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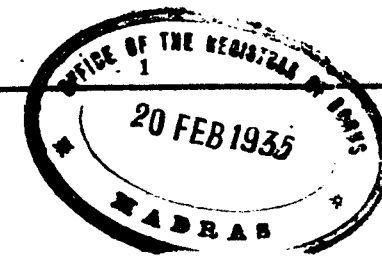
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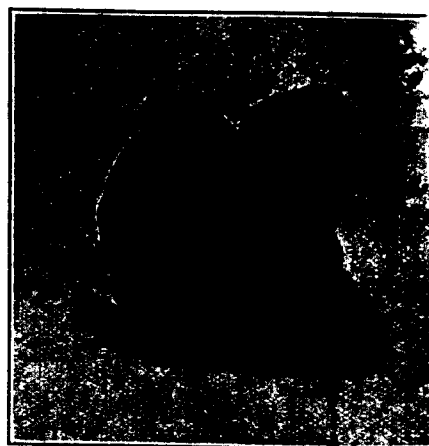
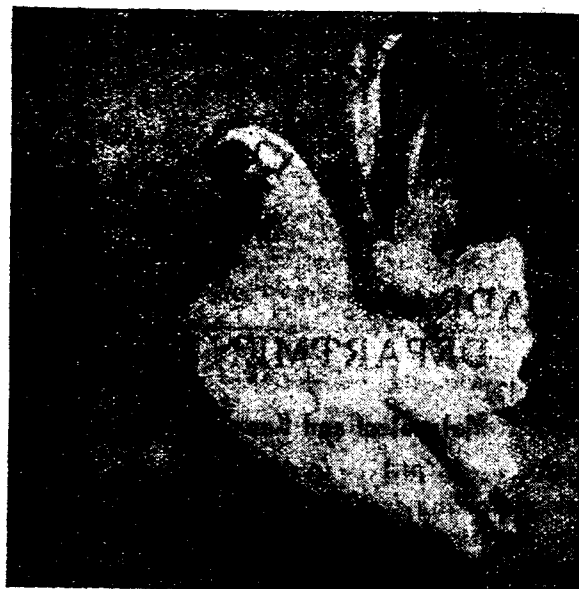
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Editorial.

Livestock in Health and in Disease. "What is the good of concentrating on strong reins to drive a horse or on rubber-tyred wheels to make the carriage comfortable if the horse is so weak that he cannot pull the carriage, or the carriage so frail that it falls to pieces directly anybody sits in it." So said our Viceroy, Lord Irwin, than whom the Indian farmer had no warmer sympathizer. These words were uttered to drive home the importance of animal husbandry to Indian national well-being.

In 1931 Madras had nearly 47 million human beings. In 1930 there were about 16½ million oxen, 13 million sheep, 7½ million goats, 6 million buffaloes, 130 thousand donkeys and 40 thousand horses, moving round about this human throng. Add to this, innumerable mules, pigs, geese, poultry, turkeys and various other domestic animals and it becomes unrealisable in what a crowd of animal beings the human being is enmeshed. A goose lives for 80 years, horse 35, buffalo 25, cattle and pigs 20, goat 15, hen 14, and sheep for 10 years. Many lives of these livestock are thus in a concurrent run with a generation of human lives and as such are in-eliminable factors in the life of man and his well-being.

Dumb as these livestock are, and living as they do lives nearer nature, they have been more the subjects of exploitation in health, than objects of attention in disease. Veterinary science is thus a development later than that of cattle breeding. When man conquered nature, cleared forests, domesticated animals and depended on their support for his well-being, he laid the foundations of the above sciences, that are this day contributing so much to human happiness. They signalize man's efforts to get over the dangers of his existence on earth as a dominant entity. The problems of animal health and welfare are thus intertwined with those of man and his well-being. The position is poignantly so with the agriculturist.

The millions of our cattle, some of them of the finest of breeds in the world, do not all represent a business proposition. The waste of expenditure incurred in India on useless cattle was computed to be something in the neighbourhood of 60 crores of rupees, an amount about equal to that spent on the Army. In any other country the unfit animals would have been slaughtered, but in India where of the triple utility, work, milk and meat, the last is the least, such a course is not easily possible. Mr. Smith has urged that the Indian cultivator cannot even afford to have both buffaloes and cattle, the former for milk and the latter for work. He urged that it will be more economic to have cattle alone and breed them for the dual purpose of work and milk. Against this ideal, the experiments in cross-breeding with foreign blood runs quite counter and has elicited the recent well merited verdict "that the results hitherto achieved in the crossing of indigenous breeds with foreign breeds indicate that this system of improving livestock in India does not produce results of a permanent nature and is not suited to the ordinary condition of the country." The grading up of local breeds is thus imminent and we urge with all the persuasion at our command the revival of the cattle breeding station for Ongoles—a breed that has a world wide reputation.

Concurrently with this, efforts should be made to mitigate the multiplication of our useless animals and the elimination of the drain that they are, in the feeding and upkeep of the good ones. The practice of dedicating scrap animals to the temple, which later on turn out to be the breeding bulls of the village should be modified and with an organization like the Hindu Religious Endowment Board, it should be possible to get into a working arrangement by which, such dedication is confined to good pedigree calves supplied by cattle farms. All animals of dubious parentage should be castrated as they are thus replaced. The action of the Punjab Government in empowering District Boards to frame regulations for the castration of scrub animals could usefully be followed by us.

The efforts of the State at cattle improvement are not enough. In England gentlemen farmers have taken the lead in cattle breeding.

They have thus shown a considerable spirit of service to the farming community and to the State. The State by itself cannot do all that is indicated as necessary in this direction. In Madras except the isolated instance of the Pattagar of Palayakottai, there are no noteworthy endeavours in this direction. It is time the fact was brought home to our landed magnates that their wealth and opportunities are merely a trust which has both privileges and responsibilities and that one of the most potent ways in which they could function towards their country and discharge their debt to their bretheren in agriculture is to provide them with good breeding bulls that will enrich their stock of work and milk animals.

Livestock are a remarkable vehicle for the conversion of earth's vegetative growth into food that has become indispensable to man. Meat, milk and eggs are some of these. Our civilization has become complex and the production and distribution of these involve organization, centralization and hygienic supervision. In the side of medicine, humanity is becoming more and more dependant on glands and other parts of animals for the treatment of diseases. The manufacture of anti-toxins and serums needs organized production and control, so that animal products can be standardised and be made safe and dependable.

Diseases due to malnutrition are as common among animals as among men. Rotational grazing is recommended. But above all, researches into grasses have to be initiated and a systematic attempt to handle herbage should be made. With a proper handling of the nutritional aspects of animal health, much of the troubles in connection with animal disease will be successfully tackled.

Diseases that man has to fear through animal infection are anthrax, rabies, tuberculosis, and innumerable other parasitic infections. The degree to which these are controlled among animals will provide the measure by which he could successfully ward them off from his ambit. It is therefore becoming imperative that the maintenance of animal health is a *sine qua non* to that of keeping up human health.

Veterinary education is centred in urban areas. It loses that benefit which comes to it with the intimate touch with livestock which rural areas give. It has therefore been urged that to mitigate this want of intimate contact, model dairies should be attached to Veterinary Colleges. The initiating of riding classes has also been recommended. These measures connote antidotes to the tendency of a mere academic contact with animals and in a measure rectify a vital defect. The need for an Institute of Veterinary Research for our province is keenly felt and it is our hope that parallel to agriculture and in proximity to it, there will soon be established, a centre of Veterinary Research.

A new orientation in our outlook is indicated as a necessity. The usual view of looking at veterinary service as merely an instrument of preventive and curative medicine should cease. The problem of disease should be viewed from the bigger back-ground of Animal Health. The maintenance of animal efficiency in health should be the major issue. What the future Veterinary Officer should be is best surmised in the words of Sir Daniel Hall "We want to see a class of men who have charge of a district, who are thinking about the horses, the cattle, the sheep and the pigs and how to keep disease away from them. Naturally, they will have to know about the endemic diseases, but breeding, environment, nutrition, and other factors in hygiene will be equally important." Such a concept may be very long before it is realized in India; but the creating of a post of Rural Commissioner that we have advocated will hasten this consummation.

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STUDIES IN *PASPALUM SCROBICULATUM*, L. THE KODO MILLET

By G. N. RANGASWAMI AYYANGAR, B.A., I.A. S.,
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AND V. PANDURANGA RAO, M.A.,
Assistant, Millets Breeding Station, Coimbatore.

The Kodo millet, *Varagu* (Tamil) and *Arika* (Telugu), occupies an area of well over a million acres in the Madras Presidency. The grain of this millet is easily preserved and proves a good famine reserve. It is a poor man's food. The crop is very drought-resistant. Only well-matured grains should be husked and used as food. Husks and immature grains are poisonous. This millet is considered safer for use as the grains get old. Both as food and fodder the crop is poor. While the crop is ripening it is considered dangerous to graze animals on it. This millet is grown mostly rain-fed, though in small areas under irrigation also. Trichinopoly and South Arcot districts have over 170,000 acres each; Kurnool, Nellore and Ramnad have each over 90,000 acres. The Nilgiris, Malabar and South Kanara are the only districts in which this crop is not grown. About 21,000 acres are raised under irrigation. Of these Coimbatore, Ramnad, Madura and Kurnool have about 13 thousand acres. This millet yields on an average 800 lb. of grain per acre with a range of 400 to 1200 lb. according to the tract. The yield of straw is about 1000 to 2000 lb. per acre. The straw is used as a manure in alkaline lands. This millet has been under study at the Millets Breeding Station and the following summarise the knowledge so far gained.

Seedlings. The seeds of this millet have a thick husk which is about 40 per cent. of the seed by weight. It is, therefore, slow in germination. On the fifth day after sowing are seen the first signs of sprouting. A single long leaf is visible and no stem is in evidence. All leaf-sheaths and under-surfaces of leaves are densely hairy. The mesocotyl is smooth with no rootlets and dries up soon. It is capable of elongation adjusting to varying depths of sowing. It is unpigmented though the adult plant develops purple pigment. When the seedlings are a fortnight old, the first secondary root makes its appearance. Secondary roots are also unpigmented.

Adult Plants. These are usually erect, and occasionally spreading or prostrate in habit and are 1 to 2½ feet in height. They differ in their leafiness. In a good leafy plant the leaves are broad and numerous and give it a dense, bushy appearance. Less leafy plants have narrow leaves giving them an all-stem and little-leaf look. The nodes are swollen or not according to varieties. The first node is hairy and the other nodes are glabrous. In a few varieties villous upper

nodes are met with. The internodes are solid. The length of internodes increases gradually from bottom to top in any tiller. The internodes, in most cases, are fully ensheathed. The number of tillers in varieties varies from 5 to 18. The early tillers set well. The later ones are more sterile. Nodes touching the ground strike root. They ascend from a prostrate and rooting many-noded base; simple or sparingly branched, usually five-noded. The leaf blades are linear to lanceolate-linear; equally wide or slightly constricted at base; glabrous; margins scabrid; smooth on either surface, broad or narrow; erect, arched or bent. The arched condition is associated with the broad leaf which droops and gives the plant its characteristic appearance. Narrow-leaved plants have very few bent leaves. The leaf is usually of a dark green colour. A few varieties have light green leaves. The midrib of the leaf is white or dull green in colour. The ligule is membranous, colourless, broad or narrow. The junction of the leaf blade and sheath is usually covered with a felt of long hairs. Rarely such hairs are short. The leaf tip remains green in most varieties but in some it dries up to brown even before the heads ripen. The size of leaf varies with the varieties and a considerable range in their length has been noted resulting in differential habits.

Purple Pigmentation. This manifests in seedlings as a purple wash. With the growth of the seedling and the elongation of the leaf-blade, leaves begin to bend and from the bend to the tip there is a wash of purple. At a further stage of growth when the basal nodes show out, their nodal bands take on the pigmentation. With increased growth, such bits of internode as the intense ensheathing leaves bare, begin to have a wash of purple more of self colour and less of lines. Leaf junctions, axils and leaf margins are purple coloured. In some the tips of glumes develop purple. The stigmas show grades of purple ranging from dark to very faint purple. In the anthers purple rings and dots are developed on a yellow background. Anthers without any easily noticeable purple pigment occur occasionally. The stigmas and anthers dry to a brown colour of grades which parallel the depth of purple in them. After the flowering is over, the panicle branches get liberated from the sheaths and the peduncles also get coloured purple. The optimum manifestation of the purple pigment is from the flowering to the milky stage of the grain, after which there is a falling off. Advancing age, however, loosens out the internodes from the clasp of the sheaths and these together with prominent nodal bands retain the purple pigment as long as they continue to be sappy. Looked at *en masse* this field crop has a characteristic violet look. Though all the varieties are purple pigmented, the depth of colour varies. In some the colour is so much reduced that only a very careful examination reveals the pigment in odd parts.

Panicle—Emergence. The panicle arises usually from the fourth node. The first sign of the growing panicle is a slight bulge in the

leaf-sheaths. The swelling increases gradually and the panicle is seen through the sheath slit. It takes about a week for it to emerge. When fully emerged it is enclosed by three overlapping leaf sheaths, which inroll one inside another at the tops. The flag and the leaf below it, likewise inroll at the top and, in most cases, do not separate even when the panicle is in full flower. In the inrolled region mentioned above the ends of the inflorescence remain stuck up. The upper end thus fixed, the floral branches, as they elongate, bend outwards at the centre. The enclosing leaf-sheaths are forced apart by the rapid growth and consequent arching of the panicle until thereby the tips are also forced out. This is the general rule but in a variety imported from Sierra Leone, the peduncles clear out of the leaf-sheaths, elongate and hold the panicles aloft and away from the leaf-sheaths.

