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The Madras Agricultural Journal

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brilliant naturalists. It must be stated, however, that until about the middle of the last century zoological studies were pursued more with the idea of discovering and elucidating scientific truths than with the object of utilising the knowledge so gained towards the everyday needs and practical affairs of man; in other words very little attention was paid to the applied aspects of the science as compared with the purely academic and philosophical sides of it. But the rapid march of civilisation, the general increase in the earth's population, the growing rivalry among the more advanced nations in the exploitation of the rich tropical regions, the frequent wars in that connection and the consequent economic needs of human communities all over the world—all these have compelled man to look for the applied aspects of the different sciences for his future needs. Thus, within the past sixty or seventy years the study of economic zoology has been making rapid strides, and this is also due a great deal to the progress of Agriculture which began to loom large in the public eye. Within a comparatively short period of time so much work has been done in Zoology that special branches of studies have developed in modern days such as Protozoology, Helminthology, Parasitology, Economic Entomology, Pisciculture, and Economic ornithology. The subject of my discourse can be conveniently dealt with in one of two ways, one method is to consider the work of the economic zoologist in the different groups of animals in their natural order, while the other is to treat of the economic importance of the various animals connected with the different human departments or activities, such as animals concerned in food and clothing, those connected with diseases, those connected with various industries and so forth. I am taking up the former method and in doing so I shall very briefly and rapidly review the work done by the zoologist in the more important economic aspects of the different groups of animals and wherever possible indicate future lines of work; anything like doing full justice to the importance or magnitude of the subject is far beyond the possibilities of a short paper like this and with the time I can reasonably expect to take to-day. I have a few slides and diagrams to illustrate some of the statements in my paper and I believe that in subjects like this a diagram is more effective and telling than a torrent of the most carefully selected adjectives.

Starting from the lower rungs of the Animal Kingdom we have the *Protozoa* or unicellular organisms. It will be seen that in no group of animals has work of such remarkable nature and magnitude been done in such a comparatively short period of time as in this group, and the branch of Protozoology has advanced by leaps and bounds and has almost outbeaten all other branches of biological study in its economic importance. The wonderful researches in the aetiology of malaria, yellow fever and sleeping sickness, the study of the causative organisms and their life histories in different hosts—these alone of the many other studies connected with Protozoa will be sufficient to indicate some of the outstanding triumphs of modern scientific investigations. Other studies worth noting are the researches in connection with the organisms causing Pebrine in silkworms, Kala Aazar in man, Surra in horses and Texas in cattle fever. Most of the protozoan investigations relate to medical and veterinary branches and the application of such knowledge in the alleviation of pain and the treatment of some of the deadly diseases to which man and beast are subject to. The love and devotion to science of many of the medical zoologists who have carried on investigations, often under very trying and risky situations, can only be compared to their marvellous achievements in the field of Science, and humanity should ever be grateful to these

eminent workers. Pebrine is the earliest known of Protozoan maladies and this disease was on the point of completely ruining the silk industry of France, when Louis Pasteur saved the same by his studies of the Pebrine organism and his method of microscopic selection of seeds. Recent researches in rabies have made it easy for medical men to diagnose as to whether a suspected dog is rabid or not by an examination of its brain cells for 'Negri' bodies and then decide as to whether a bitten patient needs the pasteur treatment or not. In the following table are enumerated some of the important protozoan organisms with their pathogenic characters to show the importance and magnitude of the work done.

NAME OF ORGANISM	DISEASE IT IS CONNECTED WITH	REMARKS
<i>Nosema bombycis</i> .	Pebrine.	In silk worms.
<i>Entamoeba histolytica</i> .	Dysentery.	In man in tropical and semitropical regions (by fly).
Negri bodies in brain.	Hydrophobia.	In dogs and man.
<i>Trypanosoma gambiense</i> .	Sleeping sickness of man.	Africa, carried by Tsetse fly. 177
<i>Plasmodium spp.</i>	Malaria.	All over tropics (by Mosquito).
<i>T. evansi</i> .	Surra in horse.	N. India (by stable fly).
<i>T. brucei</i> .	Cattle nagana.	Africa (by Tsetse fly).
<i>Piroplasma bigemina</i> .	Cattle fever.	Tick (<i>Boophilus annulatus</i>) Texas (first protozoan disease carried by arthropods).
<i>Leishmania donovani</i> .	Kala aazar.	Asia (Bug).
<i>Leptospira icteroides</i> .	Yellow fever.	Central America (mosquito).
<i>Spironema sp.</i>	Relapsing fever.	Asia (Lice).
<i>Treponema pallidum</i> .	Syphilis.	Widely distributed.

Before leaving protozoa it may be interesting to make a passing reference to the recent researches in soil protozoa and their effect on field crops. Russell and Hutchinson have propounded a theory to the effect that many soil protozoa are injurious to the growth of plants and that a partial sterilization of the soil yields better crops; this new theory is likely to lead into interesting avenues of investigation.

Leaving the unicellular animals we come to the lowest of multicellular forms, the group *Porifera* or sponges. It is probably not known to many that sponges are of animal origin and that they have any economic importance. The bath sponge or sponge of commerce used for toilet and other purposes is the fibrous skeleton (called spongin) of a colony of sponge organisms; this skeleton is rough when dry and smooth and flexible when wet. The studies on these creatures have shown that they can be artificially cultivated from cuttings in shallow seas; and at present sponge farming on a large scale is carried on in parts of the Florida coast and the Mediterranean.

From sponges we come to the next economically important group the 'Worms' which constitute a very important division both from the purely scientific and the economic points of view. As in the case of protozoa the studies on worms have been chiefly confined to those forms having a pathogenic importance and a special branch of zoology called Helminthology has been erected to include such and allied studies. Most important of such worms are the Flukes, tape worms, and the round worms including among others the human eel-worm, the pin-worm, the filariasis worm, the guinea-worm, and the notorious hook-worm. As in Malaria and yellow fever it has

been found that some of these worms during their life pass through alternate hosts. A knowledge of the relationship between the liver fluke (the cause of liver rot in sheep) and the garden snail, the human tape-worm and the ox, the guinea-worm and the water-flea, and the filarial worm and the house mosquito—all these have considerably helped us in devising various ways and means in the control of such disease carrying worms. Considerable amount of work has been done in recent years on the hook-worm (*Ancylostoma*) in the different parts of the world and it has been found that it is one of the worst maladies affecting man in the tropics, and that combined with malaria it has affected very appreciably the health of the labouring classes and racial stamina in the tropics. The Rockefeller health board is doing remarkable work of a philanthropic nature in this direction in different parts of the world.

Apart from these forms affecting the health of man there is a small group of worms called Eelworms, very minute forms with a wide distribution all over the world and affecting cultivated crops of different kinds; they live inside roots and rootlets and cause root nodules and often kill the plants. In this country we have eel worms attacking tea, pepper, betel vine, and a number of garden plants; it is probably known to many of you that the 'Ufra' disease of paddy is caused by an Eel worm. The studies on earthworms and their beneficial effects on the soil are too well known to deserve any special remark here. The Leech which is occasionally used as a blood-sucker by surgeons is a great nuisance in the hill plantations and causes great deal of bleeding among coolies working barelegged. Not much is known of the bionomics of these forest forms, and these deserve attention.

The group *Mollusca* including shelled animals is of economic importance in different ways and zoological work on them has helped man considerably. Studies on the breeding and seasonal habits of different kinds of oysters, mussels and snails have enabled such industries as oyster and shell fish farming, Pearl fisheries and mother of Pearl industry to develop on a commercial scale. There are regular oyster breeding farms in the west, especially in America where oysters are extensively used as an article of food. Snails are a delicacy in France and in some of the restaurants of Paris I was shown costly dishes made of snails called *Escargot* in French. Around Paris there exist snail farms called 'Snaileries' where special studies are made of the breeding and other habits of these creatures and number of them reared for the city markets. The importance of the Pearl oyster (*Margaritifera*) is well known to us all. The formation of pearl inside the shell of an oyster is the secretion of pearly substance by the creature around a foreign body which irritates its soft body; it is believed that this foreign body may be a grain of sand, a calcareous particle, or even the larva of a parasitic worm. The industry thrives generally in the Persian Gulf, in the Gulf of Mannar and other places. Recently in Japan Prof. Mitsukuri has very successfully produced pearls by the introduction of foreign particles inside the bodies of oysters and this method of producing what is called 'cultural pearls' as different from 'natural pearls' or 'artificial pearls' has recently been attracting great attention among those interested in Pearl fisheries. Allied to this are the minor industries, such as collection of shells and cowries of sorts and the mother of pearl industry connected with the manufacture of buttons, combs and other fancy articles.

We now come to the big sub-kingdom *Arthropoda* which includes the groups *Crustacea* (Crabs, prawns, etc.) *Arachnida* (Scorpions, spiders, ticks, mites, etc.) *Myriapoda* (centipedes and millipedes) and the division of *Insects*. The first three groups include fewer forms and are not of such

economic importance as the insects. Considerable amount of work has been done on insects both from the purely scientific and economic aspects, and the branch of Economic Entomology has come into great prominence nowadays, especially due to the rapid progress of scientific Agriculture. One important point which the economic entomologist has to note in the study of insects is the phenomenon of metamorphosis—passing through a series of different stages in the life history; the different stages are in most cases so different in structure and habits that the layman and even some educated men would refuse to believe that the leaf-eating caterpillar crawling over the plant is the young one of the gaudy butterfly hovering in the air; this aspect necessitates a more thorough study of the insects of economic importance.

It is needless to state that insects affect human interests in various ways both for good and evil more than any other or all the other groups of animals put together. To have a rough idea of the loss caused by insect pests to cultivated plants I might quote the statement of two well known American authorities. According to Webster 'It costs the American farmer more to feed his insect foes than it does to educate his children; the estimated damage done by insects comes annually to 400 million dollars while the common schools and higher educational institutions cost together only about 300 million dollars.' According to Slingerland 'the yearly losses from insect ravages aggregate nearly twice as much as it costs to maintain our army and navy, more than twice the loss by fire, twice the capital invested in manufacturing agricultural implements, and nearly three times the estimated value of the products of all the fruit orchards, vineyards and small fruit farms in the country'. A vast collection of literature has accumulated around this subject of Economic Entomology, and so I can do nothing more than give a glimpse of this subject in this short paper, one with a more comprehensive theme. Some of the farmers' pests which have gained international notoriety are the locusts, termites, scale insects, fruit flies and caterpillars of sorts. The depredations of termites are serious all over the tropics and to have an idea of their ravages we may quote Drummonds' words during his African experiences, viz. 'If a man lay down to sleep with a wooden leg, it would be a heap of dust the next morning'. I daresay many of you must have seen the termite queen. If there are any who have not had an introduction to Her Majesty I have got some specimens here. We have at present the locust problem engaging the attention of the authorities in North India, and the menace of fruit flies is always before us though the dreaded Mediterranean form (*Ceratitis*) has not come into our midst. The notorious Fluted Scale (*Icerya*) has gained admission and it remains to be seen what more is in store for the future. In addition to these crop pests are the pests of cattle and domestic animals, the household insects, and those affecting man himself. Some of these latter have been referred to in connection with Protozoan diseases. Almost every one among us, scientist or no scientist, is aware of the extent and seriousness of the harm caused to public health by the common and apparently innocent looking housefly; such dreadful diseases like cholera, typhoid, dysentery, pneumonia are easily transmitted by this insect wherever opportunities offer themselves, and we cannot sufficiently warn householders to be on the guard against this most dangerous insect.

Many of us in Coimbatore know by actual experience the part played by rats in the spread of bubonic plague; it is now well known as a result of studies that the rat flea—an active little insect living on the rat, is the transmitting agent of the disease germ from rat to man. Nor are cattle and

domestic animals free from the attention of noxious arthropods. Numerous ticks, mites and flies not only seriously affect their general condition, but often kill them in numbers. The life history of the Horse Bot is one out of the many interesting investigations not only to give us an idea of the wonderful adaptations in the animal world, but also the great value of zoological observations. The bot fly attacking the horse attaches its eggs singly on the hairs in the regions near the fore legs of the horse. When the egg is about to hatch or has just hatched the horse feels some slight irritation and licks up the maggot which on that account finds its way into the horse's stomach through the alimentary tract where it remains for some months and then passes to the soil with the faeces. If the eggs are laid beyond the reach of the horse's tongue and if the horse does not lick up the maggot, there is no hope for it but to die. The scabies in sheep, the red mange in dogs, the itch and kopra sores of man are all arthropod diseases and considerable amount of work has been done in this line both by pure zoologists and veterinary men in studying the habits of the responsible arthropod organisms and contriving control methods.

