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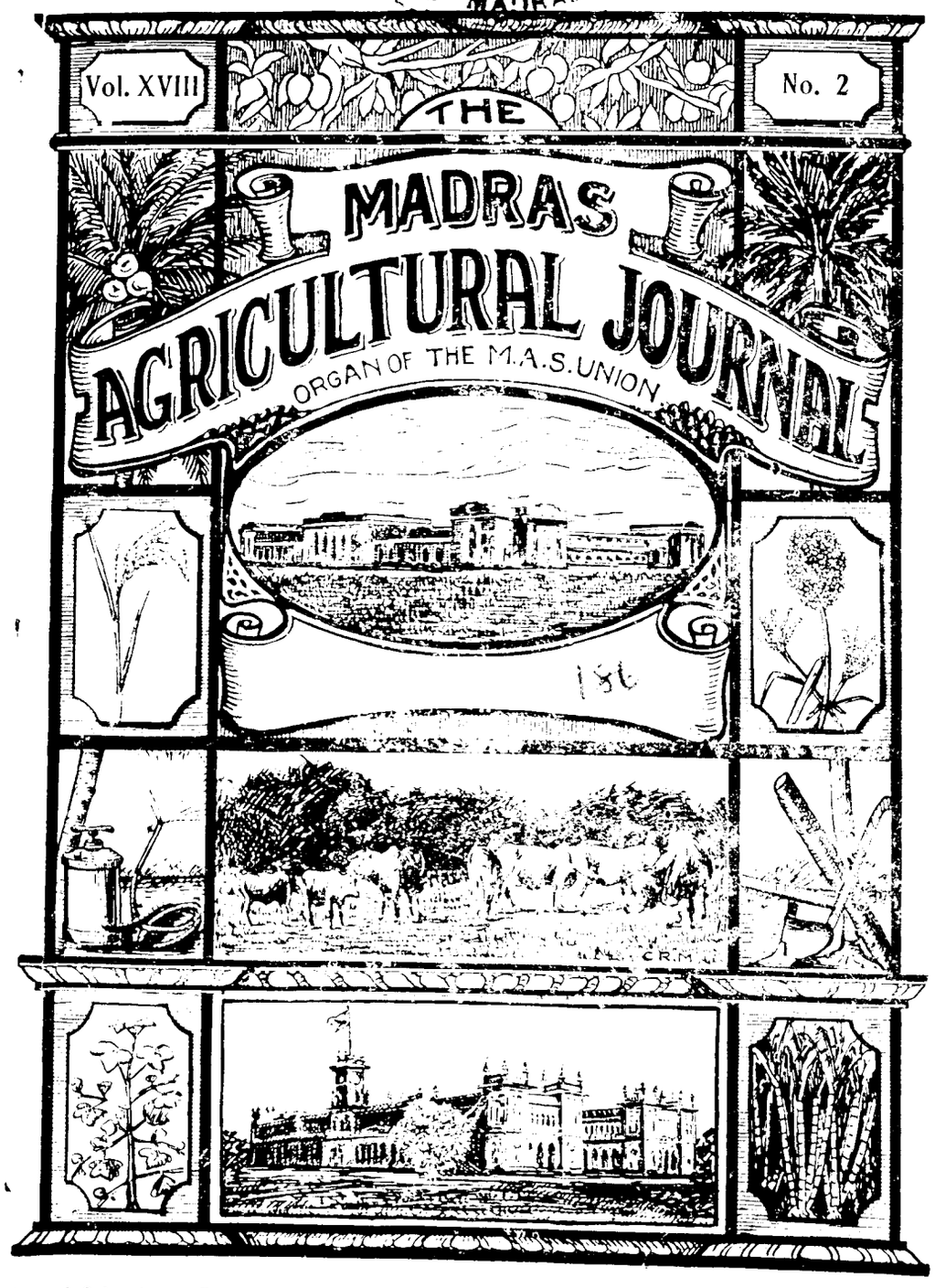