Panicle—Arrangement. Excepting the lower three nodes, the other two bear panicles. From each of the two upper nodes three separate peduncles arise. Of these the central one aborts and the two lateral grow. The abortive one bears a sessile panicle. This panicle may contain one or two branches bearing rudimentary spikelets. Of the two free growing peduncles one grows quickly and shows out earlier than the other. The earlier is always bigger and has more spikelets and less of sterility. In the later peduncle the spikelets at the tips of the branches are usually sterile. Each of these peduncles gives rise to three branches one of which aborts, the other two showing a likewise differential growth and development. These branches repeat this trimerous process until small spikelet-bearing branches of differential size arise and produce flowers. In this ultimate trimerousness some of the abortives get converted into long stalked single flowers. The weaker flower-bearing branches are mostly unbranched, whereas the stronger ones branch out and bear a larger number of flowers. The largest number of spikelets in a branch may be as many as 100.

Panicle—Branches. Each branch has a broad, flat rachis with a series of depressions corresponding to the situation of the spikelets. On the side on which the spikelets are situated, a central ridge runs along the entire length. On either side of the ridge the spikelets are arranged alternately in two series on short pedicels. In some varieties instead of the usual two-seriate condition, a branching of the pedicel gives rise to a non-seriateness, the spikelets being irregularly arranged. At the base of the branch it is two-seriate; in the middle the non-seriate condition prevails; and towards the tip the two-seriateness continues. The non-seriate condition is found in some cases along the entire length of the branch. Other variants to the simple branching of the pedicel and the production of two flowers are the following:—(1) the pedicel instead of forking into two, branches into three, each bearing a spikelet. (2) It may bear more than four flowers at different

levels. (3) Small branches arise at different levels on the ridge of the branch and these bear a fairly large number of flowers. In addition to the crowding induced by the branching of the pedicel, the double seededness of such non-seriate heads is the most important factor in the crowding and small size of the grain in the earheads that are not two-seriate. The disturbance of two-seriateness brings about a dense packing of spikelets on the flat rachis and contributes to the reduction in the size of the spikelets. Consequently the spikelets in these are $\frac{1}{3}$ to $\frac{1}{2}$ the size of those in the two-seriate panicles. It may be observed that the non-seriate varieties are early, lighter pigmented with grains of a lighter brown husk.

Spikelet—Single Seeded. The description of this spikelet has been elaborated from Hooker's Flora of British India in which a description of the variety with double seeded spikelets is not found. Spikelets orbicular, mostly decidedly plano-convex, falling entire from the short rudimentary pedicels and abaxial on the dilated rachis of spike-like racemes.

- Glume I. o (suppressed.)
 Glume II. More or less equal to the spikelet; convex; membranous; light green; deciduous; glabrous; 5-6 nerved.
 Glume III. Similar to Glume II, but less convex and more flat; light green; thin; glabrous; deciduous; 2-5 nerved; along the inner margins are seen shallow transverse pits whence the specific name "*scrobiculatum*."
 Glume IV. Horny; pale green; later develops a light or dark brown colour; glabrous; 5 transparent nerves; margin firm; obtuse; emucronate; persistent.
 Palea. Tightly embraced by the narrowly involute margins of Glume IV; similar in substance to Glume IV; 2 transparent nerves; the palea with flaps widened into a broad auricle below the middle; persistent.
 Stamens. Three; filaments short, 1 m. m. long, anthers-3, 2-3 m. m. long; 2-loculed; locules open by longitudinal lateral sutures
 Ovary. Oval; translucent; stigmas-2, styles distinct and laterally exerted near the tip of the floret; styles feathery from one-third the length from the apex.
 Lodicules. Two; fleshy; serrated tips; broadly cuneate.
 Grain. Tightly enclosed by the slightly hardened glume and palea; rotundate-elliptic; very convex in front, flat on the back; pale; scutellum up to half the length of the grain.

Spikelet—Double Seeded. In the double-seeded spikelet, between Glume II and palea of Glume IV an extra flower is interpolated. It is enclosed in an extra glume and palea. This extra flower develops seed, each spikelet thus having two seeds. Abortive conditions of this double seededness freely occur interspersed with this double fertility and arise as follows. An extra flower is developed between Glume II and palea of Glume IV. It is a perfect flower and has only an extra palea. It does not set seed.

Opening of the Flower. The opening of the first flower is generally on the second day after the emergence of the panicle. This

flowering begins between 2-30 and 3-0 a. m. on each day and continues till sunrise. Youngman and Roy (1923) note that these flowers open between 7-30 and 8-0 a. m. at Nagpur. Flowers do not commence to open from any definite region. They usually start from the middle of the floral branch and gradually spread to either ends. Instances in which flowers begin to open at either end are met with occasionally.

Anthesis of a Flower (anthers extruded). Detailed observations on the anthesis in a normal average flower are recorded below showing the trend of sequence.

2-30 a. m.	Glumes begin to open.
2-40 "	Anthers visible through opening.
3-15 "	Anthers emerge.
3-30 "	Anthers completely out.
3-35 "	Anthers dehisce.
3-45 "	Glumes close completely.

The stigmas may or may not come out of the glumes. When the glumes begin to gape the anthers crowd at the orifice and are undehisced. They are mostly non-emergent. Their filaments are 1 mm. in length. In stray cases anthers emerge, their filaments being 6 mm. long. These filaments remain turgid for a long time, often till 8-9 a. m. The anthers may emerge simultaneously or one by one or two at a time followed by the third. This stray emergence accounts for the paucity of evidences of flowering in this unobtrusive millet. When the anthers remain inside the flower, their dehiscence takes place long after the opening of the glumes. Dehiscence starts as a slit at one end and gradually spreads or it begins in the middle and proceeds to the ends. The stigmatic feathers dry in the evening. The anthers remain fresh and do not wither till next morning. The lodicules are fleshy and do not shrink immediately after the anthesis of flowers but remain fleshy for 6-8 hours after the opening of the glumes and then dry up—a probable device preventing the closing glumes from jamming the anthers.

Progress of Flowering. The following table connotes the daily anthesis energy of the 15 per cent of flowers opening during the flowering period, emerging and non-emerging anthers included.

Day of Flowering.	2-3 a. m.	3-4 a. m.	4-5 a. m.	5-6 a. m.	Total.
First Day	14	1	1	—	16
Second Day	2	10	—	1	13
Third Day	7	11	—	—	18
Total.	23	22	1	1	47

N. B. 15 per cent of the flowers in the head opened. The remaining 85 per cent were cleistogamous.

It will be seen that all the flowers in the head do not open. The percentage of open flowers in the varieties varies from nil to 50 per cent., the most frequent being 10 to 15 per cent. This millet is

therefore highly cleistogamous which explains the complete absence of natural crossing in it. Any artificial manipulation of the spikelet irretrievably damages it and many attempts at emasculation and artificial pollination proved futile.

Grain. The grain matures in 30–35 days after flowering. It is tightly enclosed by the hardened fourth glume and its palea. The husk is coloured shades of brown. In the two seriate varieties, the grain is bigger and nearly twice the size of those in the non-seriate ones. In the variety imported from Sierra Leone (referred to above), though the head is two-seriate, the grain is small. The degree of emergence of the heads has no effect on the setting of the seed, both having about the same degree of sterility. In this millet seed-setting is dependent on the season. In the year 1928, the drought affected the seed-setting in some varieties to such an extent that not even a few grains per plant could be obtained. Under favourable conditions good yields can be expected.

False Polyembryony. In the year 1931, in the course of a number of seed germinations for albinism in this millet, two instances of two seedlings arising from a single seed were noticed. The seedling had a single root and two plumules each with its own coleoptile. At the surface of the seed, the two were separate. Paraffin sections of the seed showed that the plumules had independent vascular bundles. Lower down, the cortical portions of the two shoots were found to unite, the bundles running separate. In a few sections lower down, the vascular bundles were closer and approached each other until finally they became enclosed in a single endodermis. Sections still lower down showed the root strand run into this single bundle. From this examination of the course of the vascular bundles and also of the cortical region, it will be seen that what appears to be independent at the top is, in reality, the result of the branching of a single seedling. At a very early stage in the development, the mesocotyl has branched into two, resulting in the double seedling—a case of false polyembryony. Cases of pseudo-polyembryony have been recorded by other workers. Only those pertaining to the Gramineae are noticed. In maize, Kiesselbach (1926) noted seedlings with (1) two plumules each with its own coleoptile and two primary roots enclosed in a single coleorhiza, (2) a single plumule with two primary roots in a single coleorhiza. In the case reported here, there are two plumules each with its own coleoptile but with a single radicle.

Paspalum Sanguinale, Lamk. Several species of Paspalum, especially *P. dilatatum* are grown in America, Australia and South Africa as pasture grass. A wild ally of Paspalum known as *Chicco* (*P. sanguinale*, Lamk) is grown in the Vizagapatam District. This was grown at the Millets Breeding Station for a number of years and the following notes are appended.

The seed which is very small takes 7 days to germinate, two days later than for *Varagu*. Unlike *P. scrobiculatum*, the seedlings are green and have no purple pigment anywhere in the plant. Before flowering the plants are spreading and almost prostrate. The panicle-bearing tillers become erect at flowering. Unlike *Varagu* the internodes are hollow and much exposed. At ripening stage they have a golden yellow colour. The nodes are glabrous and not swollen. The flag is the broadest leaf in the plant. The upper surface of leaves is rough and the lower is smooth. The leaves are arched and not bent. The plants have five to six heads with long well emerged straight peduncles. Occasionally their fullness leads to goose-necking. The panicle has a general resemblance to that of a well grown *Chloris barbata*. It consists of a number of fingers (or branches) arranged in irregular whorls along a short axis. An average earhead may have about 40 fingers. The bulk of these arise from the two bottom whorls, the rest of them being distributed to those above, mostly in twos and threes. Each finger may have about 100 flowers. The spikelets are arranged alternately in clusters of one to three. The spikelets are very small, the length in each being four to five times the width. The glumes are prominently ribbed and dry to a straw colour. The structure of the spikelet is like any other Paspalum. The flowers of this wild ally open from 1–30 a. m. and the anthesis continues up to 7 a. m. The greatest anthesis energy is within the first hour after opening. It takes four to five days for a panicle to complete its flowering.

This wild Paspalum scores over *P. Scrobiculatum* in a number of points, viz., more herbage, free earheads, greater drought resistance, larger number of seeds per head and absence of sterility. A cross with this wild ally is indicated as a potential source of improving the Kodo millet, if the difficulties in the manipulation of this close and delicate cleistogamous flower could be overcome.

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HILL VILLAGES OF TIRUPATTUR TALUK.

By U. B. MOHAMED ABBAS, B. Sc. Ag.

Agricultural Demonstrator, Tirupattur, N. A.

Introduction. A portion of the Eastern Ghats is situated in Tirupattur Taluk, N. Arcot district in two separate blocks viz. the Yelegiris and the Javadhi hills. The entire length of the mountain range is 45 miles in the taluk. The Yelegiri has a range of 13 miles and is situated a mile and a half from Jalarpet Railway Station, while the Javadhis with a range of 32 miles run continuously from north to

south forming a boundary on the eastern side of the taluk. The height of the hills above the sea level ranges from 2,700 to 3,900 feet. The total extent of the mountain range can be classed as (a) Reserved Forests 33,641 acres, (b) Patta lands 10,924 acres, (c) Grazing grounds 22,713 acres. *Kambugudi* the highest plateau in the Javadhi range is 3,900 feet above sea level and is 24 miles from Tirupattur town. There is a travellers' bungalow in the middle of the plateau with a good motorable road leading to it.

There are 43 villages in all, 12 in the Yelegiris and 31 in the Javadhi with a total population of 14,245 according to the latest census. Each village has 15 to 50 houses and most of them can only be reached by foot paths while a few have bridle paths. There are a few travellers' bungalows scattered here and there on the top of the Javadhi and the Yelegiri hills. The scenery from the top of the hills is very picturesque. Some parts of the hills are covered with dense vegetation and wild animals like bison, sambar, cheeta, bears and deer are found.

Climate. Owing to the favourable height of the mountain range the climatic conditions on the top of the hills are very good. The temperature ranges between 60 and 90°. The rainfall is also not very heavy, being only about 35 inches per annum and major portion of this is received during the north-east monsoon season (October to December).

People and their habits. The inhabitants of these hill villages belong to aboriginal tribes known as *Malai-yalis*. Recently a few non-malai-yali villages have also sprung up in favoured localities, by migration of the cultivating classes of the neighbouring plains. The *Malai-yalis* call themselves as Gownders and have no sub-castes. They worship both Vishnu and Siva. Each village has a Kali or a Dhurga temple. Vishnu and Siva temples are few and are held in common for all the neighbouring villages. The requirements in life of these primitive people are very few. There is no shop in any of these villages. The few things they require are salt, kerosene, matches, betel leaves, nuts, mud pots and clothes. Clothes they purchase once a year at the time of Pongal, one of the two festivals they celebrate. The rest they obtain from the neighbouring weekly shandies of the plains. The barber, black-smith, carpenter and other artisans come from the plains at regular intervals in the busy season, complete their work in the village and return to the plains. Every village has a family of *Adi-Dravadas* of the plains whose services are utilised during marriages, festivals and funerals and in return they are paid in kind annually.