As though to compensate for all these losses, we have another set of arthropods which are on the other hand useful to man in different ways; this aspect of their beneficial activities is often overlooked because it is not so very obvious as compared with the depredations of injurious forms. Sericulture, Bee-keeping, and Lac culture form the most important industries related to the respective beneficial forms—the silkworm, honey bees and the lac insect. In addition to these which may be called as productive insects there are others which help man in such acts as fighting both his plant and animal pests, as parasites, predators, etc., serving as articles of food, drug or ornaments, or in the pollination of flowers useful to him. An interesting example of the latter is furnished by the Smyrna fig the proper fruiting of which is absolutely dependent on the fertilizing wasp 'Blastophaga' for which one must have Capri figs in which the insects breed. The process is called 'Caprification,' and without this process the Smyrna fig industry does not thrive. I think it is time that I now leave this group of animals lest I unnecessarily wax eloquent on insects having become a little more familiar with them during the past two decades.

We now come to higher animals. Almost every one of them has some economic importance or other, and a good deal is well known to most of us; so, I shall just skip over the groups just touching on such points which, in my opinion, may be of interest and may not be too well known to all of us.

The studies in *Fishes* relating to the recognition of edible and poisonous forms, the breeding, spawning and migrating habits and the methods of artificial propagation, preservation and canning—have all within the past few decades helped to build up various famous and flourishing fisheries industries in almost all countries. The discovery of some kinds of fish as mosquito destroyers and their employment in mosquito-ridden regions may also be mentioned in connection with the economic importance of fishes. Some of us would naturally doubt as to whether such creatures as frogs and toads have any mission or economic importance in this world. As a typical animal for experimental purposes and dissection in science institutions the frog has been found very handy and it is practically the 'martyr' for zoological studies. It is perhaps known that the frog is used as an article of food in many western countries and I have had occasion to see them being sold alive for food purposes in the markets of California. Regular frog farming is carried on in different places and there

is said to exist in Ontario a farm in operation for the past 25 years, producing every year 7,000 living frogs, in addition to 500 lbs. of dressed frogs' leg which is regarded as a special delicacy; zoologists are employed by these farms to investigate into the life history, breeding season and habits of different frogs so as to keep the industry flourishing. All of us are familiar with the tadpole stage of the frog and it has been found by frog farmers that the tadpole does not change into the tailless frog unless the edge of the natural or artificial pond has a sloping side, and in its absence remains as a tadpole for months together. Another interesting and important problem with which these frog farmers who have to keep thousands of frogs alive all through the year is said to be that of feeding them; for, the frog does not eat anything that is not moving though the tadpole in the water eats anything. I have referred to this apparently unimportant fact just to give an example of how small points in zoological studies often become important economic problems. Toads are not generally eaten but are very useful as insect destroyers as may be found by their presence in numbers around electric lights in the streets which attract numerous small insects. Kirkland in his account of his observations on the American toad says that the toads food is about 88 per cent insects and 16 per cent of these are cut worms and counting these cutworms alone he has estimated the annual saving to the farmer by each toad as 20 dollars or nearly Rs 60. During a pest of army worms he found in toad's stomach 55 worms; as such, as an insect destroyer the toad has few superiors.

A study of lizards and snakes has generally enabled us to recognise which of them are harmless and which dangerous or poisonous. It has been found that among lizards of which there are hundreds of species the American 'Heloderma' is the solitary example of a poisonous form. As to snakes the most important of our poisonous forms are the Cobra, Russell's Viper, Bungarus and the Pit Viper. A great deal of work has been done both by Ophiologists and medical men in the study of snakes of different kinds, the poison apparatus of the different forms, the nature of the poison, the treatment of snake bites, the preparation of anti venom sera and all these have received considerable attention in modern days, and men like Col. Wall have helped the layman a good deal in this direction and deserve our grateful thanks for such work.

The economic importance of birds in various ways and the work of zoologists in that direction have developed the branch of Ornithology. Many birds are used as food both as egg, and adult, many are useful as insectivorous and helpful to man and there are a few valued for their plumage. The African Ostrich, the largest of living birds, sometimes reaching eight feet in length is reared in ostrich farms in South Africa chiefly for its beautiful white plumage. The flesh of it is not much eaten but the egg is relished and is said to contain as much food as two dozen hens' eggs. At the same time there are some like the sparrow, crow, and some graminivorous and frugivorous birds which do us harm. The study of the food, breeding and migrating habits of birds—especially of those affecting man's interests has brought economic ornithology to an important position among applied sciences.

We now come to the highest group of animals the *Mammals*, which includes among others many of the oldest companions of man like the cow, the sheep, the horse, cat, dog, rat, etc. etc. There is hardly any necessity for me to dwell on such well known and ancient aspects of mammalogy as sheep breeding, stock raising, animal Husbandry etc. etc. The rats, jackals,

squirrels, and monkeys are some of the mammals which cause often serious damage to our crops and other belongings, and attention is nowadays being paid to study the habits of these pests and vermin and to control them. The injury caused to man and his belongings by such wild animals as tigers, leopards, board, elephants etc. are also too familiar and shikars and naturalists have helped us considerably in adding to our knowledge of the habits of these animals—especially the pages of the Journal of The Bombay Natural History Society abounds in information on such topics connected with Indian forms and these will be very useful to us in many ways. I would, however, invite your attention a little to one or two interesting aspects of mammalogy with which I believe some of us are not quite familiar. I refer to the economic importance of the aquatic forms like whales, seals and the fur bearing groups of mammals like foxes, sable, otter, skunk etc. The economic importance of whales consists in the demand for a few important whale products *viz.* whale oil, whale bone, spermaceti and ambergris. Whale oil is got by boiling the thick fatty layer just below the naked body surface, 12 to 18 inches thick in some cases, and fetching about 30 tons of oil from each whale. This has been used for various purposes, chiefly candle making. Whale bone which is found in toothless whales, is a structure composed of a series of fringed plates attached to the upper jaw and this helps the creature in feeding by straining all the small animals from the water which enters its mouth. These were in use largely for ladies' (crinoline) dresses till recently but at present there is not so much demand for it. Spermaceti is a wax like solid obtained with the oil, especially from within the skull of some whales; this is also used in the manufacture of candles. Ambergris is a light solid often found inside the intestine of the sperm whale. It is a very costly stuff and lumps have been obtained worth about Rs 30,000; it is used for medicinal purposes and chiefly in the manufacture of perfumes. The flesh of whales is made into guano as with fish. Whale fishing is a very old industry and until a few decades ago whaling was carried on extensively and indiscriminately so much that some of the species of whales became almost extinct. Nowadays men engaged in this industry have found out that whaling should be restricted not only in the interests of the industry but in the interest of the conservation of the different species of whales which were almost nearing extinction. Some measures adopted in different areas comprise the annual licensing of whaling steamers, prohibition of whaling in some waters and protection of gravid females and cows accompanied by calves. In this way in the interests of zoological science as well, measures to conserve these leviathans of the ocean from becoming extinct have been gradually adopted. Similar is the story regarding the aquatic carnivora, popularly known as seals, but which include the sea lions, the walrus and the true seals. Like the whales these are adapted for an aquatic life though they have not become modified to such an extent as in the whales. Seals are hunted for their skin or pelt and for their oil. Sealing was carried on indiscriminately and seals were ruthlessly slaughtered and consequently the number of animals began to decrease considerably and the sea elephant was almost extinguished. At the suggestion of some American naturalists pressure was brought on Government and an international treaty was agreed to in 1911 whereby measures to conserve these animals were adopted. The fur bearing mammals are chiefly of the Weasel and fox family and distributed in the north temperate and polar regions. Russia, Greenland and Canada being the chief centres for the fur industry. Fur industry is a very old industry since furs were important objects of barter between civilised and savage communities. Recent investigations on the

habits of the various fur bearing forms have helped not only to place this industry on a solid foundation but to conserve many of the fur bearing animals from becoming extinct.

Gentlemen, I have now finished my very rapid survey of the economic aspects of the different groups of animals. I feel that in doing so I have chiefly dwelt only on the economic aspects of the different groups and the work done so far by the zoologist and that it was not possible for me to dwell satisfactorily on the future rôle of the zoologist, especially on such important subjects as principles of pest control, Biological methods of pest control, legislation for animal conservation especially for birds and wild beasts of sorts, and such interesting matters. Before I finish I beg to be allowed to make just a reference or two to certain other aspects of the zoologist's work which have proved of great material and moral value to mankind. The investigations on such important phenomena as Parasitism, Social life and the various adaptations in structure and habits as mimicry, protective structure, maternal instinct and a host of other characters which Thomson aptly calls 'shifts for a living' have taught many lessons to us which often influence our worldly affairs. To take only one or two examples out of the many—a knowledge of the social or family life among animals especially, such forms as ants and bees have helped us to understand such things as co-operation division of labour, union, team work and so on; similarly from parasitism in animals we have learnt how in its wake follow dependence on another and the loss of individuality and degeneration. Apart from these which might help man in his behaviour etc., the accumulated knowledge of animals in their various aspects have given plenty of material for man to understand or at least get a partial insight into such phenomena as Variation and Heredity and the principles of Genetics, Eugenics etc. The earlier but none the less remarkable and classical works of naturalists like Darwin, Wallace, Mendel and Weissman have been considerably augmented by modern zoologists and botanists in different ways. In the branch of experimental zoology which has considerably developed in connection with these studies, most remarkable and wonderful work has been done by eminent scientists like Morgan, Castle, Newman, Wilson and many others, in solving some of the most wonderful problems in Biology. The Classical work on the Pomace fly (*Drosophila*) by Prof. Morgan of Columbia and the results so far achieved in that connection will alone stand as one of the most wonderful and remarkable accomplishments in Biological science, since it led to the discovery of the Chromosome theory of heredity. Such accomplishments in co-operation with the work of Botanists on similar lines have revolutionised plant and animal breeding and made Applied Biology a science of vital importance to humanity. I cannot do better than sum up the value of the Zoologist in his relation to human activities by quoting the words of Mr. Wilson the Chief of the U. S. A. Biological Survey some years ago.

"In its relation to public welfare economic zoology is of the most vital and far reaching importance. Animal life from its lowest organisms, among which lurk some of our deadliest foes as well as beneficent friends, to the highest vertebrates, touches and affects our lives and welfare in innumerable ways. It must be studied in all its phases as never before to guard against previously unsuspected or little known diseases of man and domestic animals as well as to develop the wealth and ever increasing variety of products from which we obtain food, medicines, clothing, dyes, ornaments and an endless number of useful articles. No man can be considered well informed who has not a considerable knowledge of economic zoology in its more direct relationship to human life, while to the scientific investigator the subject has the charm of endless variety and service to mankind."

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While I yield to none in my appreciation of the importance of applied zoological work, I must be allowed to point out that there is a deplorable tendency in some quarters to belittle the value of work in pure or systematic zoology on the score that such work may not be of immediate economic importance; such an attitude on the part of one who professes to be a scientist cannot be sufficiently deprecated; for, no zoological work of an applied nature can progress on correct lines without the sure foundation of preliminary studies in pure zoology and systematics. I would invite the attention of such short-sighted men to the words of the eminent scientist Prof. Pearl—'It is the systematist who has furnished the bricks with which the whole structure of biological knowledge has been reared, without his labours the facts of organic evolution could scarcely have been perceived and it is he who to-day really sets the basic problems for the geneticist and the student of experimental biologist.'

In my opinion the most important lines in which biological work might be carried on to be of great help to the economic zoologist are intensive life history and systematic work and the study of animals from an ecological point of view—an aspect of zoology in which very little work has been done in India.

'Animal ecology is a branch of zoology which is perhaps more able to offer immediate practical help to mankind than any of the others and in the present rather parlous state of Civilisation it would seem particularly important to include it in the training of young zoologists. It is the real foundation for applied Biology. The tropical entomologist, mycologist or weedkiller will only be fulfilling his functions properly if he is first and foremost an Ecologist' (Elton).

In conclusion I would add that while in these days there is need for specialisation on the part of different biological workers each in his own branch, a general knowledge on the part of each of the specialists of what others are engaged in will be of great advantage to all; since, nowadays, there arise numerous biological problems which call for co-operation and team work.

Gentlemen, I have now finished with my apparently imperfect and unconnected thoughts. I am afraid, my paper might have been to some a rather tedious infliction; if it were so I am indeed very sorry, but if I have succeeded in creating in my hearers some interest in some of the many problems I touched upon I shall be amply repaid and feel that I have not wasted your valuable time.

WOOL YIELD IN SOUTH INDIAN SHEEP

By P. K. KRISHNAN NAMBIYAR

(Assistant Farm Manager, Chintaladevi)

The economic aspects of rearing sheep as a side industry in Southern India have already been published in the *Journal of the Textile Institute*, Vol. 19 of 1928, article 5 (a). The experiences and facts gained during the last few years of sheep rearing in Hosur compared with the local practices in South India have now made clear that something more can be expected from the indigenous breeds of Southern India, both in the form of mutton and wool, towards the betterment of the shepherds and ryots of this country.

The proper methods of breeding, rearing and management of sheep have already been mentioned in the above noted Journal. The present consideration is about the wool yield in sheep. It is true that a shepherd or a ryot can expect a better yield than what he obtains at present under the existing conditions, by adopting the methods already mentioned. The points favourable to the Bellary breed must also hold good for every other breed in Southern India.