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PLOUGHS AND PLOUGHING

BY

N. G. CHARLEY

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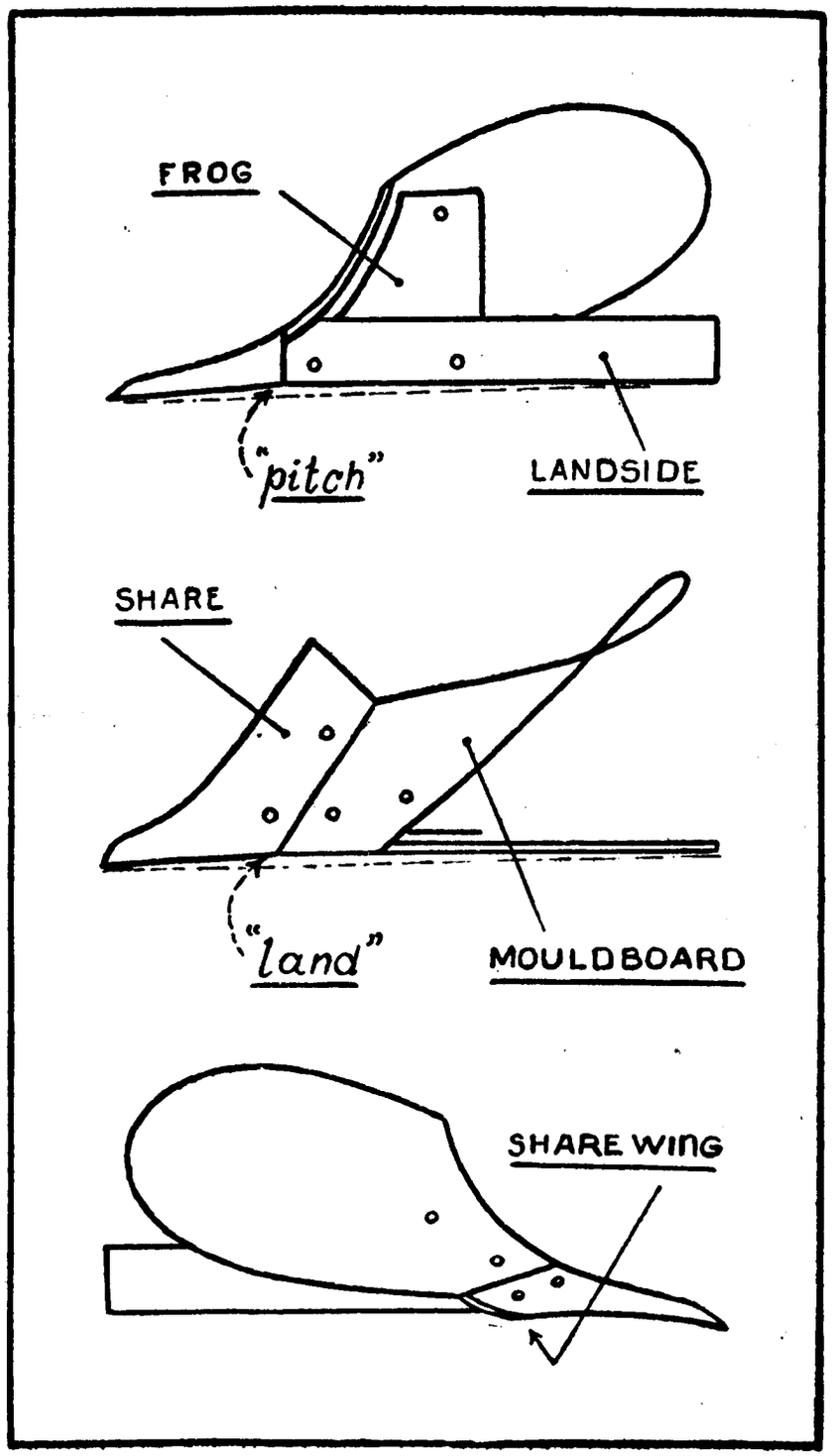
The plough is the vital part of the ryot's equipment. Ploughing is the first and foremost operation in the preparation of the soil to develop tilth. This is just as true to-day as it ever was, despite the introduction of many other forms of tillage implements. The productiveness of the soil depends upon its physical condition, its humus content, the amount and availability of water and the amount of available plant food. The ground must be ploughed to break up and pulverise the soil. Pulverising is necessary to aerate the soil and make available the plant food which envelopes each soil particle. The soil must be aerated in order that it may be thoroughly oxidised, a condition necessary to the healthy maintenance of soil bacteria. Ploughing is necessary to cover surface trash or manure and mix it with the soil so that it will decay and maintain the stock of humus and plant food. The ground must be ploughed for the purpose also of increasing the ability of the soil to absorb moisture. The seed bed must be in a well pulverised and compact condition so that the seed can germinate according to its natural inclination and the plant produce a root system necessary for vigorous growth and flowering.