A group of villages have a headman in common and he with the help of a Panchayat, a committee to which every house of the village contributes a member, settles the disputes and the fines and penalties collected go to the village common good fund which is utilised for the

celebration of Pongal or Kali festival. The people have two festivals viz. Pongal celebrated for ten days in the month of January and the other Kali or Dhurga festival celebrated in the summer months. Marriages are also regarded as public functions since all the villagers are related to one another and so every one takes part in the function. The marriage expenses are met by the bridegroom or his party and may cost about Rs. 100 besides 15 to 20 bags of paddy or ragi. Some of the villages are very malarial but the original inhabitants are highly immune to it.

There are three village Panchayat Elementary Schools for all the 43 hill villages. The one on the Yelegiri is due to the efforts of a few Anglo-Indian families that have settled there and the other two are for the children of Reddiyur and Naickenoor villages on the Javadhi inhabited by people migrated from the neighbouring plains. It will thus be seen that there is not even a single school for the *Malai-yali* villages. The postman visits some of the villages once a week and the staff of the Health Department twice a year.

Occupation. The people depend mainly on agriculture and partly on cooly work they do to the Forest Department. An average ryot has 5 to 10 acres of dry land and there is very little of wet land. There are very few wells fit for irrigation purposes, so the people have little or no chance of raising a crop except with the help of rainfall. Major portion of the annual rain-fall is received in the north-east monsoon season i.e. October to December which is the main agricultural season. The soil on the slopes and the plateau is either red loam or sandy loam with a good mixture of kankar or sandstone to a depth of 6 inches or even up to one foot with soft stone and rock underlying it. The soil has therefore very little retentive power but responds well to heavy manuring.

Ragi, cumbu, samai, varagu, tenai, cholam, castor, groundnut, mustard and wheat are raised as rainfed crops. Besides these crops, some ryots have a few plantain and jack trees. Wherever there is facility for irrigation from jungle streams, or small tanks, paddy and sugarcane are raised. In the southern portions of the Javadhi hills near Nellivasal, coffee is grown under the shade of jack trees and it fetches Rs. 50 to 150 from about 10 cents (about 100 plants) of land. With the advent of the south-west monsoon, the fields are prepared and if the season happens to be good, cumbu mixed with cholam is sown and red gram dibbled in lines. Other millets except ragi are also sown in June—July. Groundnut is also sown at the same time. In August, after a good rain, ragi is sown and castor dibbled. A few ryots sow short duration paddy also. In September—October, wheat and mustard are sown. The rain-fed crops are intercultivated only once with a country plough.

From September onwards harvest of crops begins. Cumbu is the first crop to come off the field while castor comes last. Coffee plants flower in May-June and the berries are harvested in December-January. Ryots who have wells fit for irrigation, cultivate paddy thrice in the year. Besides paddy, cholam, ragi, sugar cane, are also grown under irrigation. Every ryot has a few heads of cattle and they form a source of income. During the period the crops are on the field, the ryots graze their livestock in the forests for which they pay 8 annas per cow or bullock per annum.

The probable income of a ryot who has 10 acres of dry land with a pair of work animals, 10 calves and 6 jack trees with 5 members in the family is shown in the *appendix*. In an average year a ryot may get Rs. 10 as net profit. If he happens to be thrifty, he may save some money, acquire land from the Government, clear the forest and bring it under cultivation. To purchase and clear the forest and bring it under cultivation, it costs him about Rs. 40 per 10 acres. The savings are used for the purchase of young calves and not for the purchase of jewels, nor does he waste it on drink. Money lenders were rare and the hill tribes never used to borrow as a rule but nowadays they come down to the neighbouring plains and borrow.

Except for the two forest roads which touch a few villages, the others have to be reached only by means of bridle paths which are very rugged. They are so bad in some places that even the pack animals find it difficult to negotiate them. Hence the ryot never brings down his bulky produce like ragi and cumbu to the neighbouring shandies for sale, but has to get his groundnut, mustard, jack fruit and coffee. The hill tribes are badly in need of a fair weather road, medical aid and elementary education.

Conclusion. The following are a few agricultural improvements that can be effected with success:—

- distribution of improved strains of crops grown there e. g. E. C. 593, *Surangi* cumbu, Adt. 3 paddy etc.
- introduction of light iron ploughs of cooper 25 type.
- demonstration of better methods of cultivating crops e. g. wheat and coffee.
- introduction of money crops e. g. potato and pine apple.
- inducing ryots to grow fruit trees e. g. mangoes, oranges, pomegranates, jack, and cashew nuts. These trees come up very well.
- stationing breeding bulls with the village Panchayats for the improvement of hill cattle.

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APPENDIX

Income in kind and cash.				Expenditure in kind and cash.			
1. Ragi	4 acres	500	Madras measures	1. Ragi	500 m. m.	8 months	
2. Cumbu	2 acres	200	"	2. Cumbu	200	" 3 "	} For self use.
3. Groundnuts	3 acres	1,800	"	3. Paddy	200	" 1½ "	
4. Castor dibbled with ragi	"	200	"	4. In the months of April and May when jack fruits are available, raw fruits are boiled and consumed with ragi gruel.			
5. Dry paddy	½ acre	200	"	5. Cost of clothes	"	"	Rs. 30-0-0
6. Red gram dibbled with cumbu		200	"	6. Grazing charges	"	"	Rs. 6-0-0
7. In the remaining portion he has his chillies (dry) plantains, mustard and other things which he uses for himself.				7. Cost of 5 young cows for rearing	"	"	Rs. 10-0-0
8. By the sale of 5 heads of cattle @ Rs. 12 each			Rs. 60-0-0	8. Kist at 8 annas per acre	"	"	Rs. 5-0-0
9. By the sale of groundnuts (1800 m. m.) @ Rs. 3/- 200 m. m.			Rs. 27-0-0	9. Cost of kerosene, matches, salt, betel leaves, nuts, mud vessels each at 8 as. a week.			Rs. 26-0-0
10. By the sale of Jack fruits			Rs. 6-0-0	10. Festivals Pongal and Kali Puja	"	"	Rs. 10-0-0
11. Do. Do. Castor			Rs. 4-0-0	11. Purchase of plough parts sickles etc.	"	"	Rs. 2-0-0
12. By engaging himself or some member of the family as cooly to the forest department.			Rs. 3-0-0	12. Marriages to be attended	"	"	Rs. 1-0-0
			Total Rs. 100-0-0				Total Rs. 90-0-0

Net income is Rs. 10-0-0

HYMENOPTEROUS PARASITES OF ECONOMIC IMPORTANCE IN S. INDIA

BY T. V. RAMAKRISHNA AYYAR, B.A., Ph. D., F. Z. S.

&

V. MARGABANDU, M.A.

(Madras Agricultural Department)

The study of economic entomology has in these days attained such dimensions that various methods of control are being advocated for checking insects injurious to crops. The mechanical methods of control such as the use of insecticides, spraying, fumigation and other artificial devices such as the use of light traps, etc., have been in some cases found impracticable and uneconomical. In view of the poisonous nature of the insecticides themselves, the prohibitive cost of the treatments in some cases, the frequency and thoroughness with which these treatments have to be given, the promptness with which these have to be done, and the several meteorological factors that influence the success or failure of the results obtained and lastly the temporary and palliative nature of the results obtained, mechanical methods of control frequently become very much limited in their scope.

During recent years a new method of crop-pest control has sprung up known as the biological control of insect pests. It is a well known fact that almost every insect has at one stage or another, its parasite or predator. A parasite is one which becomes attached to the host, at some stage of its existence, and leads an ecto or endozoic existence gradually killing the host; whereas a predator is one which leads a free existence and preys on its victim killing the same immediately in most cases. Among insects, the phenomenon of parasitism is very highly developed in some of the groups of Hymenoptera, especially the Ichneumonoid families, Braconidae, Ichneumonidae, Chalcidae and Bethyilidae and the Tachinids among the Diptera in the insect world.

The object of this paper is to record the different kinds of hymenopterous parasites so far found in the South Indian region possessing some economic importance and to set forth instances, where some of the insect hosts are controlled, to a greater or lesser extent by the natural enemies. A study of this was undertaken in order to get an idea as to the indigenous parasites that exist in the region with their respective hosts, the parasite or parasites that attack a particular host, the degree to which there is parasitism and the regions where they are obtained. This would help us in getting an idea as to the possibilities for breeding parasites and liberating them in numbers to control crop pests.

A list of hymenopterous parasites with their respective hosts has been given at the end noting their distribution. Work in these parasitic groups was begun in S. India by the senior author and lists were prepared by him, one in 1919 (2), a second one in 1921, (3) and the most recent one in the Bulletin of Entomological Research, (10). There are stray publications such as the Ann. & Mag. Nat. History., Proc. U. S. Nat. Mus., Jl. Bom. Nat. Hist. Socy., Bull. Ent. Res., etc. wherein S. Indian parasites have been described by such writers as Rohwer, Gahan, Girault, Crawford, Cameron, Silvestri, Grandi, Waterston, Wilkinson, Ferriere and a host of others.

Instances where crop pests are being controlled by natural enemies noted in South India are:

Nephantis serinopa, the black headed caterpillar is a very serious pest of coconut palms both in the East Coast as well as in the West Coast. And this is a classic example wherein natural enemies are used to a degree to control the pest. In the East Coast the pest is not serious probably on account of the presence of the parasites which have a favourable environment for successful multiplication; whereas in the West Coast probably on account of the secondary parasites the primary parasites have not asserted themselves. Hence breeding laboratories were opened at three different stations, viz., Calicut, Mangalore and Ponnani where the parasites were bred in large numbers and liberated. This pest has got parasites attacking the larval and the pupal stages. There is a Bethyilid, a Microbracon, an Apanteles and an Elasmid attacking the different stages of the larva; and a Chalcid, Eulophid and an Ichneumonid attacking the pupa in addition to a Tachinid fly. In spite of so many parasites attacking a single host at different stages of the pest, it has been found difficult to control the pest on account of the secondary parasites on every one of these. The coconut caterpillar complex has been well shown diagrammatically (11a).

The life history and habits of the larval parasite *Elasmus nephantidis*, R., has been worked out at greater detail (15).

In the case of the paddy stem borer *Schoenobius incertellus* there are the egg parasites as well as the larval parasites. The chief egg parasites are—(1) *Trichogramma minutum*, R., (2) *Tetrastichus schoenobii*, Ferr. and (3) *Phanurus beneficiens*, Zehnt. Of these *Tetrastichus schoenobii* would appear to be most effective in that a single grub is able to kill 2 or 3 eggs of the host. These parasites are found during the months of February and March during the *dalva* or the second crop and this is the reason why the infestation is very low during this crop and the infestation very high during the *salva* or the first crop in the Circars. In addition to these there are the Braconid larval parasites *Tropobracon indicus*, R., *Microbracon* sp., and *Apanteles schoenobii* and the Ichneumonids *Goryphus maculipennis* and *Ischnojoppa luteolator*, F. But instances of these asserting themselves are not known.

Argyria sticticrasis. Hmps. The sugarcane borer is another in whose case in other parts of the world, biological methods of control are being carried on by utilising the egg parasite *Trichogramma minutum*, R. In India, so far the damage done to cane has not warranted a control of the pest in this direction. The egg parasite *Trichogramma minutum*, R. and *Phanurus* sp. are found in the Circars and among the larval parasite, *Stenobracon* sp.

Sesamia inferens. Wlk. the ragi borer is a clear instance where the parasites have proved of great utility under natural conditions. The infestation is high only in the *pairu* or cold weather crop and here the larval parasites check the pest. A braconid wasp keeps the pest under control. They are noticed from February to March and the percentage of parasitisation goes on increasing from February onwards till the percentage rises to 80% during the first week of March. Here is a case where the parasites have been found really useful in checking the pest at the right time unlike the egg parasites of the paddy stem borer.

Utetheisa pulchella. Linn. on Sannhemp: Egg parasites probably *Phanurus* sp. noticed on the eggs are very prominent and the parasitisation is very high during the second week of March. Eggs were collected at different periods to note the degree of parasitisation which went on rising from February to March. It was 57.24% during the last week of February; 63.82% during the first week of March and 87.88% during the 2nd week of March. In addition to these there are Tachinids parasitic on the larvae which are also high during these months; and a chalcid hyper-parasite was noticed on these Tachinid maggots.

Leaf miners on citrus: *Phyllocnistis citrella* Stn. Chalcid parasites were noticed on the pupae. Though the miners were prominent right through the year, the parasites were noticed only from February up to April. The percentage of parasitisation was worked out as 33.15. The parasites were not to be seen during the remaining part of the year.

The eggs of the Fulgorid *Pyrilla perpusilla* Wlk. which is found on cane shows parasitisation by Chalcids Dryinids. *Pyrilla* in large numbers on the cane leaves cause sooty mould on account of the secretion of honey dew and the whole crop looks black and may be detrimental to the crop too; and the breeding of egg parasites and liberating them may be tried, this depending upon the degree to which the pest attacks the crop.

The cholam borer—*Chilo simplex* Butl. The list at the end would show that this has got Ichneumonids, a number of Braconids and a Chalcid parasite on it.