The rapid deterioration of wool in these breeds was mainly due to want of proper knowledge in the art and partly due to the neglect of this industry by the well-to-do ryots. The factors that affect the economical aspects of any particular breed with regard to its wool yield are: 1. colour; 2. quantity; 3. quality. Many shepherds and ryots of these parts know that the market value of their wool depends on the above factors; yet they do not seem to try any means to overcome their difficulties on these points.

Colour. The wool in the market is generally graded in three different colours, namely white, black, and mixture. White wool fetches a better price than the other two, being more attractive. The other advantage of the colour is that it can be dyed with any other desirable colour unlike other kinds. Black stands second and lastly the mixture. It is only the last sort (mixture) that is found in large quantities in South India. One can only attribute this to the absence of pure breeds in the locality.

The colour of a particular breed can be kept up by rigorous selection and careful breeding. The details of colour inheritance is of very little use here, as it is beyond the scope of an ordinary ryot to conduct any experiment on this at present. But it is easy for them to select only pure ones from their flock, no matter whether they are whites, black-faced whites, or blacks, and to get them mated by pure ones of the same colour. Even then they may find some undesirable colours appearing here and there. These can be weeded out every year. Thus by continued efforts it will be possible to maintain a pure colour in a flock.

A flock possessing white fibres, whether it be a pure white or a black-faced white, is of more advantage as these do not turn into any other colour unless much advanced in age which of course is out of consideration as they are not generally kept unsold beyond 6 years of age. But black fibres turn grey from 3rd clipping onwards, and after that it can only be classed under

mixture. Mixture of course is far inferior and even the ryots dislike it. This is the outcome of a careless breeding and management.

Quantity: The condition and yield of the present flocks of sheep in these parts and the causes that led to such a rapid deterioration has already been explained before. The present consideration is whether one cannot increase the wool yield in South Indian sheep, if not reach the maximum yield which a particular breed is capable of putting forth. This can be obtained if the ryots and shepherds are a little more careful in noting the following main factors that induce the maximum yield in any particular breed: 1. Selection and Breeding, 2. Feeding, 3. Management, 4. Clipping, 5. Dipping.

Selection and Breeding: A ryot after having isolated a particular colour, say, white, or black-faced white, or black from his flock, his business is to see that he keeps only good woolly sheep having a few qualities of mutton class as his breeding stock because his main idea is to keep an animal capable of producing both mutton and wool at one and the same time.

These can be easily picked out by himself as his eyes are liable to be trained in this by constant attention to his flock. But to an inexperienced man the following points will help to spot out the desired sheep from his flock. A square shaped body with well spread ribs, straight and flat back with broad pelvic regions, short legs and neck with dense and compact fibres on the neck, belly and legs. They must also have a hardy muscular and quick growing nature or disposition. Quick growing or early maturity from a mutton point of view means not only weight for age, but also a quick change in the proportions of the parts. After having selected a flock of quick growing sheep with a good average wool yield, his next efforts must be to maintain it by careful breeding. This he can do by using proper breeding rams on his flock as sires and also by continued elimination of the undesired characters.

Feeding: The details of food stuffs, the time and methods of feeding etc. were already dealt with in the above-mentioned article and a repetition of the same is only superfluous. It is enough if the ryots and shepherds will only adhere to it for a satisfactory result. Proper feeding is an important factor where the health and wool yield of sheep are considered. Both overfeeding and underfeeding are bad as far as wool yield is concerned. In overfeeding not only there is waste of foodstuffs but may also lead to accumulation of more yolk in the fibre which will affect the market value of the wool produced. Further, overfeeding on rich concentrates may lead to so many other troubles, such as jaundice, diarrhoea, dysentery etc. Underfeeding is naturally detrimental to the health and wool yield of sheep. It will also be difficult to select a proper class of wool yielding sheep from flocks brought up under bad nutritive conditions.

Management: This is another factor that affects the quantity and quality of wool yield. Sheep are very timid in their habits and very easily frightened. Harsh treatment and rough handling will not only arrest their desired body growth and wool yield but will also lead to the abortions in pregnant ewes and discolouration of fibres in the clippings that follow the one on hand. For instance, a white sheep may put fresh black or pigmented fibre in places wherever it was injured by such treatment. Similarly a black sheep may produce grey or pigmented fibres in place of black ones. The real cause that leads to this kind of behaviour in sheep has not yet been fully understood.

Too much exposure to inclement weather is also detrimental to their health and will naturally tell upon the quantity and quality of wool produced

by them, as healthy animals alone can produce normal fleece. Further, if they are exposed to too much rain, the quantity of yolk present on their wool fibres will be washed away and will not only feel harsh to the touch, but also will be kept open for the harmful insects such as ticks, lice etc., and foreign matter to enter into and make a comfortable shelter in the body of the sheep.

Clipping: This is not at all practised in some parts of Southern India. In some places sheep are clipped only once and in some other parts they are clipped twice a year and these too in an indiscriminate fashion. The owners do not observe any definite season or weather for shearing their sheep and in most cases instead of this (clipping) being advantageous on both the sides, leads to harmful results such as pneumonia, catarrh, exhaustion, congestion of lungs etc., especially among young stock, between six months and two years.

The proper seasons for clipping are just a fortnight before the commencement of summer, i.e. in March and a couple of weeks before the commencement of winter, i.e. in October. Twice clipping is more advantageous as it facilitates two dippings every year; a necessity in South India, wherein frequent access of harmful insects on their bodies are observed. The clippings in the above seasons will also induce nature to accelerate the wool growth in sheep.

Methods of Clipping: The local practice of shearing sheep is by hand-shears known as spring-grass-shears or sheep-shears. These can be made locally or can be obtained from Messrs. T. E. Thompson & Co. Ltd., Calcutta for Rs 2-8 per pair. By this practice about $\frac{1}{2}$ an inch of wool is left in the body itself, as there are no expert sheavers at present in South India. Hence a full yield is not generally obtained. Further, the harmful insects and the foreign matter adhering to the body are retained on the body itself leading to subsequent troubles. It is also difficult to study the condition and health of the animals as the body is always covered with some quantity of wool.

These difficulties can be got over by using a 'Lister sheep shearing machine' which can be obtained from the Army and Navy Stores, Bombay, for Rs 166 packing and freight charges extra. In this case the wool fibres are clipped very close to the body and the whole surface is exposed; so much so all the foreign matter and the harmful insects adhering to the body fall off with each clipping and gives a fresh start for the fibres to grow. It will also be easy to study the condition and health of the animals in addition to the full yield obtained at each clipping. The labour and time taken to shear one animal in this case is much less even to an ordinary trained hand than in the previous case. But the one disadvantage is the initial cost of the machine which is really beyond the scope of an ordinary ryot. But this can be remedied by purchasing it under a co-operative basis. The machine is very simple and an ordinary cooly can handle it.

Dipping: This is generally practised after a fortnight or so from the date of clipping. The main objects are;

1. to destroy ticks and lice
2. to prevent flies and other harmful insects entering the wool fibres;
3. to heal slight wounds, scabs etc;
4. to promote the growth of wool.

The best sheep dipping powder in the market at present is the 'Cooper's Sheep dipping powder' which can be obtained from Messrs. Best & Co. Ltd., Madras, for Rs 1-10 per packet. This contains 17 per cent of arsenic and 68 per cent of sulphur. The remaining quantities are: Arsenic present as trioxide and pentoxide and Sodium combined with the above two.

This is highly poisonous and (a few drops of the same solution) if taken in, may cause even the death of the animal. The proper solution for the first dip is one packet in every 25 gallons of fresh water, and for the second, one packet in 50 gallons of fresh water. The directions with regard to the preparation of the bath and its use etc. are given on the packet itself. Two dippings were found necessary in one and the same season for a satisfactory result; the first being 50 per cent stronger than the second. An interval of two to three weeks is sufficient between the two dippings. This will certainly kill the then existing ticks, lice etc. on their body and will also cure slight wounds and scabs. The sediments of arsenic and sulphur that adhere to the body and on the wool fibres will emit a strong and prohibitive smell so as not to allow any further entrance of such insects into the wool fibres till the clipping that follows. Hence a better growth of wool is generally obtained, as there will be no other agency working against it.

The expense of dipping is very little when compared with the numerous benefits derived from it. A bath prepared out of 6 packets will be enough for at least 300 sheep for the first dip and three packets in 150 gallons for the second dip. On the whole it works out at less than 9 pies per head per year, which of course is within the limits of every ryot of this country.

There are two different opinions with regard to the disposal of the lotion left after dipping. Some say that the lotion can be utilised for disinfecting stalls, while some others are of opinion that this may lead to troubles afterwards, as the bits of wool fibres shed while dipping and these, mixed with arsenic and sulphur are likely to be licked up by the animals from the stalls. Emptying the lotion into the same pit where the bath was sunk and mixing it with earth seems safest as the removal of wool fibres from the lotion is difficult either before or after using it as a disinfectant.

Quality: The quality of any wool sample is determined by (1) Its fineness and pliability, (2) Presence of yolk, (3) Density, (Length of staples) (5) Purity, (6) Soundness.

The fineness and pliability mainly depend on the quantity of yolk present on the wool fibres. If there be a dry harsh touch the wool is said to be lacking in yolk. The proper quantity of the same gives it the necessary pliability and retains a normal healthy lustrous condition of the wool fibres. When the secretion of the yolk is ample the scales on the fibres retain their close fitting position, the lack of which makes the scales stand apart and gives a harsh touch. This state is said to be the character of a dry unhealthy fibre. A well-fed and properly managed sheep exhibits the fineness and pliability of wool fibres as well as the healthy condition of its body. A diseased or ill-fed sheep usually has very objectionable fibres because of the weakness of its body, and the crimp of its wool fibres will also be irregular. In a well fed healthy sheep, the crimp will be uniform and will be very agreeable to the touch.

Yolk: Yolk is an oil secreted by oil glands. In fine woolly breeds this is said to be in abundance, which gives a lustre to the wool fibres. Sheep under healthy conditions show a uniform distribution of the same throughout

the wool fibres. This is very limited in South Indian breeds for want of proper feeding and management.

Density: This refers to the closeness of fibres in sheep. If the fleece are not compact, it not only reduces the weight of the wool but will also keep the fibres more open resulting in lack of proper protection to its body. It will also be very easy for foreign matter to find an access into and will be difficult to get rid of them afterwards.

Length of Staple: That the length of the fleece varies according to the breed, quality, and seasons of clipping is well known. For instance, the staples in Bellary sheep are longer than that of Kollar sheep. But when fineness is taken into consideration the Kollar's is superior to that of the Bellary sheep. Further, it has also been observed elsewhere that fine wool is always a little shorter in length than the coarse stuff. Lastly from the experience gained at Hosur, it has been observed that the October clip is always a little bit longer than that obtained in March.

Purity: The wool fibres clipped from the sheep must be free from dirt and foreign matter, so as to afford a neat presentation of the same to the market. It must also be of a lustrous healthy colour, and devoid of kemp fibres. It is for this the sheep are given a bath and thorough washing just a few days prior to clipping. There should not be any dead fibre lurking inside the stuff as this will reduce the market value of the whole stuff to a large extent.

Soundness: This is important to the manufacturers as it is only the sound wool that produce good clothes. Irregularity in the strength of the yarn is highly objectionable when the manufacture of good clothes is concerned. Hence there should be uniform strength throughout the length of the fibre produced by sheep and this can only be attained by proper feeding and management. During disease or at the time of temporary illness, the fibres that are thrown out from the body surface are thinner in structure and weaker than those growing at normal times; so much so, that a single fibre has been observed with gradations of thickness and variations in structure in a particular clipping in such sheep which went through a short period of illness. Irregular feeding may also lead to similar results. These contribute largely to the brittleness or other poor quality features in the wool fibres.

Having known the brief methods of fixing a satisfactory wool yield with a decent capacity for mutton production in any particular breed of sheep in Southern India, it is but natural that one should entertain the curiosity to learn how far the Livestock Section of the Madras Agricultural Department have succeeded in producing the wool of the desired type. The facts mentioned above are mainly based upon the practical experiences gained and the observations made at the Hosur Cattle Farm during the last few years of sheep rearing. The regular increase in the wool yield shown in the statement below is the result achieved after a faithful and patient trial based on the above points during these years.

In addition to the increased quantity of wool obtained, we can also say that we have made some progress with regard to the quality of wool as well. But to give definite information on this it is very difficult as we did not keep any data either in the beginning or afterwards as it was not found to be of much importance at this stage in this country.

Statement of Wool Yield

Year	Maximum		Average	
	lbs. oz.		lbs. oz.	
1924	...		1	5½
1925	...		1	9½
1926	2	12	2	0
1927	3	8	1	15
1928	5	3	2	4
1929	7	2	2	6
1930	7	8	2	5

RURAL RECONSTRUCTION

By MR. N. SIMHADRI

(Deputy Inspector of Schools, Proddatur)

Actuarians have it that 90 per cent of the Indian people live in rural areas while only 10 per cent of it constitute the 'Intelligentsia.' India is predominantly an agricultural country and the majority of the people must remain agriculturists. The efforts of both the social ameliorist and the political worker need to be concentrated as the *Times* says 'upon promoting an enquiry which concerns the welfare of over four-fifths of the three-hundred and twenty millions of people who inhabit India.' The rural world has need of fundamental change if it is to be saved from decay—change both in its 'economic structure' and in its 'philosophy of life.'

