reported herewith (Fig. 1) arises as a terminal **:56cture, branched like a normal tassel, consisting of a central spike and several lateral branches. The lower half of the central spike is like that of a normal tassel '* in being thin and bearing several rows of paired spikelets, most of which are male while only a few are mixed ones. The upper half forms the abnormal part of the inflorescence and looks like the central axis of an ear, being thick and fleshy and bearing condensed male or mixed spikelets. It is thickest at the top and tapers downwards, a condition just the reverse of what is found in normal female axis.

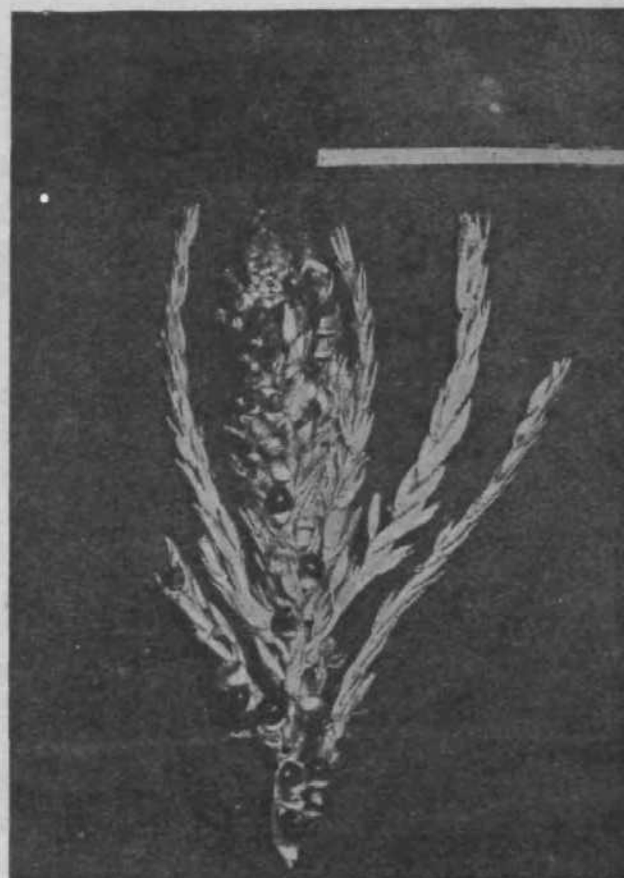
The branched nature of the inflorescence is a strong evidence against its being an ear. Branched cobs are, however, on record (Sprague, 1955), but they are more or less fasciations and furcations. This inflorescence possesses branches almost as long as the central spike, just like the' lateral spikes of a normal tassel.

The inflorescence possesses lateral branches arising sprially at the base, with the spirals wider below than above, so that they become whirlled higher up. The male spikelets borne by these branches are paired as usual, each pair consisting of a sessile and a pedicelled spikelet. In the basal most spikelets, the stalk of the pedicelled spikelets is bent downward* forming a 'U' which brings the two spikelets at the same level. It is interesting to find that at several places the sessile spikelet of the pair is replaced by a female flower, a condition also reported by Tondon (1955). In such cases the male as well as the female flowers are fertile, and selfing results in the production of grains of fairly good size. The central spike also shows all these variations.

With male and female flowers of normal fertility situated side by side the chances of selfing to occur in nature are greater, and inbred seeds could, therefore, be obtained by simply bagging such abnormal inflorescences. From this point of view such abnormalities are of profound interest to a corn breeder.

Besides they may be found helpful in throwing some light on the unsolved riddle of the origin of the ear of corn.

Our sincere thanks are due to Prof. Bahadur Singh for suggestions and going through the manuscript.



SILK

Fig. 1. Ahnormal terminal inflorescence

REFERENCES

I^EVES, R. G. 1950. Morphology of the Ear and Tassel of Maize. Amer. Jour, Bol. 37 ; 697-704.

REEVES R. G. & STANSEL, R, H. 1910. Uncontrolled vegetative development in Maize and Teosinte. Amer Jour. Bot. 27 ; 27-30.

SPRACUE, G* F. 1955. tn "Corn and Corn Improvement". Edited. Academic pres; Inc. New York.

TONDON, S. I* 1955. Abnormalities in the Ear of $Z^{ta\ ma}y$* L. Jour. Bombay. Nat. History Soc. 52 ; No. 4.