There are a number of scale insects and mealy bugs infesting many trees and plants and every one of these is attacked by a parasite or

another. Such serious scales as the *Pulvinaria maxima* Green. on nim, *Ceroplastodes cajani* on *Zizyphus jujuba*, *Aspidiotus orientalis* Newst. on tamarind, *Lecanium* species on cotton, sandal, etc., are a few instances where the parasites check them. The hymenopterous wasps especially of the super family Chalcidoidea are parasitic on the many species of Coccids. These lead an endozoic existence at least in the early stages and lead a free life in the adult stage. Parasitisation by these minute insects are not visible until after the adult parasites emerge when the exit-holes could be seen. In certain cases where the scales are transparent there will be abnormal colour. Study in these cases is rather difficult. A study of the parasites of Coccids would form a study by itself.

There are the several important crop pests of the Noctuid family often subject to parasites such as *Spodoptera mauritia*, Boisd. and *Cirphis albistigma* that attack paddy, *Prodenia litura* F.B. the tobacco caterpillar, *Achaea janata*, Linn. a serious pest on castor, *Eublemma olivaceae* Wlk. the brinjal leaf roller; and among the Pyralids several of the paddy pests, sugarcane pests, cotton and vegetable pests, have also parasites. The list at the end will give an idea as to the range of orders and families in which we find insect parasites. But for the existence of these parasites, all the crops would have been overrun by these pests and there will be no crops at all. Nature in her bounty and generosity is maintaining a balance, as it were, even without our consciousness, thus restricting the scope of these pests. This will give one an idea as to the utility of these little insects to man.

General considerations. The general life history of these parasitic wasps may be stated thus. The adult is a free living insect. It goes in search of the right host and lays an egg or eggs. The eggs may be laid singly or in an eggmass on or in the body of a caterpillar, maggot or grub. The parasites are provided with an apparatus at the tail end called the ovipositor which is used for inserting the eggs. They are even so adapted that these can be thrust from outside into the body of larvae inside the plant stems. The hatched out larvae may lead an ectozoic or endozoic existence and feed upon the tissues and vital organs of the host bringing about the gradual death of the host. The grubs after feeding on the host may come out, and spin cocoons on the surface of the host very often as in the case of Braconid wasps.

These minute wasps which we find in thousands are widely different in structure and habit and a study of these would bring to light many interesting points which would help us in the efficient utility of these parasites toward insect pest control. These may be ectozoic or endozoic and most of these are parasitic only in their larval stages. The list at the end will show that a particular species of parasite may have different hosts; a number of species may attack a single host simultaneously; some may be polyphagous; and some restricted only to particular hosts. In the case of the black scale

Saissetia nigra in California there are 51 species recorded on it. The original parasites are in some cases attacked by secondary parasites and this phenomenon is called hyper-parasitism. Some attack insects belonging to different orders or families or even groups and different stages of the hosts. We have species of *Apanteles* attacking larvae of different orders. These parasites attack the different stages of the host. There are egg parasites, larval parasites, and pupal parasites. Thus it could be seen that the host may be attacked at any stage or in all stages. There is the Trichogrammid—*Trichogramma minutum*, R., attacking the eggmasses of *Schoenobius*, *Argyria* and *Dittraea*. There is *Phanurus beneficiens*, Zehnt, attacking the eggmasses of *Schoenobius* and *Scirpophaga*. Similarly there are instances of larval parasites. Many of the Braconids and Ichneumonids are larval parasites. Among the pupal parasites there is the Chalcid *Pluristropis epilachneae*, Roh attacking the pupa of *Epilachna*, *Tetrastichus ayyari*, *Chilo simplex*, *Acanthojappa* sp., *Melanitis ismene* and so on. Among the hyper parasites we have *Perilampus microgastris*, Ferr., on *Microgastris indicus*, Wlk., *Apanteles machaeralis*, Wlk., and a Braconid parasite on *Nephantis serinopa*, M., *Mesochorus plusciphilus*, V., on *Apanteles plusiae*, Vier, and *Marietta* sp. on some of the parasites on Coccids. Specialisation has gone to such a degree that many of the Eurytomids are phytophagous and the Chalcid family *Agaonidae* live on seeds of figs. Members of the family Eurytomidae attack galls. There is the seed chalcid *Bruchophagus mellipes*, Gahan, boring into *Sesbania* seeds.

In certain cases where we notice more than one species attacking a host and where the parasites lead an endozoic life it requires a more careful and thorough study as we should be able to distinguish between the primaries and secondaries. There are instances of parasitism wherein they are parasitic on the predators of the host themselves in which case they are not beneficial. There is *Aphrastobracon flavipennis*, Ashm. which is parasitic upon *Eublemma* which is a predator on Coccids; similarly there is *Elasmus indicus* found with the Coccid *Anomalococcus indicus* which is probably predaceous on *Eublemma*. This clearly shows that a clear understanding of the interrelations of the host and the parasite are necessary.

Thus we could see how varied are the nature and kind of parasitisation, the habits of these parasites and the relationship between them and the hosts. A study of the natural enemies available in South India brings to light the following interesting points. Parasites are not found throughout the season but are found only during particular seasons, e. g., in the case of *Schoenobius* we have the egg parasites from January to March during the summer months at Samalkota; similarly we find the larval parasites from January to March in the case of the ragi borer and the egg and larval parasites of Sannhemp caterpillar and the Chalcid parasites of the citrus leaf miner could be

had only during the months of January to March. Here we find some interesting features. One is that parasites are found only during particular seasons; in these cases cited they are found only during the months of February—March; in some cases they are useful in controlling the pest as in the case of Ragi borer; in some cases though the crop exists during two seasons and the pest also is found the parasite could be found in abundance only during the second crop as in the case of *Schoenobius* and similarly in the case of *Utethesia* on Sannhemp and the citrus leaf miner *Phyllocnistis*. In the case of *Nephantis* in the West coast it becomes serious in certain seasons but the pest becomes controlled as soon as the parasites assert themselves. Thus it could be seen that there are certain meteorological and other factors that now and then put the parasites under check.

Before initiating "Biological methods of control" it is incumbent upon us to know before-hand the indigenous parasites that exist in the area with the respective hosts; and their host relations; the number and kind of parasites that attack a particular host and the number of hosts which a particular species attacks; the secondary parasites that may be found on the original parasites; the different stages of hosts that are attacked by the parasites; the seasonal abundance of these parasites and their numerical relation with that of the host; and the factor or factors that are responsible for the success or failure for the multiplication of these. All these points require elucidation. Then one should be able to eliminate the adverse factors and attempt at successful breeding of the parasites and liberating them, the kind of cages to be utilised depending upon the nature of parasites—whether egg or larval.

The list of parasites given below will show how vast the field is and how there is plenty of scope for utilising the parasites in the control of crop pests. In view of the complexity of this method of control it requires a careful study before any one starts on the work of biological control; and in this connection one may be referred to such eminent men like Howard, Thompson, Smith, Burgess, Jones and a host of others who are doing a good deal of work on insect parasites and biological methods of control. A good deal of literature by these men has accumulated and would prove very interesting study in this new line of work.

The list does not by any means profess to be complete but it is just given to show the richness of parasites found on the several major crop pests thereby showing one that there is a vast and wide field of study of great economic importance as well as of deep academic interest. It may also be added that the list gives only those South Indian forms of economic importance and does not deal with the numerous parasitic forms which affect other insects in various ways.

List of Hymenopterous Parasites of Economic Importance noted in South India.

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
LEPIDOPTERA Hesperiidae	<i>Parnara natilius</i> (Rice skipper)	<i>Xanthopimpla immaculata</i> , Mor.	Ichneumonidae	Palur (South Arcot), Madras & Coimbatore.
	do.	<i>Clinocentrus</i> sp.	Braconidae	Nellore, Kurvetnagar. Coimbatore.
	do.	<i>Eupleromalus parnarae</i> , Galh.	Pteromalidae	Coimbatore.
	do. (on pupa)	<i>Ischnojoppa luteator</i> , F.	Ichneumonidae	Coimbatore.
Lasiocampidae	<i>Taragama siva</i> (on Acacia)	<i>Henicospilus reticulatus</i> , Cam.	do.	Coimbatore.
	<i>Taragama dorsalis</i>	<i>Apanteles taragamae</i> , Vicr.	Braconidae	Bangalore.
	<i>Lasiocampid</i> larva	<i>Chalcis argentiifrons</i> , Ash.	Chalcididae	Coimbatore.
	<i>Trabala vishnu</i>	<i>Microdus funipennis</i> , Bing.	Braconidae	Coimbatore.
Limacodidae	<i>Parasa lepida</i> (on castor)	<i>Clinocentrus</i> sp.	do.	Coimbatore.
	do.	<i>Stomatocerus ayyari</i> , Galh.	Chalcididae	Coimbatore.
	do. & <i>Thosca</i> sp.	<i>Eurytoma parasac</i> , Galh.	Eurytomidae	Coimbatore.
	<i>Conthocyla rotunda</i> (on coconut palm)	<i>Alciodes</i> sp.	Braconidae	Malabar.
Lymantridae	<i>Natada nararia</i> (on <i>Pithecolobium</i>)	<i>Protapanteles</i> sp.	do.	Coimbatore.
	<i>Olena mendosa</i>	<i>Goryphus</i> sp.	Ichneumonidae	Coimbatore.
	<i>Euproctus fraterna</i> (on castor)	<i>Henicospilus (reticulatus?)</i>	do.	Coimbatore.
	do. (rose leaves)	<i>Disophrys</i> sp.	Braconidae	Madras.
	<i>Euproctis scintillans</i> and <i>E. fraternus</i> (on larva)	<i>Henicospilus mendarius</i> , Gr.	Ichneumonidae	Saidapet and Coimbatore.
	<i>Euproctis scintillans</i> (on gogu)	<i>Protapanteles</i> sp.	Braconidae	Coimbatore.

Sphingidae	<i>Orgyia postica</i> (on larva)	<i>Apanteles (Protapanteles) colemani</i> , Vicr.	do.	Mysore.
	<i>Psalis securis</i> (on paddy)	<i>Protapanteles</i> sp.	do.	Coimbatore.
	<i>Polyptychus dentatus</i> (on Cardia) (egg parasite)	<i>Anastatus coimbatorensis</i> , Gir.	Chalcididae	Coimbatore.
	<i>Daphnis nerii</i> (on larva)	<i>Troporhogas maculipennis</i> , Cam.	Braconidae	Coimbatore.
Noctuidae	<i>Macroglossum</i> sp. (an undescribed species) (on larva)	<i>Microplitis</i> sp.	do.	Coimbatore.
	<i>Aclaea janata</i> , Linn. (on larva)	<i>Tetrastichus ophiusae</i> , Cress.	Eulophidae	Mysore.
	do.	<i>Microtorfidea lissonata</i> , Vicr.	Ichneumonidae.	Mysore.
	do.	<i>Zamnochorus orientalis</i> , Vicr.	do.	do.
	do.	<i>Microplitis</i> sp.	Braconidae.	S. India.
	do. (on castor)	<i>Pariscus ocellaris</i> , Th.	Ichneumonidae.	Coimbatore.
	do.	<i>Microplitis ensirus</i> , Lyb.	Braconidae.	All over S. India. ("a specific and effective parasite on the castor semi-looper")
	do.	<i>Euplectrus leucostomus</i> , Roh.	Eulophidae.	Coimbatore.
	do.	<i>Henicospilus</i> sp.	Ichneumonidae.	do.
	<i>Proclenia litura</i> (on larva)	<i>Apanteles prodeniae</i> , Vicr.	Braconidae.	Mysore.
	do.	<i>Diocles argenteopilosa</i> , Cam.	Ichneumonidae.	Coimbatore.
	do.	<i>Chelonus</i> or <i>Cheloneilla</i> sp.	Braconidae.	do.
	<i>Plusia peponis</i> do.	<i>Apanteles plusiae</i> , Vicr.	do.	Mysore.
	do.	<i>Mesochorus plusiphilus</i> , Vicr.	Ichneumonidae	Bangalore.
	<i>Plusia signata</i> (on snake gourd)	(a hyper parasite on <i>Plusia</i>)	do.	Coimbatore.
	<i>Plusia agramma</i>	<i>Paracopidosomopsis javae</i> , Gir.	Encyrtidae.	do.
	<i>Carea subtilis</i> (on <i>Eugenia</i>)	<i>Ceraphron athanasii</i> , Gir.	Proctotrypidae.	Coimbatore.
	<i>Adisura atkinsoni</i> (on lab-lab)	<i>Tumidicoxioidea jambulana</i> , Gir.	Chalcididae.	do.
		<i>Microbracon</i> sp.	Braconidae.	do.