On a careful analysis of the rural conditions it will be found that the question resolves itself into two broad issues, viz., (1) economic, (2) cultural. The attention of the public workers or of any humanitarian leagues should first be converged upon these two aspects, for it is only on the improvement of their distressing economic situation and on the change in their outlook to raise the standard of living that the condition of this vast multitude can be made more enviable. It is only by such progress of evolution that the country can make more rapid strides on the path of progress and contribute more substantially for its constitutional and economic history.

The produce of land being the principal means of subsistence for the masses, it becomes obvious that the return which the agriculturists get for their labour all the year round is a very important question. In fact the system of land tenure affords the key to their economic prosperity. Greater security of tenure and fixation of rents on more equitable basis would give greater incentive to cultivators to improve their land. A great percentage of ryots are tenant-cultivators and unless the landholders are moderate in their demands for rent, the poor cultivators will be led to ruin due to unequal conflict and the lands being excessively infested become indifferently cultivated eventually leading to non-payment of rents, and the consequent trouble of civil courts. When village Panchayats become the universal feature of villages such matters may fitly be left for their decision. The great drawback of Indian agriculture is that it does not pursue scientific methods of agriculture. Agricultural development, if development it is, has more or less

been from a long time on empirical lines and it is no uncommon sight to see a vast congregation of cultivators sitting in dull despair of the delaying monsoon or of the pests committing havoc which they could have easily avoided with a careful selection of seeds. The department of agriculture brought into being by a benign government is finding it an uphill task to break through the impervious ignorance of the masses. Customs and conventions die hard in India and instances are not wanting to show that the use of Copper Sulphate for purifying cholam seeds has been considered heretical. The use of improved ploughs, selection of seeds, production of natural resources for maximum benefit, easy and intelligent methods of transport are a few among the immediate changes to be introduced in the agricultural system of the country, and it is no small wonder that the hesitant cultivator looks on these innovations in the time honoured system with distrust and suspicion. It becomes therefore increasingly obvious that such instructions should be incorporated in the school curriculum and the children made to imbibe the ideas with a fairness of mind. This apart, provision of a larger number of model farms and agricultural demonstrators should be made, agricultural loans act liberalised, and improvements effected from time to time, brought home to the masses through intensive propaganda. The Indian cultivator is a most conservative being and does not believe in anything which he does not see with his naked eyes. Cottage industry is another important economic factor which demands urgent resuscitation of its working conditions. Weaving, spinning, carpentry, smithy and to a certain extent shoe-making form the staple industry of the people in rural areas. A study of their methods of work reveals the deplorable fact that no attention is paid to conserving time and energy. The products manufactured under such conditions are placed in the market for sale at unconscionable rate with the result that in the end the cheaper stuff gets the better sale, while they get weather-beaten and ultimately undersold. This improvident attitude which has become a second nature with a village worker has been a serious handicap making him stumble every time he pops his head. Even in these professions the villager suffers mainly through lack of knowledge and absence of proper financial backing. The State Aid to Industries bill which was chiefly intended to advance such rural activities seems to be functioning very little in these directions. Sufficient financial aid should be forthcoming to revive these industries and to make them a more paying concern. Peripatetic weaving parties should be brought into existence in greater numbers, so that they might actually live amidst the ryots for some time demonstrating the advantages of improved looms and other auxiliary developments of modern weaving. Likewise carpentry, smithy and shoe-making may be made more paying through suitable executive agencies for bringing them into conformity with modern requirements. In the village republic these professions form important units, and it is well they are kept intact on their jobs in a manner to make them live better and work better.

Yet another factor which goes a long way in the life of rural areas is domestic gardening. For want of a better knowledge of Botany this piece of manual work has not become as efficient as it should be. It was Lala Lajpat Rai who laid insistence on this work in villages as next only to spinning. This is a kind of recreation to a student of nature and a pleasant occupation to the old and the young. No great effort is needed in this direction. One can take to this as a kind of hobby in his leisure hours. A family may subsist on its produce without difficulty and with some more effort it may be made a paying concern also. Large extent of land is lying fallow through the ignor-

ance of the villagers to harness the available resources for putting up a fine garden. The fine topes of the west coast are therefore a special feature of South India and would it not be a beauty spot if all the available land is converted into a vast expanse of green verdure? 'A thing of beauty is a joy for ever' and this the unsophisticated villager must be made conscious of. It is, therefore, a consideration of the above points that forms the crux of rural economics and every well-meaning citizen should place these in the forefront of his civic programme.

Having discussed the most important aspect of rural development, we now turn to a consideration of its cultural aspect. It is in directing our energies to rehabilitate worn-out social customs, we must guard ourselves against excessive zeal, or putting a *volte-face* or attempting to do anything *per-saltum*. It is often adjudged that the causes of our present poverty are mainly to be found in our inexorable social customs and not till caste usages are rendered more and more elastic will greater movement of labour be possible. Primary education is the only solvent of these difficulties and it should be overhauled with a view to adapt it to the crying needs of village life so that the peasant might successfully tackle problems of village hygiene, to co-operate more fully with his fellows, and take a rightful share in the civic responsibilities of the village. Besides the 3 R's, special instruction in Agriculture, Civics and Hygiene are a *sine qua non* of a sound system of rural education. It is in the schoolroom that the future citizen would imbibe ideas of better living and go forth to the world carrying this torch of knowledge to emancipate their less-tutored brethren from the thralldom of ignorance.

Education of this sort must be made universal and compulsory and must be carried, if need be, to the very door of the people. The Department of Public Health may go hand in hand with the Department of Education instilling ideas about 'plain living and high thinking' with greater advantage in the minds of the peasants. It is almost a truism to say that the villager generally takes after his neighbour, and would it not produce a salutary effect if model cottages and cattle sheds are constructed by the Health Department so that the conservative villager might shake off his prejudice and take to them more freely? Proper conservancy, providing facilities for good and abundant drinkable water, creating better ideas of light and air, are some of the important measures whose materialisation would accelerate the work of the reformer and enliven the monotonous life of the poor peasant. Private enterprise is foreign to their nature and if the State does not initiate and set the necessary example hopes of redemption are none.

One more point which needs mention *en passant* is the instruction of seasonal lectures and cinema shows. This is no doubt a costly affair but modest beginnings might be made in this direction. America sets the brightest example of propaganda work and her present high level of prosperity is in no small measure due to the daring, enterprising spirit and general literacy of the people. Rural libraries containing a choice selection of books suitable to the peasant folk are a desideratum and the village teacher who commands more leisure may be entrusted with their maintenance. Books on plants, animals, agriculture, vegetable gardening, Geography, Geology, Physiography, and civic administration and citizenship are of the utmost value to a community whose sole occupation is husbandry, while engendering in them correct notions of their environment. They must be made to supplement their agricultural income by some useful occupation so that they may earn a more assured and decent livelihood and become efficient and useful

citizens. Night Schools for adults and working men's institutes give good opportunities to combat ignorance amongst the masses. Under their auspices Agricultural and Medical Officers should go about as peripatetic teachers giving lectures illustrated by lantern slides, projecting lantern and stereoscopic displays on useful topics pertaining to Agriculture, Sanitation and Geography.

With the education of adults, the question of primary education is easily solved and the chances for children to take to education more unreservedly will be proportionately greater.

A CONTRIBUTION TO THE STUDY OF BLACK SOIL PLANTS

By P. S. JIVANNA RAO, M.A.

Introduction—Black soil also known as regur or regada covers a total area of 200,000 square miles of the Indian soil and the great bulk of the cotton crop in India is grown on it. Of this area about three million acres are within the Presidency of Madras and belong to the districts of Bellary, Cuddapah, Kurnool and Anantapur forming the Ceded or Deccan districts and portions of Guntur, Salem, Trichinopoly, Ramnad and Tinnevely districts.

The cause of the black colour and the nature of the constituents, both physical and chemical, of this soil formed the subject of special investigation by Leather (1898), Annett (1910) and Harrison (1912) who have expressed divergent views on the matter.

The characteristic features of the soil are: it consists of black clay friable when dry, sticky and adhesive when wet and cracking deeply in hot weather. It varies in depth and fertility from 1½ to 5 feet in Coimbatore and 5 to 10 feet or more in parts of Bellary and Kurnool districts being underlain in one case by kankar and by beds of red earth in the other. Retention of moisture is its most valuable property which varies according to texture and depth. Though the soil is derived from diverse formations, it possesses common characteristics which go to support an interesting type of vegetation consisting more of herbs and shrubs than trees. In addition to cotton several other crops are raised on it, namely, sorghum, tenai and cumbu among grasses, bengal gram, groundnut, red gram, black gram and indigo among the legumes, tobacco and chilli, onion, safflower, gingelly, castor, linseed, mustard, cummin, coriander etc.

Flora—By reason of its cracking during dry weather which injures the root system the soil is ill fitted for tree vegetation in general and this gives the appearance of barrenness to extensive tracts of land which are otherwise fertile. The tree flora is thus very limited and consists of a few species like *Acacia arabica*, *Balanites Roxburghii*, *Butea frondosa*, *Dichrostachys cinerea* and *Zizyphus Jujuba*. The *Nim* (*Azadirachta indica*) and the tamarind (*Tamarindus indica*) are planted in avenues and among shrubs may be noticed *Calotropis gigantea*, *Cassia auriculata* and *Opuntia Dillenii*. The half shrubs and herbs, however, are a much larger number of which the more characteristic are: *Alysicarpus rugosus*, *Aristolochia bracteata*, *Chrozophora plicata*, *Hibiscus ficulneus*, *Ischaemum pilosum*, *Jatropha glandulifera*, *Momordica tuberosa*, *Panicum Isachne*, *Phyllanthus maderaspatensis* and *Withania somnifera*.

The peculiarities that may be observed among these plants relate to the modifications of roots, stems and leaves, the extent of root system and the depth of the absorbing portion thereof, and perennation methods adopted by some of them.

Subterranean modifications—A study of the underground parts made in some of these plants discloses very interesting adaptations for successful modes of life in relation to the soil. The similarity to well known types will be manifest in many of these but attention is here drawn to them as the plants are members of a definite formation in which the soil is the principal guiding factor. Further, as Hilgard (1860, 1906), Chamberlin (1877) and others long ago realised the native vegetation consisting as it does of 'nature's crops' is an important indicator of the agricultural capabilities of a district and a study of this from various aspects is calculated to be of service in understanding the *raison d'être* of crop distribution.

The simplest modifications are to be seen in *Withania somnifera* and *Datura Metel* where the tap roots are swollen and fleshy and could be cut easily with a knife the latter root suggesting the appearance of radish. In *Momordica tuberosa* a common cucurbitaceous weed of the Ceded districts the root swells into a tuberous body beneath the attachments of the cotyledons which are hypogeal in germination and gives rise to new shoots from the base of the old ones aided by the abundance of water and reserve material stored in the tuber. Potato like tubers developing at intervals are a striking feature in the roots of *Cayratia carnosia* (*Vitis carnosia*, Wall) in which suckers are formed from injured roots—a peculiarity which is noticeable in *Aristolochia bracteata* and *Clerodendron Phlomidis*. Small tubers terminating the roots are a conspicuous feature in the root clusters of *Chlorophytum tuberosum* a weed found in Bellary (Hagari) and Kurnool (Nandyal). *Curculigo Orchioidea* (*Amaryllidaceae*) is characterised by 'pull roots' which may be said to lower the depth of the vertically elongated rhizomes. *Scilla indica* and *Dipcadi montana* possess onion like bulbs. Small bulbs terminate the slender underground shoots in *Cyperus bulbosus* and later grow into fresh plants. *Cyperus rotundus*, *Cynodon dactylon* and *Ischaemum pilosum* develop underground shoots of a varying nature.

Leaf Forms—As organs of transpiration the leaves of species in any association merit special consideration. From being utterly absent in *Opuntia Dillenii* they are about 2×25 m.m. in *Oldenlandia aspera*, minutely divided in *Acacia arabica* and attain a size of 60×100 m.m. in *Tylophora asthmatica*. Those of *Jatropha glandulifera*, *Datura Metel* and *Withania somnifera* are large and herbaceous and in *Solanum xanthocarpum* and *Argemone mexicana* they are armed with prickles. Very striking differences in size were thus observed in the leaves of plants collected from what may be termed a 'WITHANIA FORMATION'—an extensive area of black soil land near the Agricultural College and Research Institute, Coimbatore long under cultivation but given over for house sites some years ago. *Withania somnifera* is the dominant constituent of this vegetation and the chief associates are: *Alysicarpus rugosus*, *Argemone mexicana*, *Aristida adscensionis*, *Aristolochia bracteata*, *Boerhaavia repens*, *Calotropis gigantea*, *Citrullus colocynthus*, *Cynodon dactylon*, *Opuntia Dillenii*, *Panicum Isachne*, *Solanum xanthocarpum*, *Tylophora asthmatica*, *Volatarella divaricata*.