Clods in the seed bed cause large air spaces which arrest the rise of moisture from the subsoil by capillarity. The particles of soil composing the clods are not aerated, nor can the tender roots of the young plant penetrate the clods which retard root growth. The soil particles should be in close proximity though minute air spaces should exist at the same time. It matters not how good the seed is, if the soil is not in the right condition to make plant food available to nourish the starting plant; otherwise growth will be stunted and a poor start can never be made up at subsequent stages of the plant's growth.

The plough bottom, viz., the mouldboard, share and landside with the frog which holds them together is the vital part of the plough. All other parts of the plough are for the purpose only of enabling the ploughman to make the bottom work correctly. A large variety of plough bottoms are made to meet the various soil conditions and to do the various kinds of ploughing required by farmers. Plough makers have not yet been able to design any one plough bottom that can be adapted to all the different kinds of soil. They have been able to build plough bottoms that will plough remarkably well in all types of soil that have certain common characteristics, but when the demarkation is too pronounced, it is necessary to change the shapes of the mouldboards in order to properly work the soil.

There are many soil combinations, but the most common are clay, clay loam, loam, sandy loam, loamy sand, sand and muck. Clay is the most difficult soil to till on account of the peculiar effect water and air have upon it. It holds moisture longer than the other types of soil, bakes hardest, cracks deeply permitting great quantities of moisture to escape and forms clods easiest. Clay soils when ploughed too dry form large clods which are very hard to break down into pulverised condition. If such soil lacks humus in sufficient quantities to keep it friable, it nearly always forms a powdered surface and if sufficient rain comes while the soil is in this powdered condition, the soil will run into a sticky plastic mass which will later dry hard, crack and become very difficult to break up successfully. Clay being of a plastic nature is puddled by wet ploughing. If it is turned over in a closely compacted manner, the top dries out and cracks occur which form avenues of escape for the moisture below and a cloddy formation at the bottom of the seed bed is the result. Great care must be exercised in the handling of clay soils. The correct kind of plough bottom must be used to get the best results and the ploughing must be done when the moisture conditions in the soil are just



right. Loamy soils are made up of sand and clay in such composition that the identity of each is lost. Loam crumbles readily making it easy to plough and cultivate. It forms into a mellow compact seed bed. In clay loam, clay predominates in the soil composition and in sandy loam, sand predominates. A clay loam soil should be treated more like a clay soil and a sandy loam more like a sandy soil. Clay loam is much easier to plough and cultivate than clay because the sand in the loam breaks up the compact relationship between the clay particles. It has the clay characteristics of cracking and drying out and should be handled in such a way as to avoid this. Sandy loam is a mixture of sand and clay in which the sand predominates. It is more porous than loam or clay loam, works up easily and does not form large unbreakable clods. Loamy sand contains very little clay, it dries out quicker than any other type of soil, never forms clods and is the easiest soil to plough. It is a soil that should be handled with the greatest care or it will produce nothing. As soils vary from one extreme to the other, so must plough builders make plough bottoms to meet these variations.