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
LEPIDOPTERA (Contd.) Noctuidae (Contd.)	<i>Cirphis</i> sp. <i>Cirphis albistigma</i> (on paddy)	<i>Meteorus</i> sp. <i>Xanthopimpla</i> sp.	Braconidae Ichneumonidae	South Arcot. Palur (S. Arcot).
	<i>Spodoptera mauritia</i> do.	<i>Chelonus</i> sp. <i>Charops</i> sp.	Braconidae Ichneumonidae	Malabar. South India.
	do. (on barley) do. (on pupa).	<i>Ichneumon</i> sp.	do.	Ootacamund.
	<i>Earias fabia</i> (on pupa).	<i>Microbracon lefroyi</i> , Dudg. & Gough.	Braconidae	Ramnad.
	<i>Perigaes capensis</i> do. (infesting safflower plants)	<i>Euplectrus euplexia</i> , Roh. <i>Heterogamus percurrans</i> , Lyla.	Eulophidae Braconidae	Coimbatore. do.
	do.	<i>Protopanteles</i> sp. <i>Microdus</i> sp.	do. do.	do. do.
	<i>Eublemma olivaceae</i> (Brinjal leaf roller)	<i>Hymenobosmena</i> sp. <i>Aphrastobracon flavipennis</i> , Ash. <i>Cremastus noxiosus</i> , Mori.	Ichneumonidae Braconidae Ichneumonidae	do. S. India. Coimbatore.
	do.			
	<i>Eublemma scitula</i> A Noctuid larva (on maize stalk)			
Pyralidae	<i>Chilo simplex</i> (on Sorghum)	<i>Xanthopimpla pedator</i> , F. <i>Iphiaulax</i> sp. <i>Merionotus</i> sp.	do. Braconidae do.	do. Coimbatore, Kurnool. Coimbatore.
	do.	<i>Apanteles flavipes</i> , Cam.	do.	Poona.
	do.	<i>Apanteles</i> (<i>Stenoplectura</i>) sp.	do.	Godavari & Coimbatore
	do.	<i>Iphiaulax scitophthalmus</i> , Cam.	do.	S. India.
	do.	<i>Glyptomorpha</i> (<i>Bracon</i>) <i>deesae</i> , Cam.	do.	do.
	do.	<i>Apanteles</i> sp. (probably new).	do.	Mandya.
	do.	<i>Microbracon cilioides</i> Ramakrishna.	do.	S. India.

do.	<i>Xanthopimpla nrsari</i> .	Ichneumonidae	All over India.
do. (on pupa)	<i>Tetrastichus ayyari</i> , Roh.	Eulophidae.	Coimbatore.
<i>Schoenobius</i> (egg mass)	<i>Tetrastichus schoenobii</i> , F.	do.	Hebbal, Mysore.
do.	<i>Phanurus beneficiens</i> , Zehnt.	Scelionidae.	do.
do.	<i>Trichogramma minutum</i> , R.	Trichogrammatidae.	do.
do. (larva)	<i>Tropobracon indicus</i> , R.	Braconidae.	do.
do.	<i>Microbracon</i> sp.	do.	do.
do.	<i>Goryphus maculipennis</i> , Cam.	Ichneumonidae.	Godavari Dt
do.	<i>Apanteles schoenobii</i> , W.	Braconidae.	Hebbal, Mysore.
do.	<i>Ischnojoppa luteolator</i> , F.	Ichneumonidae.	Very common in Coimbatore & all S. India.
<i>Scirpophaga</i> (egg mass) <i>Diatraea</i> (egg mass) <i>Sylepta derogata</i> (cotton leaf roller)	<i>Phanurus beneficiens</i> , Zehnt.	Scelionidae	Bangalore.
	<i>Trichogramma minutum</i> , R.	Trichogrammatidae.	Hebbal, Mysore.
	<i>Neopimplodes sylepta</i> , Vier.	Ichneumonidae	Mysore.
	<i>Microtoridea lissonata</i> , Vier.	do.	do.
	<i>Elasmus indicus</i> , Roh.	Elasmidae.	S. India.
	<i>Pristomerus eusephera</i> , Vier.	Ichneumonidae.	Bangalore.
	<i>Pristomerus testaceus</i> , Mori.	do.	Attur, Chinglepet.
	<i>Lianarotoma</i> sp.	Braconidae.	Coimbatore.
	<i>Apanteles machaeratis</i> , Wlk.	do.	Nilambur, Madras.
	<i>Cardiophiles</i> sp.	do.	Ganjam.
<i>Euzophera particula</i> (brinjal fruit borer) <i>Euzophera particella</i> <i>Pyrausta machaeratis</i> <i>Cnephlocrocis madriales</i> (Paddy leaf-roller) <i>Etiella zinckenella</i> (Infesting sunnhemp) <i>Crocidelomia binotalis</i> (on Radish)	<i>Phanerotoma</i> sp.	do.	Coimbatore.
	<i>Microbracon</i> sp.	do.	do.
	<i>Microbracon lefroyi</i> , Dud & Gough.	do.	S. India.
	<i>Microbracon malleus</i> Ramakrishna.	do.	do.

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
LEPIDOPTERA (Contd.) Pyralidae (Contd.)	<i>Antigastra catalaunalis</i> (Gingelly leaf-caterpillar)	<i>Hymenobosmena</i> sp.	Ichneumonidae.	Coimbatore.
	<i>Dichrocis</i> (on castor seed)	<i>Diocetes trochanterata</i> , Morl.	do.	do.
	<i>Pyralid larva</i> (boring into the fruit & pods of <i>Pongamia glabra</i>)	<i>Microbracon pictus</i> , Ramakrishna.	Braconidae.	do.
Pterophoridae	<i>Scirpophaga</i> (egg-mass)	<i>Phanurus beneficiens</i> , Zehnt.	Scelionidae.	(Bangalore)
	<i>Diatraea</i> (egg-mass)	<i>Trichogramma minutum</i> , R.	Trichogrammatidae.	Hebbal, Mysore.
	<i>Exelastis atomasa</i> (on Red-gram)	<i>Protopanteles</i> sp.	Braconidae.	Hebbal, Mysore.
Gelechiidae	<i>Stomopteryx nerteria</i>	<i>Chelonella</i> sp.	do.	South Arcot.
	<i>Platyedra</i> (cotton Bollworm)	<i>Microbracon lefroyi</i> , Dudge & Gough.	do.	India.
	do.	<i>Chelonus or chelonella</i> sp.	do.	South India.
Xyloryctidae	<i>Phorinanaa blapsigona</i> (on brinjal bud)	<i>Microbracon incarnatus</i> , Ramakrishna.	do.	do.
	<i>Nephantis serinopa</i>	<i>Elasmus nephantidis</i> , Roh.	Elasmidae.	do.
	do.	<i>Stenotocerus sulcatiscutellum</i> , Gri.	Chalcididae.	do.
Gracillariidae	do. (on pupa)	<i>Trichospilus pupivora</i> , Ferr.	Eulophidae.	Cochin.
	do.	<i>Xanthopimpla punctata</i> , F.	Ichneumonidae.	Calicut.
	<i>Cyphostichus coarula</i>	<i>Euryscotolinx Coimbatorensis</i> Roh.	Eulophidae.	Coimbatore.
Hypsidae	<i>Gracillaria soyella</i> (on Red gram)	<i>Amphistella indica</i> , Gir.	Chalcididae.	India.
	<i>Nyctemera lactinia</i> (on larva)	<i>Euplectrus nyctemerae</i> , Craw.	Eulophidae.	Bangalore.

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
Arctiade	<i>Hypsa ficus</i> (on <i>Ficus indicus</i>)	<i>Disophrys</i> sp.	Braconidae.	Coimbatore.
	<i>Larva of</i>	<i>Meteorus arcticiida</i> , Vier.	do.	Mysore.
	<i>Cretonotus albistriga</i>	<i>Apanteles</i> (Protopanteles) <i>cratonoti</i> , Vier.	do.	do.
Papilionidae	<i>Diacrisia obliqua confusa</i> Hairy caterpillars.	<i>Apanteles obliquae</i> , Wlk.	do.	Nilambur, Madras.
	<i>Papilio demoleus</i> & <i>P. polytes</i> .	<i>Henicospilus horsfieldi</i> , Cam.	Ichneumonidae.	S. India.
	<i>Stenopus alternus</i>	<i>Apanteles</i> (Protopanteles) <i>papiliotis</i> Vier.	Braconidae.	Mysore.
Notodontidae	<i>Phycodes radiata</i>	<i>Apanteles</i> (Protopanteles) <i>stauropi</i> , Vier.	do.	do.
	<i>Argyrochloa illepidia</i>	<i>Apanteles phycodis</i> , Vier.	do.	do.
	do.	<i>Eugathis cryptophlebia</i> , Vier.	do.	do.
Saturnidae	<i>Cricula trifenestralis</i>	<i>Trissomalus fulvicornis</i> , Roh.	Bethylidae.	do.
	<i>Azygophleps scalaris</i>	<i>Xanthopimpla pedator</i> , F.	Ichneumonidae.	S. India.
	On different plants	<i>Pristomerus</i> sp.	do.	Coimbatore.
Zeuzeridae	<i>Psychid larva</i>	<i>Phanarotoma</i> sp.	do.	do.
	<i>Melanitis</i>	<i>Goryphus nursui</i> , Cam.	do.	do.
	(on paddy) on pupa	<i>Acanthopoppa</i> sp.	do.	Godavery Dt.
Bombycidae	<i>Ocinara</i>	<i>Goryphus?</i> <i>fuscigerus</i> , Cam.	do.	Coimbatore.
	<i>Vioachola</i> (on soapnut fruit)	<i>Charops obtusus</i> , Morl.	do.	do.
	<i>Alcides affaber</i> (attacking <i>Hibiscus cannabinus</i> stem boring weevil)	<i>Aphrastobracon alcidiphagus</i> , Ramk.	Braconidae.	Coimbatore.
COLEOPTERA	<i>Alcides bubo</i> (on the grub)	<i>Campyloneurus ceylonicus</i> , Cam.	do.	do.
	<i>Acinensis</i> sp. (on the grubs)	<i>Ipobracon dentiscapa</i> , Ramakrishna.	do.	Salem.
	<i>Calandra oryzae</i> (Rice weevil)	<i>Petiromatus oryzae</i> , Cam.	Pteromalidae.	All over S. India.
Curculionidae	<i>Aspidomorphia</i> (on grubs)	<i>Tetrastichus colemani</i> , Craw.	Eulophidae.	Bangalore.

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
COLEOPTERA (Contd.) Buprestidae	<i>Buprestid</i> borer <i>Sphenophorus</i> spp. (on larvae boring into groundnut, cotton & pulses) <i>Sitotroga</i> (infesting stored Coriander) <i>Bruchus chinensis</i> (on larva) do.	<i>Vipis gracilis</i> , Ramakrishna. <i>Glyptomorphus</i> (<i>Iphiaulax</i>) <i>smeenus</i> Cam. <i>Meraporus vandinei</i> , Tuck. = <i>Aplatomorpha catandreae</i> , How. <i>Bruchocida orientalis</i> , Craw. <i>Bruchobius colemani</i> , Craw. <i>Spathius</i> sp. <i>Pleurotropus foveolatus</i> , Craw. <i>Pleurotropus epilachneae</i> , Roh. <i>Homalotylus flaminus</i> (Dalm). <i>Tetrastichus colemani</i> , Craw. <i>Metaphoma</i> sp. (probably new.) <i>Tetrastichus nyensis</i> , Roh. <i>Diachasma</i> <i>morpho conperi</i> , Vier. <i>Bathyaulex trypaniptaya Ramakrishna</i> . <i>Bathyaulex carpomyiae</i> , Ramkr. <i>Opius fletcheri</i> Silv. <i>Austroopius</i> sp.	Braconidae. do. Super. Chalcidoidea. Eupelmidae. Pteromalidae Braconidae Eulophidae. do. do. Eupelmidae. Eulophidae. Broconidae. do. do. do. do.	Coimbatore. Coimbatore, Bellary. Madras. Bangalore. Bangalore & Coimbatore. Coimbatore. Bangalore. Coimbatore. Bangalore. do. Coimbatore. India. Anantapur Dt. Coimbatore. Throughout India. S. India.
Bostrychidae	<i>Dinoderus</i> (shot-hole borer in bamboo frame work)			
Coccinellidae	<i>Epilachna</i> (grubs) do. (on pupa) <i>Coccinellid</i> grubs <i>Aspidomorphus miliaris</i> (on larva) <i>Xylotrechus</i> .			
Chrysomelidae				
Cerambycidae				
DIPTERA				
Anthomyiidae	<i>Cholus</i> maggot			
Trypetidae	Fruit fly <i>Bactrocera</i> sp. (on Alangium fruits) <i>Carpomyia vesuviana</i> (attacking Zizyphus fruits) <i>Dacus</i> (<i>Chaetodacus</i>) <i>cucurbitae</i> <i>Dacus longistylus</i> (attacking seed capsules of Calotropis)			

	<i>Dacus</i> (<i>Chaetodacus</i>) <i>incisus</i> (infesting fruits of the tree of <i>Careya arborea</i>) <i>Dacus</i> (<i>Chaetodacus</i>) <i>incisus</i> . do. On a fly boring into Zizyphus fruits On fruit flies On fruit fly maggots (collected and taken to Australia by Compere in 1907). <i>Aphrodyla sesami</i> (Gingelly gall-fly) Cholam gall-fly Galls on <i>Macrona arneria</i> probably on gall-flies From cumbu grains probably on gall-flies From grass galls-probably on gall-flies. do <i>Pachydiptosis oryzae</i> -Paddy gall flies. <i>Syrphus</i> (on water melon)	<i>Opius incisi</i> , Silv. <i>Opius</i> (<i>Biosteres</i>) <i>persulcatus</i> , Sila. <i>Opius</i> (<i>Biosteres</i>) <i>compensans</i> , Silv. <i>Opius</i> (<i>Biosteres</i>) <i>carpomyiae</i> , Silv. <i>Asobara orientalis</i> , Vier. <i>Syntomosphyrum indicum</i> , Silv. <i>Eurytoma dentipectus</i> , Gah. <i>Tetrastichus coimbatorensis</i> , Roh. <i>Tetrastichus isaaci</i> , Roh. <i>Tetrastichus okawus</i> , Roh. <i>Neonastatus trochantericus</i> , Gah. <i>Xestonodidea foersteri</i> , Gah. <i>Folygnotus</i> sp. <i>Bassus orientalis</i> , Cam.	do. do. do. do. do. Super. Chalcidoidea Eurytomidae. Eulophidae. do. do. Encyrtidae. Platygasteridae do. Ichneumonidae. Braconidae. Encyrtidae do.	Coorg. do. do. Coimbatore. S. India. Coimbatore. do. do. do. do. do. Tanjore. Coimbatore. Bangalore. do. do. Coimbatore.
Cecidomyiidae				
Syrphidae				
HEMIPTERA				
Aphidae	<i>Aphis</i> on tobacco <i>Aphis maidis</i> (on ragi) <i>Eurybrachys</i> (on eggs) <i>Pundatuoya</i> (<i>Cholam</i> shoot fulgorid)	<i>Aphidius colemani</i> , Vier. <i>Aphidencyrus</i> sp. <i>Leurocerus</i> n. sp. <i>Paramagrus optabilis</i> , Perk.		
Fulgoridae				