Root Development—Wide diversity exists in the matter of root behaviour. The tap roots in *Withania somnifera*, *Boerhaavia repens*, *Pentstemon microphylla* and *Echolium Linneanum* penetrate to beyond 2½ feet depth in the soil. That of the hardy and persistent *Cocculus pendulus* penetrates to beyond 8 or 9 feet maintaining a tortuous course and giving suckers from injured roots thus defying all attempts at eradication. Surface absorbing roots with spreading laterals are a special feature of the adventitious roots in *Opuntia Dillenii* and *Tylophora asthmatica* and in the laterals of *Withania somnifera* which sometimes measure even about 6 feet in length and are occasionally attacked by the parasite *Orobancha cernua* at some distance from the main root. The absorbing roots in the bulbous *Scilla indica* and *Dipcadi montana* and the tuberous *Momordica tuberosa* generally arise beyond 6 inches in the soil and in *Chlorophytum tuberosum* they arise in delicate tufts from the ends of the tubers. In *Jatropha glandulifera* the first four laterals arise from the same point immediately within the soil and grow in advance of the main root.

Economics—In the assemblage of crops cultivated on black soils one notices prototypes of plants composing the natural vegetation. Thus: *Abutilon indicum*, *Hibiscus micranthus*, *H. ficulneus* and *H. panduriformis* are allied to cotton (*Gossypium herbaceum*, *G. indicum*), Bimilipatam jute (*H. cannabinus*) and okra (*H. esculentus*). The leguminous weeds *Indigofera trita* and *Phaseolus trilobus* though particularly related to Indigo (*I. tinctoria*) and Black gram (*P. Mungo*) respectively, offer further possibilities for leguminous crops in general of which groundnut has now spread with extraordinary rapidity in new areas. It is interesting to note that *Volatarella divaricata* a weed of black soils is from the systematic point of view a close relative of safflower (*Carrhamus tinctorius*). The solanaceous crops may likewise be said to be well suited for the black soil like their wild forbears. Other examples may be given for the orders *Gramineae*, *Euphorbiaceae*, *Pedaliaceae*, *Cucurbitaceae*, *Vitaceae* etc. It may be said that cultivation methods have intensified in these crops the responses and modifications which are a natural though less conspicuous feature of the corresponding wild types.

Of the large number of plants referred to in this paper though a few happen to be pests in agriculture like *Aristolochia bracteata*, *Clerodendron Phlomidis*, *Cocculus pendulus*, *Cynodon dactylon*, *Cyperus rotundus*, and the parasites *Striga* and *Orobancha* others possess special qualifications for being exploited. Mention may only be made of *Scilla indica* the Indian squill, *Tylophora asthmatica* having properties similar to those of *Ipecacuanha*, *Datura Metel*, *Withania somnifera* (*Aswagandha*), *Boerhaavia repens* (*Punarnava*), *Cardiospermum Halicacabum* and others of wide repute in Indian medicine.

The leguminous weeds *Rhynchosia minima* and *Phaseolus trilobus* and the grasses *Panicum Isachne*, *Cynodon dactylon*, *Iseilema laxum* and *Andropogon annulatus* are good fodder for cattle while one weed *Euphorbia corrigioloides* is said to fatten sheep.

Finally a word of suggestion may also be made with regard to *Zizyphus Jujuba* a hardy perennial indigenous to black soil districts which may be turned to very good account by being employed as stocks for superior varieties by budding. Jujube is said to be a very remunerative crop among fruits requiring less labour and attention and notable success has already

been achieved by horticulturists in Kurnool District (Panyam) where a *Citrus* × *Feronia* combination was tried with success in 1924.

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ECONOMICS OF GRAPEVINE CULTIVATION

By C. RANGASWAMI AYYANGAR

(Assistant Demonstrator in Mycology)

The cultivation of grapevine was introduced in Tamil country forty years ago. Rev. Larney was the first to introduce it in Panjampatti village in the Madura district. The cultivation of vine gradually spread from one village to another and now nearly eighty acres are under this crop in several villages in Madura and Trichy districts. The cultivation aspect of it has already been dealt with in an article published in the Madras Agricultural Students' Union Journal, Vol. XI. 1923.

About three hundred vines are planted to an acre. Each garden on an average consists of fifteen to twenty vines and seldom can a cultivator pay attention to more than fifty vines. The vines begin to yield only two years after planting and the following statement gives a record of income and expenditure for the first three years after planting.

Details

1 YEAR:

Preparatory cultivation (i.e.) ploughing

			Rs	A	P
Levelling, and digging of pits	...	...	80	0	0
Erecting pandal	...	...	280	0	0
Manuring (leafmould)	...	...	130	0	0

After cultivation

Manuring, cattle manure at 70 cartloads. per acre	...	...	70	0	0
Weeding	...	...	30	0	0
Irrigation	...	...	270	0	0

Total ... 860 0 0

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Economics of Grapevine Cultivation

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2 YEAR:

			Rs	A	P
Renewing old and unserviceable parts	...	...	90	0	0
Manuring, weeding, and irrigation	...	...	370	0	0
Pruning	...	...	40	0	0
Spraying (four times)	...	...	100	0	0
Harvesting and carrying charges	...	...	130	0	0
			730	0	0

Average yield per vine 2 mds. at 4 Rs. per md.

Do do Acre (300 vines yielding 600 mds.)	...	...	2,400	0	0
Expenses for first and second year	...	...	1,900	0	0
Gain per acre at the end of the 2nd Year	...	...	810	0	0

3 YEAR:

Expenses for the third year	...	...	730	0	0
Cost of produce per acre	...	...	2,400	0	0
Total expense	...	...	730	0	0
Gain per acre at the end of the third year	...	...	1,670	0	0

Marketing.—The chief markets for the produce are (1) chief towns of the southern parts of the Presidency (i.e.) Tinnevely, Madura, Tanjore etc. (2) Colombo. Trade with the latter market is carried on only in June and July when Australian grapes are scarce. The cultivator sells his produce locally to an agent of recognised fruit-sellers in the towns named above. Occasionally the services of the local agent are not utilised and the cultivator himself directly deals with the merchants.

Packing.—Until recently fruits used to be packed in bamboo baskets. An innovation has been introduced which is gaining much favour amongst sellers. This consists in utilising earthen pots with holes bored to admit air. This is reported also to minimise damage.

Disease.—Grapevine is subject to a very serious fungoid disease, namely, mildew, causing the leaves and fruits to shrivel and fall down. Fortunately the disease can easily be checked by spraying with Bordeaux mixture. The cultivators of Maichaelpatti and Panjampatti suffered heavy loss due to this disease prior to the year 1920, when they did not know the efficacy of Bordeaux mixture. In 1920, however, the Mycology section of the Agricultural Department came to their rescue, and gave them a cheap and effective remedy to combat the disease. Since then, they have by systematic spraying, very effectively prevented the appearance of the disease. Most of the cultivators own sprayers and know how to prepare Bordeaux mixture.

Anthraxnose or birds eye disease.—Is yet another disease, which has made its appearance within two years. Experiments have been in progress to find a suitable remedy, as Bordeaux mixture is not very effective. Limesulphur is found to be effective. Another patent fungicide 'Solbar' is being tried to combat the disease.

Citronella oil (Burgoyne's) ...	...	...	½ oz.
Spirits of camphor ...	...	...	¼ oz.
Cedar-wood oil ...	...	...	¼ oz.
White petroleum jelly (B.P.) ...	...	...	2 ozs.

The petroleum jelly should be melted and the other constituents then added, the mixture being well-stirred. Bottle (a 3 oz. wide-mouthed jar is a convenient size) and cool rapidly, preferably by placing the bottle (which should be kept closed) in a basin of cold water or in a refrigerator.

The formula gives a firm, whitish, non-staining cream of pleasant odour which, in addition to its properties as a mosquito deterrent, is soothing, antiseptic and beneficial to the skin (petroleum jelly, it will be remembered, is the base of most face creams). One application usually lasts for a whole night, and only a very small quantity need be used on each occasion. To avoid using it on the face in the evenings, the cream has been employed by some as a brilliantine for the hair, as it was found that for a time this keeps mosquitoes away almost as successfully as if the whole face were smeared with it.—*Cedric Dover*.

'The Indian Journal of Medical Research'—Vol. XVII, No. 3.—January 1930, P. 961, Coffee Chemistry.

Some of the results of *Von Hahn's* studies on the chemistry of coffee as a beverage are of importance from an agricultural standpoint. The theory has been that vitamins are destroyed by high temperatures, so that coffee roasted at 180° C would no longer contain vitamins. *Von Hahn* has shown however that there is a large quantity of vitamins in roasted coffee, probably belonging to the fat soluble group. The vitamin content of the beverage depends on the active surface of ground coffee present.

A medium degree of roasting gives the greatest active surface and it is possibly more than a coincidence that it is to this degree that coffee is roasted in Germany; in other countries a greater or lesser degree of roasting is preferred. It is true that little fruit is eaten in Germany and it may be supposed that on account of this and the consequent deficiency of their food in vitamins Germans have instinctively arrived at a preference for the taste of medium roasted coffee.

As regards grinding, one would think that the active surface of the coffee would increase in proportion to its fineness, but this is not at all the case. The maximum active surface and consequently the greatest vitamin activity is found in infusions of medium ground coffee.

From this work it seems that the antirachitic vitamin will probably be found in coffee and that the anti-scorbutic one may be present in large quantities. Coffee is therefore not only an agreeable luxury but may supply a vitamin deficiency.—*International Review of Agriculture*, Year XXI, No. 2.

Studies on the rice blast disease

The symptoms of rice blast (*Piricularia oryzae*) are most conspicuous in leaf blades and panicles, but observable also on caryopses, young roots and buds, leaf-sheaths, culm-nodes, and flower-stalks. The size of conidia varies with moisture and temp; under warm and moist conditions they are large and narrow, while under reverse conditions small and broad. For the formation of each conidium on the conidiophore in darkness

5-10 min. are necessary, and during 1 night more than 10 conidia may be developed on 1 conidiophore. Conidia may germinate in 12-16 hr. after they begin to be produced. Their germination can take place between 15—20° C., the optimum being 25-28° C. Conidia produced under dry conditions germinate better than those formed under moist conditions. When very moist, conidia are unable to germinate, but do so when dry conditions are resorted. They germinate better in an acid than an alkaline reaction, while they, as well as hyphae, grow better under the latter than under the former. Sunlight exercises great influence in every stage of development, especially direct sunlight greatly delays germination as well as growth. Both conidia and hyphae are resistant to high temp. under dry conditions. When conidia are subjected to 60° C for 30 hrs., about half of them survive, but when placed in water at 50° C for 13-15 min. all die. When conidia germinate, appressoria are generally produced at the apex of germ-tubes. The appressoria, which have been mistaken for chlamydospores are thick-walled cells secreting a mucilaginous substance, by which they adhere to the host's surface. The germ-tubes and appressoria enter the host through stomata and epidermal cells themselves. *Conidia were observed to survive for 1 year on the host out of doors or even for 2 years in nutrient media.* They may live long floating on the water surface of a rice-field, but will die within 2 weeks when they sink. Various methods of control are discussed.—(Courtesy Japanese Jour. Bot.)—*Biological abstracts*, Vol. 4. No. 5.

Sooty Fungus on Sugar-Cane

Inquiries frequently come to hand regarding the appearance of a dirty blackish discolouration of the older cane leaves. . . . Some growers view this with more concern than is necessary, thinking their cane to be smitten by some new disease which will suddenly wipe out their crops; and what appears to add weight to their ideas on this matter is the fact, that often only certain varieties are affected, which, would give one the impression that this was the commencement of a serious disease.

Actually, this is only a minor trouble caused as a result of aphids feeding on the cane leaves. Colonies of these very small insects, or plant lice as they are sometimes called, are most commonly found on the underneath side of the older cane leaves, where they are attended by ants. A very intimate association exists between aphids, and ants, some colonies of aphids being unable to thrive unless ants are present to look after them. Ants frequently find suitable food plants for the aphids, and when these are overcrowded the young aphids are transferred to other plants or to other portions of the same plant which are not so thickly populated; in addition they also afford them a certain amount of protection from their enemies. In return for this attention, the aphids secrete a kind of honey dew, which is eagerly sought after by the ants, and from this peculiar relationship, aphids have sometimes been referred to as ants' cows.

In the case of sugar-cane aphids, some of the honey dew secreted by them falls on the surface of the leaves immediately beneath where the colonies are feeding, and this gives the cane leaves a shining sticky appearance. Later on, a fungus commences to grow on this honey dew, and gradually extends, over the whole surface on which the honey dew has fallen. The fungus is blackish in colour, and this produces the dirty, sooty discolouration previously

NOTES AND COMMENTS

The Late Mr. T. Viraraghavan, I.C.S.