The plough bottom is similar in its action to a three-sided wedge. The cutting edge of the share and the landside, which cut the furrow slice free from the subsoil and the furrow wall, form the flat sides of the wedge. The mouldboard and upper part of the share are curved and made to perform the functions of lifting, pulverising, turning and compacting the soil into an inverted position. The principle of the pulverising effect of the mouldboard is illustrated by bending a pack of cards or the pages of a book. The layers of particles composing the furrow slice like the cards in the pack are made to slide one over the other so that the cohesion of the soil particles is broken. In addition to this shearing action, the bending of the furrow slice by the mouldboard produces a direct breaking effect which assists in the pulverising of the soil. Whether the furrow slice is broken into larger or smaller clods depends on the tenacity with which the particles hold together and the shape of the mouldboard for pulverising. Clay would be broken into clods with the same type of mouldboard that successfully pulverises sandy soil. For this reason all types of plough bottoms that are used in ploughing the looser soils are bluffer than those used in ploughing soils that stick together, such as clay. The mouldboard should lean more towards the bluff as sand predominates in the soil composition and more towards the longer curve as clay predominates. The pulverising of the more tenacious clay soils cannot be effected by increasing the abruptness of

the mouldboard curvature as one might at first expect. In soils containing much clay, the furrow slice will suffer disintegration due to direct breaking and will be broken into clods if a bluff mouldboard is employed. The shearing of the soil particles which plays the biggest part in pulverising will be resisted by their cohesion and pulverising will not be effected.

A mellow loam soil and soils of similar texture which are capable of being directly pulverised with the plough should be ploughed with a pulverising bottom. As the clay content and so the cohesion of the soil particles increases, the mouldboard curvature should be made longer and less abrupt. If clay soils are in the right condition for ploughing, they can be successfully pulverised with the right kind of plough bottom, though never to the same extent, of course, as loamy soils. If, however, they are too moist or too dry, they must be ploughed with a bottom that will invert the furrow slice without materially disturbing its composition and pulverised afterwards with other implements.

The amount of moisture the soil contains as well as the texture of the soil determines whether the ground should be ploughed with a pulverising mouldboard or an easier turning mouldboard that will turn it over without so much attempt at pulverising. Up to a certain limit, moisture in the soil will greatly facilitate pulverising and it is very desirable that the condition of the ground should be carefully studied and the ploughing done as far as possible when the moisture conditions in the soil are such as will permit the best quality of work. A mouldboard that does a perfect job of ploughing in a soil in right condition will fail to work if the soil contains too much moisture. The cohesion of the granules of a closely textured soil like clay is increased by the pressure of the soil against the mouldboard if the soil is ploughed too wet and the soil granules will not fall apart in the act of ploughing. The wet plastic soil in passing over the surface of the mouldboard is moulded into a solid mass in the curve of the mouldboard. A sticky wet clay cannot, therefore, be pulverised directly with the plough and requires a mouldboard with a long gradual curve that will turn over the furrow slice almost intact leaving it to be pulverised with a disc harrow or other implement after it has dried out sufficiently. Similarly, for the ploughing of wet lands containing more than a certain amount of clay, a flattish mouldboard is required.

Between the short abruptly curved mouldboard and the long gradual curve are many styles of bottoms to meet the many

different soil conditions, but for general use, bottoms may be classified as breaker, general-purpose, stubble, black-land and slat mouldboard bottoms. The breaker is used in tough sod where complete turning of the furrow slice without materially disturbing its composition, is desired. In ploughing sod all portions of the grass should be completely buried and the ground packed as closely as possible to exclude all air and sunlight so that the grass will die and decay rapidly. Wherever a ray of sunlight is able to peep through the furrow tops the grass will sprout again. The mouldboard of the breaker plough has, therefore, a long gradual curve. The general-purpose bottom is equipped with a mouldboard of medium curvature and meets the demand for a bottom that will do satisfactory work in the varying conditions found on the average farm. Stubble bottoms have high bluff mouldboards and are specially adapted to ploughing in old ground where good pulverising of the soil may be effected. The black-land bottom is made for use in heavy, sticky, black or chocolate soils which are hard to break and harder still to scour. It is built with a low front and easy tapering mouldboard designed to shed the soil and draw as lightly as possible. The black-land type of bottom is a very suitable one for wet lands, particularly where clay predominates in the soil composition. The slat mouldboard bottom which is described further on in this article is made for loose, sticky soils in which solid mouldboard ploughs completely fail to scour. There is, of course, a number of variations of these general bottom shapes.