Host family.	Host insect.	Parasitic insect.	Parasite family.	Distribution.
HEMIPTERA (Contd.) Coccidae	<i>Ceroplastodes cajani</i>	<i>Aphycus fuscicornis</i> , Gah.	Encyrtidae	Coimbatore.
	do.	<i>Anicetus ceylonensis</i> , How.	do.	do.
	do.	<i>Chiloneurus</i> sp.	do.	S. India.
	<i>Lecanium nigrum</i>	<i>Metaphycus</i> n. sp.	Aphelinidae	Coimbatore.
	do.	<i>Eucomys lecaniorum</i> , Mayr.	Miscogasteridae	do.
	do.	<i>Anaristius ceroplastae</i> , How.	Encyrtidae	do.
	do.	= <i>Coccophagus orientalis</i> , How.	do.	S. India.
	do.	<i>Scutellista cyanea</i> , Mot.	do.	do.
	do.	<i>Encyrtus lecaniorum</i> , Mayr.	do.	do.
	do.	= <i>Eucomys lecaniorum</i> , Mayr.	do.	do.
	do.	<i>Anicetus ceylonensis</i> , How.	do.	do.
	do.	<i>Microterys kotinskyi</i> , Fell.	Braconidae.	Coimbatore.
	do.	<i>Encyrtus barbatus</i> , Timb.	Aphelinidae	do.
	do.	<i>Megalomum</i> sp.	Encyrtidae	do.
	<i>Putvinaria maxima</i>	<i>Marietta leopoldina</i> , Mot.	do.	do.
Coreidae Pentatomidae	do.	<i>Anicetus ceylonensis</i> , How.	do.	S. India.
	do.	<i>Aphycus flavus</i>	do.	do.
	do.	<i>Aphycus</i> n. sp.	do.	Coimbatore.
	do.	<i>Perissopterus</i> n. sp.	do.	do.
	<i>Putvinaria psidii</i>	<i>Microterys kotinskyi</i> , Fullaway.	do.	do.
	do.	<i>Adelencyrtus chionaspidis</i> .	Aphelinidae	do.
	do.	<i>Aphelinus mytilaspidis</i> .	Encyrtidae	do.
	do.	<i>Encyrtus flavus</i> .	Aphelinidae	do.
	do.	<i>Coccophagus</i> sp.	do.	do.
	<i>Putvinaria</i> sp.	<i>Metaphycus</i> n. sp.	do.	do.
	<i>Pseudococcus citri</i>	<i>Tetraneura indicus</i> .	do.	do.
	<i>Lecanium haemisphaericum</i>	<i>Comys rufescens</i> .	do.	do.

Coreidae Pentatomidae	do.	<i>Coccophagus</i> sp.	Aphelinidae	S. India.
	do.	<i>Aphycus</i> sp.	Encyrtidae	do.
	<i>Lecanium discrepans</i>	<i>Coccophagus</i> sp.	Aphelinidae	do.
	do.	<i>Aphycus</i> sp.	Encyrtidae	do.
	<i>Lecanium oleae</i>	<i>Scutellista cyanea</i> , Mot.	Miscogasteridae	Coimbatore.
	<i>Saissetia nigra</i>	<i>Microterys kotinskyi</i> , Fullaway.	do.	do.
	do.	<i>Encyrtus barbatus</i> , Timb.	Encyrtidae	do.
	<i>Ceroplastes confusus</i>	<i>Scutellista cyanea</i> , Mot.	Miscogasteridae	S. India.
	<i>Inglesia chelonoides</i>	An Aphelinine chalcid.	do.	do.
	<i>Anomalococcus indicus</i>	<i>Elasmus indicus</i> , R.	do.	do.
	<i>Phenococcus insolitus</i>	A Eulophid chalcid	do.	do.
	<i>Phenacoccus iceryoides</i>	3 or 4 small chalcids.	do.	do.
	<i>Tachardia lacca</i>	<i>Gamphyloneurus indicus</i> , R.	do.	do.
	<i>Icerya aegyptiaca</i>	2 small chalcids.	do.	do.
	<i>Mytilaspis piparis</i>	A Eulophid chalcid.	do.	Coimbatore.
ORTHOPTERA Locustidae	Coccids on <i>Acacia</i>	<i>Elasmus indicus</i> , R.	Proctotrypidae	do.
	<i>Clavigrella gibbosa</i> (on eggs)	<i>Hadronotus fulviventris</i> .	Platygastridae	Bangalore.
	<i>Dolycoris indicus</i> (on eggs)	<i>Telenomus colemani</i> , Craw.	Encyrtidae	Mysoore.
	<i>Degonetes serratus</i> (on eggs)	<i>Anastatus colemani</i> .	Platygastridae	Bangalore.
	<i>Coptosoma cribraria</i>	<i>Telenomus laticulcus</i> .	Platygastridae	Coimbatore.
	Locustid eggs on Cordia leaf	<i>Pediobopsis locustivora</i> , Roh.	Eulophidae.	do.
	<i>Hieroglyphus banian</i> (on eggs)	<i>Scelis</i> sp.	Scelionidae.	do.
	<i>Oryza velox</i> on paddy (on eggs)	do.	do.	do.
	do.	<i>Anastatus</i> sp.	do.	do.
	do.	<i>Tumidiscapus oshlagus</i> , Gir.	do.	do.
	<i>mantis</i> sp. (egg capsules)	<i>Podagrion</i> sp.	Super. Chalcidoidea.	do.

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RAO SAHEB V. MUTHUSWAMI AYYAR

Mr. V. Muthuswami Ayyar was born on the 16th of December 1879 in the village of Kummalakudi in Tanjore district. His later, intimate, though official, connection with practical agriculture, was more than foreshadowed by his parentage, his father and grandfather being tillers of the soil in their ancestral property of a few acres in their native village. Mr. Muthuswami Ayyar, through his maternal uncle, who lived at Madura, had a number of chances of visiting that historic town and having his early years impregnated with that religious outlook which the associations of the ancient temple served to implant on all impressionable natures in early childhood. Muthuswami's education however was completely confined to St. Peter's College, Tanjore, from where he passed out in 1898. He immediately joined the College of Agriculture in Saidapet, from where he passed out with honours in 1902 winning the Robertson Medal. He was selected by the Department for further training and after a year's stay at Koilpatti, was deputed to the Bombay Presidency where he served on the Poona, the Surat and the Nadiad Farms. On his return, he

served as Farm Manager at Palur, Samalkota, Taliparamba and Anakapalle for various periods up to the year 1918, when he was transferred to Coimbatore as the Teaching Assistant in Agriculture. His long official career of over 32 years is thus defined into two periods—the earlier one from 1902 to 1918, having been spent on some of the biggest farms of this department, and the latter a period of another sixteen years spent at the Agricultural College, Coimbatore.

His choice as teaching assistant was therefore a very happy one, for, he came equipped to his task with the experience gained as a Farm Manager of several stations. Circumstances were less favourable to him than to others of his equipment and training, and it was not till almost the fag end of his career that he was gazetted as Lecturer in Agriculture and that too in an officiating vacancy. Government, however on the eve of his retirement recognised his meritorious service by the award of a Rao Sahib in the birthday honours in June last. He laid down his office on the 16th of December 1934.

Rao Sahib Muthuswami Ayyar in addition to his official duties at the College was intimately and personally connected with a number of activities on the Estate. The Officers' Club, the Officers' Mess, the Co-operative Stores, the Co-operative Society, the Radhakalyanam celebrations, and the Madras Agricultural Students' Union all owe a great deal of their present position to his selfless labours for their inception, or growth or maintenance. The Union especially, and the Journal bear and will bear the stamp of his personality for many more years to come. For a number of years 1920 to 1926 he was an important office-bearer, either as Secretary or as Editor or as Sub Editor or as Vice President and during those five years the responsibility for steering the Union and the Journal was chiefly in his hands, and this he did with great credit drawing unto him by his own example, a band of devoted workers who have helped to build up our traditions.

Rao Sahib Muthuswami Ayyar was a great social worker. He was the friend of the poor, the downtrodden and the despondent. His great heart flowed out in sympathy towards the sufferings of others, and many are those, who when in trouble, domestic or official, have been consoled by his comforting words and guided by his sage advice. He was held in great veneration by all estate residents. By his simplicity—both of dress and of habits—his outspokenness, his accessibility and his readiness to place himself at the service of any one who required him, he endeared himself not only to his students and his colleagues but to his superiors as well.

Rao Sahib Muthuswami Ayyar was an ideal teacher, who combined in himself erudite knowledge and the power to draw out the best from his students. With his quiet unassuming ways and almost paternal

solicitude for his pupils, he created a feeling of reverence in their minds and a desire to be as well informed in practical agriculture as he himself was. He was in fact something like the gurus of old, who not only by precept but also by example, set the standard of high thinking and plain living before their sishyas.

After thirty-two years of active service one cannot grudge him the rest that he so richly deserves; but it is the expressed opinion on many a quarter, that with him, will pass out a mass of information and an encyclopaedic amount of details about agriculture in this Presidency. It is the sincere wish and request of all his students that in the days of his retirement, he will, for the sake of the generations yet to come, translate all his ideas into concrete expositions that will serve as books of reference to the future student of agriculture. Personalities such as his shed light, lustre and love, with peace and good will prevailing, all round them and it is our prayer to the Almighty that Rao Sahab V. Muthuswami Ayyar will be spared very many more years, not only to enjoy his happy retirement in sound and active health, but also to contribute to making his little world of ours with its factions and strifes, a more cheerful and a more worthy place to live in. (M. R. B.)

Research Notes.

The effect of X-rays on Sorghum Pollen.

X-rays are a potential source for inducing mutations. Most of the work on X-radiation is confined to the irradiation of seeds—dry or germinating—under different conditions. In some cases the entire plant is irradiated, while in others the embryo in all stages of development is subjected to X-rays. Very little work with irradiated pollen has been done. The only records available, so far as we are aware, are those of Stadler and McKay and Goodspeed.

Pollen of sorghum was exposed to X-rays for 5, 10 and 15 minutes with a set up of 70 k. v., 1 m. a. target distance of 16 cm. without aluminium filter, and subsequently germinated in artificial media. The germinating medium was—41 per cent sucrose with 1.5 per cent shred agar. It will be seen from the following table that the different dosages have not resulted in statistically significant differences.

Duration of exposure to X-rays.	No. of pollen grains on the medium.		Percentage of germination.
	Sown.	Germinated.	
5 minutes.	1,232	371	30.1
10 "	1,333	389	29.2
15 "	1,414	408	28.9

Pollen treated as above was used to fertilise selected stigmas. Though pollen treated with different dosages germinated without much difference due to dosage, it will be noticed from the following table that the longer exposures were considerably less effective at fertilisation.

Duration of exposure to X-rays.	No. of flowers emasculated and pollinated.	No. of seeds set.	Percentage of seed-setting.
5 minutes.	48	20	41.7
10 "	39	7	18.0
15 "	61	11	18.0

It is remarkable that in the progeny raised from these seeds, one plant exhibited a suppression of the top eight leaf-blades showing only a stem merely ensheathed.

Millet Breeding Station,
Coimbatore, 21—11—'34.

G. N. Rangaswami Ayyangar.

V. Panduranga Rao.

ABSTRACTS

Report of the rice production and trade in the Madras Presidency By C. R. Srinivasan. The rice area and rice production have been generally on the increase during the last decade in almost all the rice producing countries of the east, particularly in Burma, Siam and Indo-China who on account of their huge exportable surplus, figure prominently in the international rice trade. Among the provinces of India, Madras occupies the fourth place as regards rice acreage and the third place as regards total production. The area under rice in Madras is about 11.4 million acres which form about 30 per cent of the area under cultivation. Of the 11.4 million acres, 8.2 millions are under irrigation while the balance is entirely dependent on rain. The net quantity of 5,036,322 tons of clean rice and 3,638,833 tons of millets produced annually in the province allows a consumption of 5 cwt. of cereals per year per adult head of the population which has been estimated to be 75 per cent of the total population. This quantity should be almost enough for the requirements of the Province, but since the yields of millets and the rice in the unirrigated areas are entirely dependent on favourable monsoons, there are big fluctuations in the production from year to year. There is usually a deficit of two to three hundred thousand tons of rice which she has to import from other countries and Provinces. Though this deficit was being met almost entirely by Burma previously, recently two other countries, Siam and Indo-China, have come into the field. The imports into Madras from these countries are continuously on the increase, and the import from Siam in particular is getting abnormally high since the beginning of 1934.