We are very sorry to hear of the untimely death, due to an accident while riding, of Mr. T. Viraraghavan, I.C.S., the eldest son of Sir T. Vijayaraghavachariar, K.B.E., an honorary member of our union and the Vice President of Agricultural Research Council. We offer our heartfelt condolences to Sir and Lady Vijayaraghavachariar in their sad bereavement.

Deleterious effects of saline drinking waters

1. In *Science* of May 30, 1930 there is an interesting reference regarding the deleterious effects of certain saline drinking waters which are said to be widely prevalent in parts of Dakota, Montana and other states of America. The waters of these regions contain from 1500 to 5756 parts of total solids per million—not much different from the waters of wells in and round Coimbatore, Ceded Districts, etc. The writer of the article describing the effects of such waters says 'the drastic cathartic action and the weakening effect of the natural solutions of Epsom and Glover's salts on man and life stock are well known in these regions. Some persons believe that disorders of kidneys and the liver also result but that effect is not established. It seems true though that no matter how well they are fed, cattle and hogs cannot be fattened for the market while they drink such waters. Indeed, the case is even worse; the cattle develop a run down, ragged appearance and many eventually weaken and die prematurely. The principal difficulty in such cases seems to be that degeneration of the bone sets in, so that most of the lime is abstracted from them. These bones are reduced to gristle that can be tied in knots and easily punctured with a knife. Calves are stunted in growth and many never mature at all. The cows develop strange appetite for bones, leather, wood etc. The condition is alleviated but perhaps not cured by feeding bone meal or ground lime stone.'

It seems probable that people using such waters are affected in the same way as cattle but perhaps in a different degree so that question of human physiology and diet are also introduced.

Forcing coconuts to yield

Mr. S. N. Chandrasekara Iyyar, M.A., Assistant Lecturer in Botany, writes to us about the experience he came across regarding the effect of cactus manuring to coconuts in trenches dug around the trees. A number of coconuts in a garden near Coimbatore, had not been bearing for nearly ten years although they were normal and healthy in other respects and free from fungus and insect attacks. As a remedy, the owner of the garden dug trenches round the trees, filled them up with cut pieces of cactus (*Opuntia dillenii*) and covered them up with loose soil. Six months later, the trees began to flower freely and bear fruits. Apart from the manurial effect of the cactus, it is possible that the root pruning given by digging trenches around the trees, might have been primarily responsible for this favourable effect. We would invite short notes of experiences of this sort from our readers, for publication in the journal.

GLEANINGS

A poisonous substance known as Lyso-lecithin has been found in ordinary polished rice by a Japanese investigator, Dr. Motoe Iwaka; obtained only after repeated extraction with alcohol, it probably has little effect on human beings through ordinary consumption of the cereal, but may however have some relation to the factor in polished rice, which causes the nervous disease, beri-beri, which has been previously thought to be due to the absence of vitamin B. Further investigations are proceeding.—(*Science*, July 18, 1930.)

Space versus Matter

According to *Professor Einstein*, 'Space will have to be regarded as a primary thing and *matter* as having been derived from it, so to speak, as a secondary result'. Space is now turning round and eating up matter. We have always regarded matter as a primary thing and space as a secondary result. Space is now having its revenge, so to speak, and is eating up matter.—*Science*, June 13, 1930.

Sir Oliver Lodge writes as follows under date June 20, 1930, to *Nature* of July 5, 1933: 'Referring to Prof. Einstein's Nottingham Lecture, I note that he virtually agreed with me in claiming matter as passive and space as active. Matter is that which is acted upon; space is that which acts. Matter is inert; space is energetic. Matter *does* nothing, though it serves to display the energy of which space is full; it merely sails placidly along the path of least resistance, like a straw in a stream or a leaf in the wind.

It used to be thought that potential or static energy existed in the ether, while locomotive energy was possessed by matter, but we now know that momentum is electromagnetic, and accordingly exists in the space around the unit of matter which displays it. So, strictly speaking, all energy belongs to space; matter only affords a means of detecting and using it.

'Although matter has no energy and never does anything, yet it is to us the conspicuous thing, because our nerves which are themselves material, respond to the perturbations of space; thereby stimulating our sense-organs, and giving us information about those perturbations. Matter is one of the perturbations, but is entirely inert. Space is the primary and active thing.

Space with physical properties is usually called ether; but what those properties are, is the problem before us—a problem which must have deep-seated philosophical consequences.'—*Nature*, July 5, 1930, p. 9.

An Improved Citronella Mosquito Deterrent

Citronella oil and the various proprietary preparations containing it, are of necessity extensively used in the tropics, but their volatility renders their effects very transient, the pure oil being also often irritating to the skin. The use of liquid vaseline, which retards the volatility of the oil, as a base, or the addition of spirits of camphor and cedarwood oil, produces more satisfactory, but by no means ideal, results, and has suggested to me the formula which follows. It has been used with great success for the last two years in India, Burma and British Malaya.

referred to as appearing on the leaves. Living as it does on the secretions from the aphids and not on the plant tissue, the fungus has little effect on the growth of the cane plant, and the only injury it does is to block up some of the breathing pores of the older leaves.

Aphids have a short life cycle, and during their adult stage produce a large number of young. They therefore are very prolific and this accounts for their sudden appearance in large numbers in places where formerly there were no signs of them. The number of natural enemies with which they have to contend is large, ladybirds and their larvae, certain fly larvae, and others, all exacting toll from their colonies. Weather conditions also have a big controlling effect, and a sudden increase in the aphid population is soon brought about under control by these several agencies. Therefore artificial control measures are unnecessary.

From this it will be apparent that this sooty fungus is only a temporary visitation, and once the aphids disappear and the older leaves fall off, the cane soon assumes its former green appearance.—*Queensland Agricultural Journal*, Vol. 33, Part 6.

Tannic Acid treatment of burns

The fatal result of severe burns are due in many cases to the absorption into the circulation of toxic substances derived from protein decomposition at the site of the injury. This condition can be prevented by the early application of tannic acid which coagulates all damaged tissues forming an impermeable layer preventing the absorption of toxins. After cleaning the burnt parts with antiseptics, a 2.5 % solution is applied, the application being repeated at hourly intervals for 10 to 12 hours. The treatment is painless the parts becoming insensitised after 2 or 3 applications and the formation of scar tissue with its tendency to contract and produce deformities is also reduced to a minimum.

The use of sulphur di-oxide in shipping grapes

The general principle of the treatment consists in surrounding grapes with an atmosphere of air containing from 1.8 to 3.0 % by volume of cool sulphur di-oxide. The grapes absorb the sulphur di-oxide from this dilute mixture at a relatively slow rate, the amount absorbed being regulated by the concentration of the gas in the atmosphere and the time of exposure.

The practical value of the treatment is the repression of the development of decay-causing organisms chiefly moulds with the consequent lengthening of the keeping period. The rate of activity of the normal life processes of the grape tissue is decreased. It must be remembered however, that sulphur di-oxide will not transform poor grapes into good ones and so the quality or the condition of the fruits will not improve. *Bull. 147 of California University*. (Grapes fumigated with sulphur di-oxide absorb small quantity of the gas. The presence of sulphur di-oxide in articles of food is prohibited by the Ministry of Health Regulations. *Editor M.A.J.*)

CORRESPONDENCE

COST OF PRODUCTION OF PADDY

To

THE EDITOR,

THE MADRAS AGRICULTURAL JOURNAL.

Sir,

I have now come to the end of the present series of cost of production of crops, and in conclusion I take the opportunity of discussing shortly the variations which occur in the series of figures obtained by the Agricultural Demonstrator, Salem, in the Omalur Taluk. The following statement shows the production cost of paddy per acre from 6 ryots whom we may call A, B, C, D, E & F. Notes on the ryots and their methods of cultivation are given in the *Madras Agricultural Journal* from March onwards and should be familiar to your readers if they have taken the trouble to read them.

TABLE I

Statement showing the cost of cultivation of paddy per acre, as ascertained from enquiries of six ryots in Salem District

PARTICULARS	Ryot A Seshan chavadi		Ryot B Seshan chavadi		Ryot C Pottipuram		Ryot D Pottipuram		Ryot E Pottipuram		Ryot F Pottipuram	
	Rs	A	Rs	A	Rs	A	Rs	A	Rs	A	Rs	A
Preparatory cultivation	9	0	35	15	24	12	5	0	8	1	16	2
Manures and application	17	5	21	2	16	14	3	0	3	6	15	11
Sowing Cost of seed	12	12	15	9	23	2	10	4	14	8	18	7
Cost of raising seedlings												
Transplanting	58	3	37	12	56	2	43	0	46	10	54	8
Irrigation	5	4	3	1	3	12	1	4	...	...	2	0
After cultivation	7	14	6	4	7	6	4	10	6	14	9	7
Harvesting and Threshing	20	0	7	8	36	0	...	...	13	5	15	7
Interest on the investment	...	...	...	...	...	...	39	0	51	2	...	...
Rent on land	3	2	13	6	7	8	...	...	...	...	4	0
Assessment	0	8	...	...	...	...	...	...	...	...	1	6
Miscellaneous	...	...	...	...	...	...	...	...	...	...	...	...
	134	0	140	9	175	8	106	2	143	14	137	0

(A) had good cattle (worth Rs 400) and fed them well using groundnut cake, cotton seed and bran as concentrates. Casual labour, both men and women, are moderately well paid in comparison.

(B) grazed his cattle (worth Rs 400) as far as possible, and gave concentrates while they were in hard mhoting work. Cattle were hired when necessary. His casual labour is moderately well paid.

(C) also grazed his cattle (worth Rs 500) as far as possible, and fed cotton seed and bran as concentrates during irrigation. His rate for casual labour is less than what A and B are paying but greater than what the other ryots D, E and F pay in the same village.

(D) had poor cattle (worth Rs 120) fed them badly, and gave no concentrates. Rates for labour which was mostly done by members of the family are shown at a bare maintenance rate. His cost of production is the least of any, but his yield is small and his profit is very low. He is quite a good example of the 'bare maintenance' system of farming.

(E) had cattle (worth Rs 200). His maintenance charges per pair are low and he evidently feeds them poorly. His rates for casual labour are also low.

(F) evidently had fairly good cattle which he fed on cut green grass or grazed. No concentrated food was given and consequently his maintenance rate was low. His rates for labour are slightly higher than D's and about the same as E's.

It is perfectly evident that the size of the holding and the nature of the ownership affects not only the profit per acre, but also the way in which human and bullock labour is treated. The size of the holding of D and E is one acre or less, and consequently uneconomic in size. The rent paid by them on the *varam* system, viz. 2/5 of the crop amounts to Rs 30 and Rs 51-2-0 respectively, while the tenant out of his 3/5 of the crop has to bear all cultivation expenses. The consequence is, that their cattle are poor and are poorly fed, and their labourers whether belonging to the family or casual, receive a very low return for their work. It is very evident that if progress is to be made, and the land is to produce increased yields, it is the bounden duty of the owner to take an added interest in the way of providing manures, and to make such terms with his tenants that the latter can accumulate sufficient capital to ensure proper manuring of the land, farming on an economic holding, the maintenance of sufficiently good cattle to do the necessary work, and the payment to his labourers on a scale higher than bare maintenance.

The final question with which I would like to deal at present, is the criticism and suggestions offered by Mr. Hilson in his letter of 1st April 1930 with regard to cost of bullock labour published in your May 1930 issue. He stipulates the following data.

- (i) Cost or value of bullocks
- (ii) Length of working life
- (iii) Value when sold
- (iv) Amount spent on food, attendance, medicines and veterinary attendance.
- (v) Cost of shoeing if shod.

The total cost of interest on capital expended, depreciation, cost of food,

attendance, medicines and shoeing for the year divided by the actual number of days worked gives the cost of a day's work per pair.

Taking our 6 ryots the cost of bullocks per day for each is shown in table V and this figure varies largely with the food given, and the amount of work especially mhoting work required of them. If the year had been more favourable two differences would have been apparent

- (1) There would have been more grazing
- (2) There would have been less mhoting work and consequently less need for concentrated food.

Therefore the total cost of keeping the work cattle per annum would be reduced, but against that they would probably have worked for fewer days in the year. F has other dry and garden areas in addition to his paddy land, and consequently his cattle work for a greater number of days per annum than, for example, A's cattle appear to do.

In this way, the resulting figure of the calculations carried out in Mr. Hilson's way will not be a constant one, but will be liable to considerable variation between ryot and ryot and will also vary annually on the same holding. The only way in which such a method could be put into operation, would be to take an individual holding and cost all crops grown on that holding during the year. This, however, would involve a radical change of method from that on which this series is based. When a sufficient number of holdings have been costed over a number of years, an average standard figure will be obtained to which costs found on individual holdings may be compared under the various headings. If an individual case is found, where for example the cost of concentrated food is very high as compared to the standards, steps may be taken to find out why this is so, and if possible the cause remedied.