For deep ploughing down to eight inches or more, a plough bottom of the right type should be used. If a bottom of not more than six to seven inches capacity is used, the furrow slice cannot be properly pulverised and portions of the slice will pass over the top of the mouldboard or, in soils that stick together, the furrow slice will be set on edge and roll back into the furrow as the plough passes on. A plough bottom will usually do its best work when ploughing at a depth equal to half its width.

In some countries where clay land predominates and rainfall is excessive, underdraining is practised. A plough is used which has a share narrower than the mouldboard. In ploughing the land a portion of the furrow is not cut entirely off. The mouldboard pushes the cut part of the furrow solidly against the preceding furrow shaping the furrow to leave the top diamond shaped with drainage facilities at the bottom. This gives the furrow slice an opportunity to dry out so that it may be successfully tilled.

A knowledge of what constitutes good ploughing is necessary before one can judge whether the bottom is particularly adapted to the soil. It does not matter what type of soil is being tilled. The conditions necessary for plant growth must be the same. The soil must be well pulverised and properly compacted so that natural agencies may have the greatest effect whether the soil be clay, sand, muck or any other. Unfortunately, no method of expressing or measuring tilth in a concrete manner has yet been devised and the ultimate test of tilth must be found in its effect upon the plant itself. It is impossible, therefore, to lay down a set of laws or rules to determine what constitutes prize ploughing. The most beautiful job of ploughing on the surface is no proof that the ground will grow the best crop. Before the best results can be expected, however, we know that the following requirements should be fully met. Each furrow should be straight from end to end. The top lines of the furrows should be uniform without breaks or depressions. The top of the furrow may be slightly ridged. The ground should be thoroughly pulverised from top to bottom of the furrow with no air spaces anywhere between the furrow slices. Trash must not be visible in the line of the furrow and should be buried in the lower outside corner of the furrow to interfere as little as possible with the upward trend of moisture by capillarity. Furrows should be of uniform width and depth, compared one with the other. In the case of loose sandy soils, the more level the ground is left after ploughing the better, since less moisture will escape under these conditions than if the furrow tops are left ridged or crowned. The right plough bottom must be used to leave the ground in this condition. The best method of judging ploughing by these standards is to take a spade or similar instrument and observe the condition of the bottom of the furrow by carefully removing some soil so that a full depth cross section of a number of adjacent furrows is exposed. Clods, trash and air spaces, if any, may thus be revealed.

Ploughs are made of steel and cast iron and the ryot should consider which type will best suit his particular soil conditions and give him the most economical service. The latter type of plough is usualiy referred to as a 'chilled' plough because of the chilling process the cast iron wearing parts are subjected to in the process of hardening them. In steel ploughs of the best quality the principal wearing parts, the mouldboards and shares, are made from what is known as soft centre steel. This steel is composed of three layers fused together. The two outside layers are of high carbon steel to ensure hardness and good scouring and wearing

properties and the centre layer is of soft steel to impart toughness and prevent the breaking of the brittle outside layers. A steel mouldboard of this kind is about a quarter of an inch in thickness. These soft centre steel bottoms are in more general use than solid steel bottoms in advanced agricultural countries. They have very much better wearing and scouring properties than the solid steel bottoms. Solid steel shares are sometimes used with soft centre steel mouldboards where soil conditions do not require the more costly soft centre steel shares for scouring. The steel ploughs which are being manufactured for this country have mouldboards and shares of solid steel which is less costly and the thickness of the mouldboards varies from about one-eighth of an inch on ploughs of the popular 'Meston' class to about three-sixteenths of an inch on those of the 'Victory' size. Solid steel bottoms, however, have not such good scouring properties as soft centre steel bottoms because they cannot be tempered for fear of rendering the steel too brittle and are likely to break under shock and heavy loads in difficult soils.