The entire import of Siam consists of broken rice, a bye-product in the preparation of raw rice for the international markets and is therefore very cheap. This cheapness combined with low transport charges by steamers is an inducement for the importers to bring it into the province in large quantities. Although its consumption is mainly confined to the poorer classes its price makes the price of the local produce come down relatively. There is no doubt that apart from the general economic depression gripping practically every country of the world, it is this huge import of the foreign rice into Madras that is responsible for disturbing the price levels of the local product. It so happens that the imports arrive at ports situated in the tracts which used to be the chief markets for the surplus product of the deltaic tracts in the province. In addition this imported rice is even sent to the centres in the interior up to distances of 80 to 100 miles from the ports where it competes with local rice. The rice or fall in price of the local rice follows more or less that of the imported rice. The price of rice in Madras at present is almost the same as that during the period 1904-08, i.e., it has come down by over 50 per cent since the depression began.

The railways are the chief means of transport of the local rice from place to place and the railway freight rates which had increased from 30 to 80 per cent during the last 15 years continue to-day at that level with certain exceptions, in spite of the fact that the value of the produce has come down considerably. Though the railway companies have allowed concession rates for the internal movement of the local produce wherever they come in competition with other means of transport, the advantages of such concessions cannot be fully availed of on account of the arrival of the cheap foreign rice at the ports and its distribution in the neighbourhood. Examination of the various agencies employed and the charges paid from the time the local produce is bought, up to the time it is offered to the consumer as a finished product gives no scope for a reduction in any of the items except the railway freights. Because of the high railway freights the movement of the produce within the province is getting more and more restricted and the foreign rice is gradually replacing it with the result that the condition of the rice grower is getting to be increasingly serious. The cost of production of rice was only 50 per cent of the market value of the produce before 1930, but now it has gone up to 70 to 80 per cent of the value, leaving the cultivator a much smaller margin to meet his other expenses from.

Besides the huge foreign imports, there is a certain amount of rice imported into the province from Bombay, Bengal, Central Provinces and it is not of much concern except probably the import from Central Provinces into the Vizagapatam district.

As regards foreign export from Madras, it amounted to only 75,504 tons in 1933-34 or roughly 1.5 per cent of the production. The exports are for Ceylon, Federated Malaya States and Strait Settlements. While the export from Godavari to Ceylon has considerably declined, that from Tanjore is being maintained and there is even a slight improvement since last year after the reduction in railway freights. The exports from Tanjore to Federated Malaya States and Strait Settlements are, however, again on the decline. The inland supply of rice from Madras, to the total extent of 2,402 (thousand maunds) in 1933-34 is for the markets of Mysore, Hyderabad and Bombay Deccan. This supply fluctuates with the production in these places. The long distance and the high transport charge by railways act as a deterrent against a larger movement than at present.

Examining the inland movement of rice within the province, the areas chiefly concerned in it are the districts of Godavari, Kistna, Nellore and Tanjore. The despatches from Northern Circars and Nellore are mainly in the form of raw rice though East and West Godavari districts send out some parboiled rice as well. In the Southern and Central districts, the movement is mainly confined to parboiled rice and paddy.

Machine milling of rice has made the hand pounding method obsolete in the rural areas. While rice is consumed as raw rice throughout the Circars and Ceded districts, in the South, Central and West Coast districts, it is mainly consumed as parboiled rice. The method of preparing parboiled rice varies according to the tracts and according to the size of the plant used in the manufacture. The movement of grain as paddy is confined mostly to places where the machine made parboiled rice is not popular. There is no doubt that it is the railway freight that stands in the way of greater internal movement of rice. Wherever the railway companies allowed concession rates the traffic has definitely increased.

Rice millers do not generally adopt any grade or standard for the produce they deal in. They mill rice according to the requirements of each market. A certain amount of adulteration between old and new, and superior and inferior rice, is always practised, particularly in the trade of raw rice. Good polishing

and the elimination of broken rice are practised only in the case of milling fine rice as it does not pay to adopt them in the case of coarse rice. In the trade there is no common unit followed. The produce is dealt, both in measure and in weight and the units of measure and weight vary from place to place often leading to confusion. The merit of the Departmental strains is appreciated by millers and merchants who pay a premium of two annas per bag of paddy for the produce obtained from them. It will be necessary to maintain their purity by the supply of pure stocks of seed from seed farms run in the different areas under Departmental supervision.

While the big landlords may be able to store their produce for some time after harvest, releasing it when price improves and even borrow money on the security of such stored produce, the large number of small cultivators have no such facilities, as they are obliged to sell off their produce immediately after harvest when price is low.

The following are some of the directions in which improvements may be introduced:—

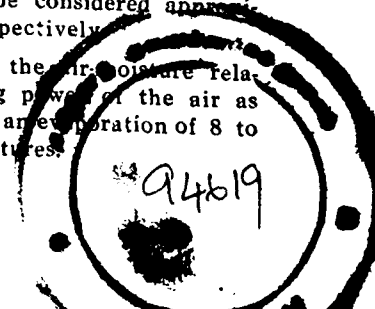
- (i) Prohibition of the import of foreign rice and paddy or the imposition of a duty on such imports.
- (ii) Reducing the railway freights to the minimum for transporting rice and paddy from all the producing centres in the Province to the different consuming centres and retaining the maximum freight rates for transport of foreign imports arriving in the ports to inland centres,
- (iii) Forming associations of millers and merchants and using such associations to fix grades of produce, to control adulteration, and to introduce the system of purchase and sale by a standard unit of weight,
- (iv) Publishing regularly in the vernacular dailies of the Province, the market rates for rice and paddy at all the important centres of the Province,
- (v) Organization of co-operative purchase and sale societies with warehousing arrangements to help the small cultivators, and
- (vi) Hastening the spread of improved strains in all the rice tracts and intensifying the propaganda about better cultivation and manuring of the fields, so that the acre yields will be improved and the cost of production proportionately reduced. (Author's summary).

The Relation of Air Conditions to Tobacco curing. By Johnson and Ogden. (*Wisconsin Agri. Exp. Stn. Research Bulletin 110, July 1931*). By means of three constant air control chambers, operated simultaneously, the influence of various temperature and humidity conditions was determined on the rate of curing of tobacco and the quality of the product.

On this basis, the optimum temperature for curing was found to lie between 90 and 95°F., provided that a sufficiently high humidity was maintained at the same time. The ordinary range of constant temperatures which will permit of approximately normal curing, assuming favourable humidities at the same time, however, lies between 65° and 100°F.

The optimum relative humidity for curing is dependent upon the temperature. In general, at temperatures between 75° and 100°F., a percentage relative humidity corresponding to the temperature figure may be considered approximately satisfactory i.e., at 75, 80, 85, 90 and 95 per cent respectively.

Relative humidity is not as satisfactory a measure of the air moisture relations surrounding curing tobacco as is the evaporating power of the air as measured by Livingston atmometers. On the latter basis, an evaporation of 8 to 12 cc. per day appears to be most desirable for all temperatures.



Detailed records of temperature and humidity conditions prevailing in the curing sheds have been taken over a period of six seasons. The average daily temperature over weekly periods rarely exceed 75°F., even at the top of the shed, indicating that ideal curing conditions are only for short periods of time. The average daily relative humidity for weekly periods was found to vary from as low as 44 per cent to as high as 96 per cent. The average daily evaporating power of the air for weekly periods has varied from about 3 cc. to 21 cc., a ratio of 1 to 7, indicating a much greater variation in actual air moisture relations than may be suspected from the records of relative humidity. Significant differences in temperature and humidity exist between the upper and lower tiers of the curing shed.

A preliminary report is made on the application of artificial heat to the air curing process, by means of a hot-air-furnace system installed in a curing shed. The practicability of the method will depend upon a number of factors yet to be determined.

Studies on the nature of "Pole-rot" and other forms of damage to the leaf occurring during the curing process have been aided by the use of toxic dusts such as the organic mercury compounds. The evidence from these studies points conclusively to the direct relation between a species *Alternaria* and "pole-rot".

(Author's summary).

Gleanings.

"Back to the Land"—Mr. Lloyd George's Precept and Example. When Indian Leaders advise Indian young men to go "back to the land," they do not set them an example by themselves becoming cultivators. But when Mr. Lloyd George spoke on the national importance of agriculture he meant business. Recently he and 100 Surrey farmers had been comparing notes on potatoes at a demonstration plot on his farm. He was overjoyed when it was found that his plot had come out best in the demonstration. He is more proud of his orchards than of anything else he has ever done. His eyes were bright as a child's when he plunged in among his heavily laden apple trees, to point out those that won him the first prize at the Crystal Palace, and others that had yielded fruit of unsuspected flavour and rich colouring. He went unerringly, obviously knowing them by heart, to other trees in the orchards that had so far been disappointments. "Remember those Worcesters you saw here last time?" he said; "No good at all. I was thinking of giving them up. Well, this year they have done wonderfully. Won the first prize." The farm at Churt is not the mere plaything of an elder statesman. It is a definite contribution to agriculture. For it was derelict when he took it, abandoned on account of its low grade soil, third or fourth class. Mr. Lloyd George is showing that it can yield abundantly when properly used. Mr. Lloyd George is cultivating about 24 out of 500 acres. Before his time the farm employed three men. To-day it employs thirty-one, earning from 45 s. to 50 s. per week. "I am happy," he said, "happier than I have ever been in my life. Politics were fun. I enjoyed all that; but they weren't somehow as satisfying as this is. I am addressing you not as an ex-Prime Minister, but as a registered potato-grower. I have ceased to be a politician. I have now become a cultivator of the soil; so that what I say is without reference to politics, and merely my observations as a cultivator of land. I am opposed to the policy of restricting production merely to raise prices. It suits me personally, but in the long run it won't do any good." (*The Modern Review* for November, 1934, page 634.)

World Search for Pasture-grasses. Drought-resistant grass species, to be used in rebuilding the depleted rangelands of the west, are to be sought in

Central Asia by an expedition being sent out by the U. S. Department of Agriculture. On the edge of the Gobi Desert there are great natural grasslands, which have been pastured for thousands of years by nomad tribes, without any sign of exhaustion. In this region the temperature ranges from 100 degrees Fahrenheit in the summer to 40 degrees below zero in the winter, and severe droughts are frequent. Yet the grasses survive, and the herds of livestock and game thrive on them. The leader of the expedition will be Professor Nicholas Roerich, veteran explorer of interior Asia, from Kashmir to Altai mountains. With him will be his son, George Roerich, an expert in Central Asiatic languages, and two U. S. Department of Agricultural specialists in grasses H. G. MacMillan and J. L. Stephens. (*Science* Vol. 80. No. 2068. Supp. p. 8).

Wheel and Bearing Equipment for Farm Wagons and Trailers. Studies of the draft of wheel equipment for farm wagons and trailers conducted at the Ohio Experiment Station are briefly summarized. The wheels were tested on meadow, cultivated soil, cinders, gravel, and concrete roads. The net loads varied from 2,000 to 5,000 lb., and the rates of travel from 2.5 to 20 miles per hour. The wheel tires were of steel and rubber.

The cultivated soil required the greatest draft, followed in order by meadow, gravel, cinder, and concrete roads. On four of the five tractive surfaces and at all loads and rates of travel, the low pressure pneumatic tyre required less draft than any of the other types of wheels tested. The only exception was on concrete road, where there was very little difference between the steel wheel and the low-pressure pneumatic tyre. The greatest difference in draft between the low-pressure pneumatic tyre and the steel wheel occurred on gravel roads.

The importance of wheel diameter depends largely upon the tractive surfaces over which the load is transported. In cultivated soil, however, the smaller diameter wheels required more draft, ranging from 1 to 15 per cent more and depending upon the weight of the load transported and the rate of travel. On hard-surfaced roads or even in meadow, very little difference in draft was noted.

The width of rim seems to be a factor in cultivated soil only. With loads weighing from 5,000 to 6,000 lb. the 6 in. rim gave a slight advantage. The 5 in. rim excelled at all loads weighing below 5,000 lb. Wheels equipped with roller bearings show a decided decrease in the draft of the wagon. On cinder road the wagon skein type of bearing required the greatest draft, while the taper-roller bearing required the least. (*Experiment Station Record* Vol. 71, No. 2, Aug. 1934, Page 255.)