An example of the type of comparison which may be made from the present series, can be drawn from table I. The average production cost of 6 ryots for an acre of paddy amounts to Rs 156-3-0. Ryot C is definitely higher than the average, largely because he had so much irrigation to do, and the crop had a certain amount of disease in the early stages thereby reducing yields. Ryot B on the other hand is below average. His later irrigation costs are lower than the others, and while his assessment is higher, the interest on capital charged is considerably less. This last point requires investigation. In the first place is the figure correct and if it is correct, how has he been able to keep the figure so low, and can the methods adopted by him be applied in the other cases?

It is therefore seen that the methods adopted for costing in this series will, it followed up, eventually lead to more intensive methods e.g. costing of all crops grown on individual holdings.

My thanks are due to all Demonstrators who helped to obtain the figures given.

AGRICULTURAL COLLEGE,
COIMBATORE,
14th August 1930.

D. G. MUNRO.

To

THE EDITOR,

THE MADRAS AGRICULTURAL JOURNAL

Sir,

I have read Mr. Balakrishnan's article on betel vine with interest; having read it it is not possible to pass it over without calling some of his conclusions to question.

Apart from certain discrepancies which have unhappily crept in there, are certain other points which from a scientific point requires elucidation. Under the drainage experiments mention is made in the third paragraph that a better yield for the raised ridges would indicate that drainage was the chief defect. I am unable to agree with the writer and there appear to be other factors as well which have contributed to a higher yield in the raised, and which seemed to have been lost sight of. For all that I know I might be in the wrong and I wish to be corrected if I were so.

Mr. Balakrishnan does not mention where from the earth was got to raise the ridge whether it was from the trench or from outside. If it was from the trench bare removal of soil to a sufficient depth will itself afford better drainage and there was no necessity to raise it further. From whichever source the soil was brought extra soil surface has been created round the vines to a height of 2 feet which is sufficient to induce root development from some more of the nodes now earthed up with the result it has become possible for the vines to get more of plant nutrition through a more prolific production of roots.

Another factor equally important is by earthing, more of plant nutrition is made available to the vines from the raised surface, which is denied to the unraised. And naturally there is greater chance of the raised giving a higher yield over the raised. These two factors, that is creating a more solid area for production of root and giving more of plant nutrition by applying sub soil at the top have been in my judgement more primarily responsible for higher yields. If the trench was merely deepened and yields of vines of the adjoining ridge compared with that of the one having undeeptened trench any defect in drainage will have been more prominently brought out. As it is with the present materials it is not safe to rush to the conclusion that it is defective drainage that is the cause of reduced yields.

Yours truly
M. S. KYLASAM.

REPLY

To

THE EDITOR,

THE MADRAS AGRICULTURAL JOURNAL.

Dear Sir,

Most of the points raised by Mr. Kylasam in his letter have been discussed by myself and answered in the concluding portion of my article appearing in the August issue. If after reading the entire article, Mr. Kylasam still entertains any doubts I will only be too glad to clear them up, on a specific reference from him.

Yours truly
M. R. BALAKRISHNAN.

College News and Notes

The Students' Club.—The inaugural address of the Students' Club was delivered this year by the Rev. Frederick Saunders, B.A., B.D., in the Freeman Hall on Friday the 8th of August under the presidency of Dr. T. V. Ramakrishna Ayyar, B.A., F.E.S., F.Z.S., PH.D., the subject of the lecture being 'Life in Foreign Universities.' The lecturer gave a clear description of University life as gained from his personal experience during his stay in the Universities of Cambridge, Oxford, London and Berlin, dwelt with the life and ideals of the several Universities and referred to the spirit of freedom prevalent in the atmosphere of those Universities incidentally bringing out that liberty never degenerated into license. He brought home to the audience the truth that knowledge for its own sake was to be aimed at and that students should take as a model precept, the words of Thomas Edison who said on an occasion that he had no time to make his own fortune while he was all the time enriching the world. The president in his concluding remarks said that from his experience abroad he learnt that University life made one self-reliant and rounded off one's angularities. He said that students entered the great Universities to gain knowledge and when they left the portals of the College, were in addition imbued with a spirit to serve their kind and country. He emphasised the need for research and likened the University to a sacred fire ever burning wherein passing generations of students lit their torches of learning.

Welcome to the freshers.—What has come to be a regular annual function—the welcome to the freshers—came off this year on the 5th of July. Tea and formal introduction of the freshers to the seniors over, several of the senior students made welcome speeches giving to the freshers an idea of and an insight into the college life, its activities, the advantages of a residential system whereby students from different parts of the Presidency had chances of mixing not only in the class room but in the Sports field and the common mess rooms as well. The freshers thanking their hosts for the welcome, assured them that they would live up to the traditions of the College.

Athletic activities.—On Friday the 8th of August our College Cricket Team tried conclusions with the Stanes High School Team in the first round of the fight for the Y.M.C.A. Shield. Entering first on an easy wicket the visitors piled up a huge total of 268 runs for the loss of but two wickets, two of their batsmen remaining not out with individual centuries to their credit when they declared their innings closed a little after lunch. As many as seven bowlers were tried by the College team but they were quite innocuous against the batsman who scored at a steady and rapid rate, although Patnaik was treated with some respect and did not give away many runs. Venturing out in their turn before the tea interval, an hour sufficed to see the home team all dismissed for a paltry total of but 45 runs, only S. N. Venkataraman and Narayanan entering double digits. The match thus ended in a victory for the Stanes by an Innings and 223 runs.

On the 16th, our College met the Coimbatore College Cricket team and had to own defeat again, although we put up a more creditable performance than against the Stanes. With the issue undecided till the last over of the day

(sportingly allowed by our Captain) the match was exciting from beginning to end. Entering first, the College team scored 156 runs to which S. N. Venkataraman contributed a faultless and quickly scored 67. The visitors managed to score this for the loss of but seven wickets although an extra over had to be allowed after time, for scoring two runs which were required for a win.

The College team won the first round of the Abraham Memorial Tournament against the London Mission High School, beating the opponents by the odd goal in five. In the finals, however, played on Monday, 1st September, our boys lost to the Municipal High School team after an exciting and interesting struggle, the Municipal High School notching off the winner in the extra time granted. The College team was good, but the forwards lacked finish and team work, otherwise a different tale would have been told. We wish the students would pay more attention to practice and combined team work, and we are sure that laurels will await them in future.

Government grant to Students' Club.—It is understood the Government have sanctioned a sum of Rs. 3,000 to the Students' Club for Athletic equipment. We congratulate the Students' Club on this windfall, and with the better and higher-class outfits, we expect an enhanced standard of play in the several games and sports, in the coming years.

Visitors.—Mr. B. P. Deshpande, M. Ag., Cotton Entomologist, Surat, was here on a visit from 23rd to 29th August. Mr. Deshpande, is in charge of the Spotted Bollworm Investigation in Surat, and during his stay here, studied the cotton pests of the Presidency, and the effect of the enforcement of the Pest Act. He also discussed cotton problems with the Government Entomologist, the Cotton Specialist and the Deputy Director of Agriculture, VIII Circle.

The Agricultural Estate Board and the College Council.—The College Board having changed its functions very much since the separation of teaching from research, Government have approved of the proposals of the Director of Agriculture to form two separate bodies—The Agricultural Estate Board and the College Council—the former to deal with questions concerning the Research Building, allocation of residential buildings, centralisation, sanitation, and general amenities of the estate—and the latter to consider and report on all questions that affect the College and students, including course of study, etc. By the new order, the Estate Board constitutes all the Heads of Research sections and the Principal as its ex-officio members and two other officers irrespective of cadre elected by the staff. Messrs. M. R. Balakrishnan, Assistant to the Government Agricultural Chemist and P. D. Karunakar, Agricultural Bacteriologist were declared elected to the Board this year on the results of the election by ballot held on 11th August. We understand that the term of these elected members is two years.

The College Council will be constituted by the Principal, the Heads of Teaching Sections and four other officers nominated by the Director of Agriculture. The Government Agricultural Chemist, the Millets Specialist, the Research Engineer and Deputy Director of Agriculture, 8th circle, have been nominated for the current term.

An *Estate Sanitary Committee* is also to be formed with the Principal, the Sanitary Inspector, and the Warden as ex-officio members and the others to be elected by the residents of the Estate, which for the purpose of election has been divided into a number of wards. Nominations have been called for and the elections will take place during September,

The Association of the Upper Subordinate Officers.—A general body meeting of the Association was held on Saturday the 16th, August with Mr. S. N. Chandrasekhara Ayyar in the chair. Before the proceedings commenced the following resolution was passed all members standing.

This Association places on record its deep sense of sorrow at the sad and premature demise of Mr. M. Ramiah Shetty, a promising member of the Association, and conveys its heartfelt condolences to the bereaved parents.

After the adoption of the minutes of the last meeting, the first item taken up was that with reference to reservation of quarters for the upper subordinates on the Estate. After some discussion the following resolution was unanimously adopted.

Whereas the reservation of the D type quarters exclusively for the Ministerial staff and Fieldmen has resulted in great hardship to the upper subordinates and whereas many of them who have put in more than one year's service do not stand a chance of getting any quarters in the near future, this Association requests the Principal to extend the same principle of reservation to other types of subordinates' quarters, viz., A, B and C types for exclusive allotment to the upper subordinate officers.

The next two items put down for discussion were postponed to be taken up in the next meeting, after obtaining fuller information on these questions. These items refer to the recent orders with-holding increment to Probationers and to those disallowing grant of the first increment to subordinates when promoted to the IV grade after they have been drawing the maximum of the V grade for more than a year.

In their Memorandum No. 2676—III/30-1, dated 1st September 1930, the Government have replied as follows to the Associations' letter sent on 19th July with a copy of the resolution passed at the General body meeting held during College Day week. 'The Association of the Upper Subordinate Officers of the Agricultural Department is informed that the question of increasing the post in the higher grades of the cadre of the Upper Subordinates cannot be reopened so soon after the recent orders on the subject.'

The Association of Economic Biologists.—A meeting of the Association of Economic Biologists was held on Tuesday the 26th of August under the presidency of Dr. T. V. Ramakrishna Ayyar when two papers, the one by Rao Bahadur T. S. Venkataraman on 'Sugarcane Sorghum hybrid and the other by Mr. V. Ramanathan on 'The position of the first fruiting branch in Madras Cottons' were read.

Manager's Notice

Subscribers are kindly requested to intimate change of address, to facilitate correct and early dispatch of the journal.

Weather Review

AUGUST 1930

Rainfall Data

Division	Station	Actual	Departure from normal	Total from 1st January
Circars	Gopalpore	6.5	—0.8	28.0
	Vizagapatam	4.3	—0.8	23.0
	Cocanada	3.1	—2.4	18.6
	Masulipatam	3.8	—2.8	22.3
Ceded Dists.	Kurnool	2.6	—1.5	12.6
	Bellary	1.1	—1.0	9.7
	Anantapur	1.8	—0.9	9.8
	Cuddapah	1.6	—4.1	17.6
Carnatic	Nellore	0.4	—2.9	15.8
	Madras	3.6	—0.9	19.6
	Cuddalore	3.0	—2.3	32.7
	Vellore	4.6	—1.2	21.6
Central	Salem	3.6	—2.9	21.2
	Coimbatore Town	0.1	—1.3	10.3
	Coimbatore Research Institute	0.1	—1.1	10.3
	Trichinopoly	1.7	—2.1	17.6
South	Negapatam	1.3	—2.2	28.0
	Madura	4.5	+0.2	19.2
	Pamban	...	—0.6	16.5
	Palamcottah	...	—0.4	7.1
West Coast	Trivandrum	2.5	—2.1	39.2
	Cochin	7.8	—4.4	67.7
	Calicut	10.6	—4.7	76.4
	Mangalore	13.6	—9.6	102.7
Mysore and Coorg Hills	Bangalore	1.6	—4.6	19.6
	Mercara	25.7	...	84.3
	Kodaikanal	4.8	—1.7	25.5
	Coonoor	1.6	—2.2	23.4

General Summary of weather conditions

The monsoon was active on the West Coast and on the North Madras Coast at the beginning of the month and rainfall was moderately heavy. A depression influenced the weather in the north of the Bay for the first five days and then passed out of the reporting area. Thunderstorms began to appear in the South and though wide-spread, rainfall was scanty.

Pressure distribution was of the usual type for the greater part of the month but the last week changed over to that typical of October, with an area

of uniform pressure in the centre of the Bay, accompanied by irregular winds, and showery weather over the greater part of the area. By this time the monsoon had received from the whole of India except the North East India where rainfall continued to be wide-spread and heavy.

Rainfall was below normal over the whole of the area, the defect being slight in the two northernmost districts, and most marked in the area covering the Carnatic and the central districts.

Temperature was in excess for the greater part of the month over the East Coast, but fell rapidly with the change in pressure distribution, and was markedly below normal on the last day of the month.