Chilled ploughs are constructed by an entirely different process from steel ploughs. The parts are cast in moulds and the *chill*, as plough makers call the term of hardening, crystallises the metal so that the grain of the metal is edgewise of the surface instead of lengthwise as it is in steel sheets due to the rolling process in the course of manufacture. The ends of the metal crystals thus form the surface of the mouldboard and for this reason chilled mouldboards are very hard and wear for many years. The share and other wearing parts are chilled in a similar manner. The thickness of a chilled mouldboard is about three-eighths to half an inch. The chilling effect is usually made to penetrate about a quarter of an inch of this total thickness so that a chilled mouldboard will present a hard chilled surface until the entire thickness of the chilled portion is worn away. A properly chilled casting has a flinty hardness which it is impossible to duplicate in steel by the best hardening process. This exceptional hardness enables a chilled plough to much better withstand the scratching action of sand, stones and like material which will quickly wear away a steel plough and ruin the polish on its mouldboard so that it will fail to shed the soil. In fact, there is no abrasive action of the soil that will affect the scouring qualities of a properly chilled metal. The more a chilled plough is operated in sandy soil, the smoother it becomes and the higher polish it takes. The ends of the metal crystals form the surface for scouring and the dirt passing over the ends of the crystals has a tendency to polish rather than cut

grooves in the metal. Chilled ploughs are not affected by rust. The needle crystals of the metal merely corrode on the ends which form the surface and the surface can be repolished after long exposure to the weather by turning a few furrows with the plough.

Steel ploughs are unsuitable for soils containing sand or stones and are subject to rapid wear in such soils. Steel shares, nevertheless, may prove an advantage in ground containing large stones which are likely to break a chilled share. A steel plough after use in sandy soil will fail to scour when put to work in sticky soils. The sand scratches the steel and leaves a feather edge which ruins the dirt polish and the plastic silt fills the scratches and causes the soil to adhere to the mouldboard.

A plough bottom must scour if good work is to be done with it. The most common cause of a plough failing to scour is the lack of this earth polish. An extra hard finish is necessary to make a plough scour well and the material from which the mouldboard is made and the way it is made have very much to do in the matter of scouring. Improper adjustment of the plough, incorrect shape of mouldboard, or a dull or incorrectly set share, are other causes. The trouble may be due again to the plough not running in the true line of draught or the soil may be too loose and not exerting sufficient pressure on the mouldboard to prevent the soil from sticking. For loose, sticky soils the curvature of the mouldboard should be very slight to disturb the furrow slice as little as possible in the act of turning. Ploughing a little deeper will put more pressure on the mouldboard and often overcomes the difficulty of sticking soil. Scouring troubles may be due to soft spots in the mouldboard. If the surface of the mouldboard has a cloudy appearing spot which is darker than the surrounding surface, this spot is softer than the rest of the surface. The only remedy is a new mouldboard. The chilled surface may be worn through in spots till the soft unchilled iron is exposed or in the case of soft centre steel the hard outside layer may be worn through and the soft centre exposed. In cheap low grade ploughs, the mouldboard will often consist of soft low grade steel and the surface will never scour except under very favourable conditions. High grade ploughs do much superior work, are lighter in draught and are very much cheaper in the long run.

There are some soils so sticky by nature that the ordinary mouldboard plough bottom will not scour in them at all, no matter how good the surface of the mouldboard and how gentle its curvature. A slat type of mouldboard is the only type that will prove

effective under these conditions. By substituting slats for the regular mouldboard, the friction of the furrow slice is concentrated on a smaller area making it scour better and with less draught. The slats at the same time present sufficient surface to constrain the motion of the furrow slice.

Loams free from coarse sand, sticky clay soils and tough waxy soils can be worked most successfully with steel ploughs because these soils have in them the properties necessary to make the dirt polish on the mouldboard without scratching it. Whenever such conditions prevail, steel ploughs are to be preferred. Though generally more expensive than the chilled plough, the steel plough has the advantage of being lighter in weight and the steel shares may be repaired cheaply by the local blacksmith with a little experience of such work. In certain soil conditions a combination of chilled iron share and soft centre or solid steel mouldboard is used with good results.