Development of Root System of Tobacco under varied conditions, with particular reference to Cultural Practice and Fire-holding Capacity. Roots of tobacco were examined at several stages in their development by excavating trenches at various distances and removing the soil in successive layers, 10 cm. wide and 20 cm. deep. Washing the soil from the roots was also employed. In transplanting the 6 wk-old seedlings from the nursery beds the tap root is usually broken so that nearly all the roots arising later belong to the secondary root system. A close relationship exists between growth of new roots and soil moisture. Transplanting is usually done at the end of the dry monsoon. Thus watering for a period of 10 days is necessary for root establishment. Although growth of these roots may continue slowly thereafter, yet no new roots arise until the plants are again irrigated or rains occur. Both rate of growth and the degree of branching were greater in wet than in dry soil (no field soil water-content determinations are given). The number of roots and the depth of penetration were also greater in wet and irrigated soils than in soil unirrigated and unwatered by rain. The dry, heavy, clay soil consists of hard clods into which the roots cannot penetrate; consequently, they develop chiefly in the crevices

between the clods, and are distorted, thick woody and sparingly branched. Upon the advent of rains the colloidal soil swells and largely or entirely closes the crevices, cutting off the air supply to these deeper roots, which die, probably as a result of oxygen deficiency. In the meantime a new growth of fine, densely branched roots has spread horizontally in the surface soil. Not enough water is applied in irrigation to close the crevices and pores of the clay soil. In sandy soil irrigation or rains cause an increase in the number of roots both in the shallower and deeper soil, nor is there normal oblique direction of growth appreciably changed. Roots served by tillage operations branch freely in wet soil but not at all in dry, where they often wither and die. Manuring with sulphate of ammonia and green manure (*Crotalaria anagyroides*) resulted in a greater number of adventitious roots, their more rapid growth and more profuse branching. The direction of growth was scarcely affected and the depth of penetration only slightly increased. The roots of banana (*Musa*) spread widely just beneath the soil-surface and none penetrated beyond the first foot. Applications of phosphoric acid had no effect upon depth of root penetration. Greater drought resistance of tobacco strain (EK) over strain (Y-10) was shown to be due to more adventitious roots, more extensive root branching, a higher rate of root growth, and a more thorough occupation of the soil. Maximum depths of penetration were 84 and 70 cm. respectively. Root habits in regard to cultural practice are discussed. Irrigating soils of high chloride content in the surface soil will stimulate the absorption of too much chloride and in consequence will reduce the fire-holding capacity of the tobacco. Hence in such soils root development must be checked until rains set in, which dilute or leach the chlorides. Since irrigation does not bring these results about, or, if so, only temporarily, even fertilizers free from chlorides may harm the fire-holding capacity by stimulating the development of the absorbing area of the root system during the dry season. (*Biological Abstracts* Vol. 8 (5)—No. 11723—1934).

Crop and Trade Reports.

Paddy-Crop, 1934-35—Second forecast report. The average of the areas under paddy in the Madras Presidency during the five years ending 1932-33 has represented 13.3 per cent. of the total area under paddy in India.

The area sown with paddy up to the 25th November 1934 is estimated at 9,711,000 acres. When compared with the area of 10,491,000 acres estimated for the corresponding period of the previous year, it reveals a decrease of 7.4 per cent. The decrease in area occurs in all districts outside the Circars (Vizagapatam excepted) and Kurnool and is due to the receipt of late and insufficient rains. The first crop has been generally harvested throughout the Presidency. Normal yields have been reported from all districts except Guntur, Bellary, Anantapur, Cuddapah, Nellore, Chingleput, Salem, Coimbatore, Trichinopoly, Tinnevely and Malabar. The seasonal factor for the Presidency works out at 98 per cent. of the average as against 97 per cent. in the corresponding period of the previous year. The wholesale price of paddy per imperial maund of 82-2/7 lb. as reported from important markets towards the close of November 1934, was Rs. 2-14-0 in Madura, Rs. 2-13-0 in Nandyal and Vellore, Rs. 2-11-0 in Nellore and Salem, Rs. 2-10-0 in Tinnevely, Rs. 1-14-0 in Rajahmundry, Rs. 1-13-0 in Berhampur, Rs. 1-11-0 in Cocanada, and ranged from Rs. 2-0-0 to 2-6-0 in the other markets. When compared with the prices reported for October 1934, these prices are stationary in Berhampur, Vizianagaram, Nandyal, Vellore, Nizampatam, Tinnevely and Cochin; they have risen by 4 to 5 per cent. in Vizagapatam, Salem and Kumbakonam and are lower by 28 per cent. in Cocanada, 3 per cent. in Madura and 5 to 20 per cent. in the other markets.

Groundnut crop, Madras—1934—Intermediate report. The condition of the winter crop of groundnut is satisfactory in Vizagapatam, Chingleput, South Arcot, Chittoor and North Arcot. The crop has been affected by late sowing and subsequent heavy rains in Ganjam and by drought to some extent in the other districts, especially in the light soils of Bellary where it is reported to have suffered very much.

The wholesale price of groundnut (shelled) per imperial maund of 82-2/7 lb. as reported from important markets towards the close of October 1934 was Rs. 4-8-0 in Cuddalore, Rs. 4-5-0 in Vizagapatam and Vizianagaram and ranged from Rs. 3-8-0 to Rs. 3-13-0 in the other stations. When compared with the prices of the previous month, these prices reveal a rise of 19 per cent in Vizianagaram, 3 per cent in Vizagapatam and a fall of 13 per cent in Nandyal, 9 per cent in Cuddapah, 8 per cent in Cuddalore and 5 per cent in Salem.

Gingelly Crop—1934-35—Intermediate report. The yield of gingelly is expected to be normal only in Madura, Ramnad, Tinnevely and the West Coast. The crop has been affected to some extent by drought in most of the other districts.

Sugarcane Crop—Madras—1934. Intermediate report. The sugarcane crop was affected to some extent by drought in Bellary, Anantapur and Salem. The rains received towards the end of October and the beginning of November have lodged the crop in parts of the Cuddapah taluk. The condition of the crop is satisfactory in the other districts and the yield is expected to be normal if the season continues to be favourable.

The wholesale price of jaggery per Imperial maund of 82-2/7 lb. as reported from important markets towards the close of November 1934 was Rs. 10-5-0 in Erode, Rs. 7-2-0 in Trichinopoly, Rs. 6-5-0 in Nandyal, Rs. 6-3-0 in Bellary, Rs. 6-2-0 in Rajahmundry, Rs. 5-13-0 in Ellore and Cuddapah, Rs. 5-8-0 in Vizagapatam and Rs. 4-14-0 in Guntur and Vellore. When compared with the prices of the previous month, these prices reveal a rise of 2 per cent in Trichinopoly and a fall of 34 per cent in Guntur, 32 per cent in Vellore, 24 per cent in Nandyal, 21 per cent in Cuddapah, 19 per cent in Ellore, 16 per cent in Bellary, 11 per cent in Rajahmundry and 3 per cent in Vizagapatam. The price remained stationary in Erode.

College News & Notes.

Students' Corner. With the terminal examinations in progress, athletic activities were not very much in evidence during the month, on the college *maidan*; The Students' Club however participated in the Inter-District Olympic Sports held in Coimbatore and had the credit of knocking off the big cup—The Rao Bahadur Thiruvengadaswamy Mudaliar Cup—for the highest aggregate in the open events. They also entered for the Health Week Tournament in Foot ball and ran out winners. Of local interest, the final match in the Krishnamoorthy Rao Memorial Inter-Tutorial Hockey Tournament resulted in a win for Mr. P. V. Ramiah's wards who met and beat Mr. Sundararaman's.

The College Day Celebrations. The College Day Celebrations came off on the 13th (Conference) 14th (Business meeting and Entertainments) and 15th (Sports) of December. A detailed description will be published in the next issue.

Farewell. Rao Sahib V. Muthuswamy Ayyar, Lecturer in Agriculture, who retired from active service on 16th December was the recipient of a number of 'teas' arranged in his honour, by the students, the officers' club, the Indian Officers' Association and by other friends. Mr. K. Raghavacharya who was posted as lecturer in Agriculture, in his place assumed charge of his duties from 16th.

Visitors. Mr. R. C. Burt, Acting Vice-chairman of the Imperial Council of Agricultural Research, Mr. Hutchinson, Plant Geneticist, Indore, Mr. P. H. Rama Reddy, Secretary, Indian Central Cotton Committee, and Mr. S. V. Ramamurthy, Director of Agriculture, were amongst those who visited the College during the month, in addition to those who attended the College Day and Conference.

Association of Economic Biologists. Under the auspices of the above Association, Mr. Hutchinson delivered a very interesting lecture on the 9th on the "Importance of Genetics to the Crop Breeder."

Weather Review (NOVEMBER—1934)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	2.7	-1.3	4.47	South	Negapatam	8.9	-8.8	34.9
	Berhampore *	0.8	-6.1	33.2		Aduthurai *	4.8	-5.6	30.4
	Calingapatam	0.4	-3.5	25.0		Madura	2.9	-2.1	24.7
	Vizagapatam	4.1	+0.3	33.1		Pamban	4.2	-7.8	30.1
	Anakapalli *	3.6	-1.7	34.7		Koilpatti *	0.7	-6.3	23.1
	Samalkota *	2.3	-1.3	36.0		Palamkottah	0.6	-6.8	23.9
	Maruteru *	1.4	-3.7	28.4	West Coast	Trivandrum	6.5	-0.1	56.2
	Cocanada	4.1	-1.3	40.3		Cochin	3.1	-3.5	97.9
	Masulipatam	7.7	+2.0	35.1		Calicut	6.2	+0.9	107.9
	Guntur *	1.7	-1.9	33.5		Pattambi *	4.3	+0.5	89.7
Ceded Dists.	Kurnool	2.0	+0.9	20.3		Taliparamba *	4.4	0.0	131.0
	Nandyal *	1.5	0.0	27.0		Kasargode *	3.0	-1.0	121.4
	Hagari *	1.6	-0.2	14.8		Nileshwar *	3.2	-0.2	126.5
	Bellary	1.0	-1.2	14.4		Mangalore	1.4	-1.7	116.1
	Anantapur	0.3	...	9.2	Mysore and Coorg	Chitaldrug	0.6	-1.6	26.8
	Cuddapah	3.2	-0.4	23.3		Bangalore	1.1	-1.9	24.5
Carnatic	Nellore	2.4	-8.9	19.9		Mysore	3.7	+1.2	36.3
	Madras	1.9	-12.4	34.5		Mercara	2.0	-1.2	109.4
	Palur *	7.9	-3.4	53.9	Hills.	Kodaikanal	5.1	-3.1	53.9
	Palakuppam *	2.8	-8.1	35.6		Coonoor	5.4	...	51.1
	Cuddalore	10.2	-4.9	52.2		Ootacamund *	4.7	-0.3	43.7
Central	Vellore	7.2	+0.3	40.4		Nanjanad *	2.5	-1.5	40.0
	Hosur cattle farm *	2.3	0.8	24.7					
	Salem	3.6	-0.2	34.4					
	Coimbatore	1.1	-2.7	19.6					
	Coimbatore Res. Inst. *	2.7	-1.8	22.2					
	Trichinopoly	6.1	+0.5	25.7					

* Meteorological Stations of the Agricultural Department.

Summary of General Weather Conditions.

Weather remained dry over the major portion of the country after the 10th. Three depressions appeared during the month causing generally local rain in different portions of the country. The unsettled conditions off Konkan which were forming towards the end of last month developed into a storm on the 1st centred within one degree of Lat. $14\frac{1}{2}^{\circ}$ N and Long. $71\frac{1}{2}^{\circ}$ E. This caused widespread rain in Konkan and Deccan and local rain in Malabar, North Madras and Central Provinces. The storm moved northwards on the 4th and got filled up on

the 5th off Kathiwar. A second depression appeared on the 5th in the South East Bay of Bengal and moving North-Northwest developed into a storm and crossed the Arakan coast near Akyab on the 10th November. It weakened after causing widespread rain in South East Madras, Chota Nagpur, Bihar, Bengal and Assam. Locally heavy rain occurred in Burma and the Chittagong coast. After the 10th weather remained generally dry over the country except for a few falls in Tennesserium and South Madras. The third depression appeared in the Bay on the 25th and developed into a storm centred within a degree of Lat. 10° N and Long 84° E on the 26th, causing local rain in South East Madras, the storm crossed the coast near Negapatam on the 28th, weakened and became unimportant on the 29th. This caused local rain in South East Madras, Mysore and a few falls along the North Madras coast.

Four western disturbances affected the extreme north on the 6th, 9th, 16th and 20th causing a few showers in Kashmir and Baluchistan and passed away eastwards.

Rainfall was markedly below normal in the whole of the Presidency, that in Madras being in defect by—12.4." Night temperatures were below normal over the Peninsula during the dry weather period.

Weather Report for the Research Institute Observatory:

Report No. 11/34.

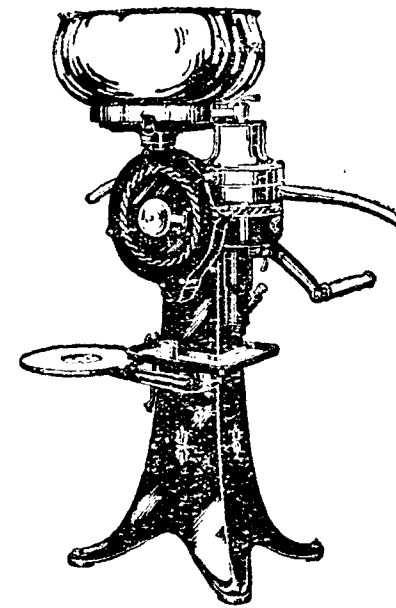
Absolute maximum in shade	88.5° F
Absolute Minimum in shade	57.5° F
Mean maximum in shade	84.6° F
Departure from normal	-0.1° F
Mean minimum in shade	66.5° F
Departure from normal	-2.2° F
Total rainfall	2.74"
Departure from normal	-1.79"
Heaviest fall in 24 hours	1.19"
Total number of rainy days	4
Mean daily wind velocity	3.3 M. P. H.
Mean humidity at 8 hours	74.2%
Departure from normal	-7.1%
Total hours of Bright Sunshine	202.1
Mean daily hours of Bright Sunshine	6.7

General Summary. Rainfall is in defect by -1.79". Minimum temperature is below normal. Humidity is in large defect.



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