Weather Report for the Research Institute Observatory

Absolute Maximum in Shade	94° · 0
Absolute Minimum in Shade	65° · 0
Mean Maximum in Shade	89° · 4
Mean Minimum in Shade	70° · 9
Total Rainfall	0 · 05 Inches
Average Rainfall for August	1 · 27 "
Departure from Normal	—1 · 22 "
Number of rainy days	Nil
Heaviest fall in 24 hours	0 · 03 Inches
Mean Daily wind velocity	4 · 1 M. P. H.
Mean 8.00 Hours wind velocity	3 · 9 "
Mean Humidity	71 · 5 %
Total Hours of bright sunshine	212 · 5 Hours
Mean daily hours of bright sunshine	6 · 8 "

Summary of weather conditions

Pressure was high and steady for the greater part of the month after the monsoon receded from the West Coast.

Rainfall was very scanty and amounted to 0.05 inch against an average of 1.27 inch. Thunder and lightning was frequent but the local storms were active to the west and north of the observatory.

With the reversion of the pressure distribution to that typical of October, northerly winds began towards the end of the month and the upper air movements as judged by the movements of clouds was from some point in the North-East quadrant.

Skies were moderately clouded and the mean daily period of bright sunshine were 6.8 hours.

P. V. R.

P. S. N.



APPENDIX

A Complete list of Books received in the Agricultural College and Research Institute Library for the year 1929, was published in the March issue of this year, Vol. XVIII, No. 3. From now onwards it is proposed to publish the full list of Books, Bulletins, Pamphlets and other publications received in the Library, commencing from the month of July 1930, for the benefit of our readers.—Ed. M. A. J.

List of Books received in the Agricultural College and Research Institute Library, from January to June 1930.

1. *British Journal Photographic Almanac*.—Brown G. E. 1930.
2. *Bibliographia genetica*—Vol. 1-5. Dr. J. P. Lotsy. 1930.
3. *India in 1928-29*.
4. *Fundamental Rules and Subsidiary Rules 1930*.
5. *Indian Year-Book*. 1930.

List of Books, Bulletins and other Publications received during July 1930

BOOKS

- | | | | |
|--|-----------------------|-----|------|
| 1. <i>Food ...</i> | By McCarrison | ... | 1929 |
| 2. <i>The Indian Sugar Industry ...</i> | S. M. Hadi | ... | 1928 |
| 3. <i>A Text Book of Punjab Agriculture ...</i> | Roberts and Faulkner. | ... | |
| 4. <i>Fields and Farmers of Oudh ...</i> | R. Mukerjea | ... | 1929 |
| 5. <i>Life and Labour in a South Gujarat Village ...</i> | G. C. Mukhtyar | ... | |
| 6. <i>Climate and Weather ...</i> | H. N. Dickson | ... | 1928 |
| 7. <i>Classification of Flowering Plants, Volume 1, 2nd Edition.</i> | A. B. Rendle | ... | 1930 |
| 8. <i>General Insectorum—Coleoptera Adepaga—Sub-Fam. Carabinae ...</i> | G. Vachar | ... | 1930 |
| 9. <i>Diptera Danica—Part VII—Platypezidae, Tachinidae ...</i> | | ... | |
| 10. <i>Guide to Foreign Studies ...</i> | M. C. Mohan | ... | |
| 11. <i>The Report of the Madras Provincial Banking Enquiry Committee—6 Vols. ...</i> | | ... | 1930 |

REPORTS

1. Agricultural Statistics of India 1927-1928. Volume I.
2. Administration Report for 1928-29. *Madras Co-operative Societies.*
3. Do. do. *Department of Agriculture and Forests—Indo-China (in French).*

4. Administration Report for 1929.

5. Do. do.
6. Do. 1928.

Hong-Kong Botanical and Forest Department.
Nyasaland Protectorate.
U.S.A. Connecticut Agriculture Experimental Station published as Bulletins No. 39-56.

BULLETINS

7. A Method of Increasing the Manurial Bone Phosphate. *Value of Pusa Bulletin No. 204.*
8. Studies on Asiatic Cholera. *Indian Medical Research Memoirs. No. 14.*
9. (a) An Investigation into the value of Etherised Vaccin in the Prophylactic Treatment of Rabies.
(b) The Comparative Immunizing value of Semple's Carbolized Vaccine and the Etherised Vaccines of Alivisators and Hempt. *do. No. 13.*
10. (a) A Study of Indian Medicinal Plants (ii) *Gymnena Sylvestre*, Br.
(b) A Comparative Study of the Dried Barks of the Commoner Indian Species of Genus *Terminatia*, Ltd. *do. No. 16.*
11. A Preliminary Note on Varieties of *Santalum Ablum*, Linn. in Mysore. *Mysore Sandal Spike Investigation Committee Bulletin No. 1.*
12. What it is doing for the Improvement of Mysore Coffee. *Mysore Coffee Experimental Station Bulletin No. 1.*
13. Report on an Economic Survey of Birampur. *Board of Economic Enquiry, Punjab. Rural Publication Series. No. 1.*
14. Rates of Food Consumption by Zamindars. *do. No. 6.*
15. Sixty years of Punjab Food Prices 1861-1920. *do. No. 7.*
16. The Cultivation and Commercial Possibilities of the *Robusta* types of Coffee. *Ceylon Agricultural Department Bulletin No. 87.*
17. A Preliminary account of Three Rice Stem Borers. *F. M. S. Agricultural Department Scientific Series. No. 1.*
18. Seed Marketing Hints for the Farmer. *U.S.A. Farmers' Bulletin No. 1232.*
19. Preparation of Fresh Tomatoes for market. *do. „ 1291.*
20. Varieties of Hard Red Spring Wheat. *do. „ 1621.*
21. The Hessian Fly and how losses from it can be avoided. *do. „ 1627.*
22. Growing Black Locust Trees. *do. „ 1628.*

23. Steam Sterilization of soil for tobacco and other crops. *U.S.A. Farmers' Bulletin* No. 1629.
24. The Relationships between Roads and Agriculture in New York. *U.S.A. Cornell University Bulletin.* No. 479.
25. Economic Studies of Dairy Farming in New York IX. *do.* " 483.
26. Rural Population—Tompkins & Schuyler Counties—New York. *do.* " 487.
27. The Clover Leaf Caterpillar and the Clover Leaf Tyer. *do.* " 489.
28. Abandoned Farm Areas in New York. *do.* " 490.
29. Varietal Experiments in Soy beans in New York. *do.* " 491.
30. Organisation of the Sowing Center in the Home. *do.* " 492.
31. Village Service Agencies—New York. *do.* " 493.
32. Some facts concerning the distribution of fruits and vegetables by wholesalers and jobbers in large terminal markets. *do.* " 494.
33. Apple varieties—Prices, yields and Acreages. *do.* " 495.
34. An Economic Study of Farm Electrification in New York. *do.* " 496.
35. Pollination and other factors affecting the set of fruit. *U.S.A. Cornell University Agricultural Bulletin* No. 497.
36. Protecting Orchard Crops from Diseases and Insects. *do* " 498.
37. Inheritance and Linkage Relations of Vireccent seedlings in Maize. *Memoir* " 125.
38. Effect of storage in finely divided foods upon the stability of the D. Vitamin of Cod Liver Oil. *do* " 126.
39. Report on Inspection of Commercial Fertilisers for 1928. *Connecticut Agri. Expt. Station. Bulletin* No. 296.
40. The Effect of topping and suckering on Havana Seed Tobacco. *do* " 297.
41. Administration Report of the Director, 1928. *do* " 298.
42. Report of the Tobacco Sub-Station, 1928. *do* " 299.
43. The Composition of some commercial Insecticides, Fungicides, Bactericides, Rodenticides and weed killers. *do* " 300.
44. Control studies on the Plum Curculio in Connecticut Apple Orchards. *do* " 301.
45. The Willow Scab Fungus. *do* " 302.
46. Report on Inspection of Commercial feeding stuffs. *do* " 303.
47. The Asiatic Beetle in Connecticut. *do* " 304.
48. 28th Report of the State Entomologist of Connecticut. *do* " 305.

49. Soil Reaction and Liming as factors in Tobacco Production in Connecticut. *Connecticut Agri. Expt. Station. Bulletin* No. 306.
50. 33rd Report on Food Products and 21st Report on Drug Products, 1928. *do* " 307.
51. The Control of the Asiatic Beetle in Lawns. *do Bulletin of Immediate Information* No. 62.
52. The European Corn Borer. *do* " 63.
53. The Japanese Beetle Quarantine. *do* " 64.
54. The Asiatic Beetle Quarantine. *do* " 65.
55. The Satin Moth Quarantine. *do* " 66.
56. Control of ant invasions. *do* " 67.
57. The Dehydration of Prunes. (Revised). *U.S.A. California Agri. Bulletin* No. 404.
58. Abode Construction. *do* " 472.
59. Economic Aspects of the Sheep Industry. *do* " 473.
60. Walnut Supply and Price Situation. *do* " 475.
61. Poultry Houses and Equipment. *U.S.A. California Agri. Bulletin* No. 476.
62. Feeding and Management of Dairy Calves in California. *do* " 478.
63. (a) Irrigation Experiments with Peaches } *do* " 479.
- (b) Canning Quality of Irrigated Peaches. }
64. The use, value and cost of credit in Agriculture. *do* " 480.
65. Utilisation of Wild Oat Hay for fattening yearling steers. *do* " 481.
66. Substitutes for wooden Breakpins. *do* " 482.
67. Utilisation of surplus prunes. *do* " 483.
68. The Effect of Dormant Pruning on the Carbohydrate metabolism of *Vitis vinifera*. *Hilgardia Volume* No. 4 No. 6.
69. Factors which modify the resistance of wheat to Bunt *Tilletia Tritici*. *do* " 7.
70. An Experimental Study of Tests for the detection of carriers of *Bacterium Paucorum*. *do* " 8.
71. A Comparative Investigation of certain film forming fungi. *do* " 9.
72. Comparisons of Daytime and Night time soil and Air Temperatures. *do* " 10.
73. Rural Organisations and the Farm Family. *Wisconsin Research Bulletin* No. 96.
74. Inheritance of Fusarium Wilt Resistance in Canning Peas. *do* " 97.
75. New Science for an old art. *Bulletin* " 410.
76. Use of Exhaust steam in Dairy Plants. *do* " 411.
77. Rotation and the Tobacco crop. *do* " 412.
78. Fertilisers for Tobacco. *do* " 413.
79. Permanent Pastures can be improved. *do* " 414.



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| 81. Undulant fever in Man and abortion
disease in cattle. | do " 128. |
| 82. Results of a long time mineral feeding
experiments with Dairy Cattle. | do " 129. |
| 83. The use of Peat in the Green-house. | Special Bulletin " 194. |
| 84. The marketing of Poultry and Poultry
products. | Union of S. Africa Agri.
Bulletin No. 59. |
| 85. The prevention of mould wastage in
oranges. | do " 64. |
| 86. Merino-wool classing. | do " 71. |
| 87. Report on the Co-operative marketing
during 1927-28. | Union of S. Africa Agri.
Bulletin 74. |
| 88. The Principles of Co-operation. | do 80. |
| 89. Yields of Para Rubber on Expt. Stations
1891-1929. | Gold Coast Agri. Bulletin
No. 18. |
| 90. Flies injurious to Domestic Animals in
Mauritius. | Mauritius Agri. Bulletin.
Scientific Series No. 15. |

PAMPHLETS, CIRCULARS ETC.

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| 91. Note on the cultivation and management
of grass land at the Hosur Livestock
Research Station. | Madras Agri. Pamphlet
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| 92. Breeding and Rearing of cattle and
buffaloes | Leaflet No. 31. |
| 93. Broad hints for Everyday use. | Revised.
Leaflet No. 64. |
| i. Feed your bullocks. | |
| ii. Keep good bullocks. | |
| 94. Sheep Dipping. | Minister of Agri. &
Fisheries, England Leaf-
let No. 145. |
| 95. Potato growing in allotments and small
gardens. | do " 296. |
| 96. Tuberculosis in Poultry. | do " 1. |
| 97. Making a model to show how forests
prevent erosion. | Advisory Leaflet U.S.A.
Agri. Leaflet. No. 58. |
| 98. Method of testing the capacity of Fruit and
vegetable containers under the United
States Standard Containers Acts. | U. S. A. Miscellaneous
Publication No. 75. |
| 99. An annotated list of Literature References
on garment sizes and body measure-
ments. | do " 78. |
| 100. Anthelmintics for the removal of thorn-
headed worms for swine. | do " 79. |
| 101. Electrical Statistics for California Farms. | U. S. A. California Cir-
cular No. 316. |
| 102. Rearing Dairy Heifers free from tuber-
culosis and abortion disease. | do Extn. Service
Circular No. 33. |
| 103. Plum growing in California. | do " 34. |
| 104. Bee-keeping for the beginner in California. | do " 36. |
| 105. Home and Farm Preparation of Pickles. | do " 37. |
| 106. Alfalfa varieties and seed supply. | do " 38. |

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