From the foregoing it is obvious that the ryot can use both types of plough to good advantage and where it is possible to interchange the steel wearing parts with chilled parts, the advantage is double because of the saving in expense.

Knowing how to drive the team properly, making the hitch correctly and knowing that the plough bottom is in correct condition, are points that determine good ploughmanship. The share is the most vital part in making the plough work successfully provided the plough bottom is suited to the particular soil conditions. Draft, penetration, steady running and good work all depend on the share. If all adjustments have been made on the clevis and the plough still fails to work successfully some part of the plough bottom is out of shape and in all probability it will be the share. If the share has the correct shape for penetration and land suction, there should be no difficulty in making the plough work correctly. The plough bottom should run level and cut all furrows the same depth and the same width. If the plough develops a tendency to ride out of the ground, the share has become worn round on the underside, giving it a sled runner effect. Sharpening the point on the top side or replacing it with a new one are the only remedies. If the plough has a tendency to move forward with a jumping motion and the furrow bottom is uneven and full of gouged places, the plough is running on its point. Provided the hitch is not too high so that the whole plough bottom is tilted, the share point is bent down too much. This should not occur with a new factory-made share but may happen if a steel

share has been handed to an inexperienced blacksmith for sharpening and setting. Many of the iron ploughs working in this country will be found to be running on their points and a good deal out of proper adjustment so that they are not giving their best results. Those who are adopting the iron plough should bear carefully in mind the difference between this implement and the country plough in the setting of the point. The country plough is tilted at an angle with the furrow sole so that the point will engage sufficiently to keep the plough in the ground. The iron plough bottom must run perfectly level to give the best results. Its point is already set down at the required angle to cause sufficient penetration, and tilting of the whole plough bottom will cause the point to gouge into the furrow sole and seriously impair the efficiency of the mouldboard in pulverising the furrow slice. Not only must the plough bottom be level in a fore and aft direction, but also in a lateral direction. An even more objectionable practice than running the plough on its share point is the practice of leaning the plough over towards the land side so as to incline the point away from the land and prevent the plough from taking too wide a furrow. In holding the plough handle vertically upright, as it should be held, so that the plough bottom is perfectly level when viewed from behind, the ryot finds that the plough runs much too far into land. This is due to the wide yoking of the bullocks. The plough tends, of course, to take up a position immediately behind the mid point on the yoke where the plough rope or pole is attached. One bullock must walk in the furrow. As the land side bullock is yoked closer to the furrow bullock, the mid point of the yoke comes closer to the furrow and more directly over the line of the furrow which the plough is required to cut. It is of very much importance, therefore, that the bullocks should be yoked sufficiently close together to bring the point on the yoke where the plough rope is attached, directly ahead of the plough. There will then be no necessity to cant the plough to prevent its taking too much land. The canting of the plough raises the mouldboard so that most of the furrow slice passes underneath it. The mouldboard is thus rendered largely ineffective and the work is necessarily of very poor quality. If a walking plough is in perfect adjustment, only the slightest effort should be required on the handles to keep the plough in running position. Walking ploughs require more wing on the share than wheeled ploughs. This additional wing surface is necessary as a bearing to keep the plough running level. On wheeled ploughs, the wheels carry the weight and keep the plough on an even keel. If a walking plough has a tendency to lean over landwards, the wing of the share is bent up too much and if to the

opposite side, the wing is too low and the cutting edge should be raised. If these incorrect settings of the share occur on a wheeled plough, the wheels have to bear the brunt and either the land wheel or the furrow wheel has to carry too much weight and the bearings and axles wear out quickly. To do the best ploughing, the share must be kept sharp and well adjusted. The accompanying illustrations show the proper shaping and angle of the point and the correct form of the share wing. The point should have a gradual wedge-shaped slant extending a slight distance landwards from a line parallel with the landside to make it hold the land and slightly downwards below a line parallel to the bottom of the landside to hold it in the ground. The amounts the point is deflected are called respectively the 'land' or 'land suction' and the 'pitch' or 'under point suction.' The amount of pitch depends on the type of plough and the soil conditions. Stiff clay soils are harder to penetrate than loam soils and require more pitch on the share point. The wing of the share should be so shaped as to keep the plough bottom level. When the plough is placed on a level board so that only the point of the share is allowed to project beyond the edge of the board the under-surface of the landside and the edge of the share should be in contact all round with the surface of the board. Shares and bottoms made by different makers have differences in shapes, but the general principle is the same.

The object of the landside on a mouldboard plough is to keep the plough from gouging into the furrow wall or swerving to one side whenever the share strikes some obstruction such as a small root or stone or encounters an irregularity of soil texture along the cutting edge of the share which will tend momentarily to deflect the plough from its straight course. It is obvious that since all the soil is turned to one side, there is a constant tendency for the plough to shear off into the land and the landside is constantly resisting this tendency. The landside pressure against the furrow wall holds the plough in its true line. On the country plough, each side of the plough bottom does an equal amount of work in pushing the soil aside and only variations in soil texture tend to move the plough from its straight course. There should be sufficient area of surface on the landside to render it effective. Ploughs for shallow ploughing require a long and narrow landside to give the required area. On general-purpose ploughs the necessary surface can be acquired by giving more height and not so much length to the landside. Some plough bottoms are made with a sloping landside and cut a sloping furrow wall. When the

furrow slice is turned by the mouldboard into a vertical position, it falls over due to its own weight because it has no square edge which will tend to support it in this position like the furrow slice which has a vertical furrow wall. The result is that it is lodged against the previous furrow slice with a greater impact, is so shaped that it fits more snugly at the outside bottom corner of the furrow so that no air spaces remain and, on account of its chamfered edge, leaves the surface of the ploughing more level. This is an advantage in sandy soils. Another advantage of the sloping land-side is that the shin cuts the furrow wall with greater ease just as a knife cuts a piece of wood better when operated with a slanting cut. This has a tendency to lighten the draught.

The curvature of the upper portion of the share and the mouldboard and the angle of the mouldboard with the furrow line have much to do with the draught of a plough bottom as well as its pulverising qualities. The draught of a plough is determined largely, however, by the scouring qualities of the metal of which it is made. Chilled bottoms being harder than steel bottoms are somewhat lighter in draught. The amount of moisture in the ground, the looseness or compactness of the soil and the amount of stubble, trash and roots, etc. are determining factors in the draught of the plough. Too much moisture in the soil adds draught in the same way as not enough moisture. Generally speaking, the plough bottom that does the best work pulls the hardest because it requires more energy to break a clod into many pieces than into only a few.

The theoretical line of draught between the centre of draught or centre of weight of the plough bottom and the centre of power on the bullock yoke will always straighten. Because this draught line straightens the depth and width adjustments can be made with the clevis on the front of the beam, in the case of short beam ploughs. To plough deeper the clevis is raised and to plough shallower the clevis is lowered. If it is desired to take more land, the clevis is placed to the right on right hand ploughs and if a narrower furrow is required, the clevis is placed to the left. On a left-hand plough, like the 'Monsoon', these two adjustments for width of furrow are opposite. It should be mentioned here that a head or gauge wheel is not intended as a means of adjusting the depth of furrow but only as a means of keeping the plough steady and maintaining a uniform depth of ploughing after the desired depth has been determined by means of the clevis adjustment. The head-wheel should be adjusted so that it bears only lightly on the land after the correct depth

adjustment has been made on the clevis. In almost all cases where a head-wheel is being used by the ryot, it will be found to be so adjusted that it is working in opposition to an incorrect setting of the clevis, preventing the plough going too deep, so that the wheel is under heavy load instead of a gentle pressure against the land. This incorrect adjustment of the head-wheel causes rapid wear of the axle and bearings and a very considerable increase in the draught of the plough. In the case of ploughs with long poles, the depth adjustment is made by altering the angle of the pole with the plough bottom, or, if the pole is a fixture on the plough, by lengthening or shortening the hitch. Reference has been made to the improper adjustment of many of the iron ploughs working in this country. The long draught pole is responsible for much of this. With a long shaft, incorrect adjustments do not show up so plainly and a plough bottom running on its point is a source of discomfort to the bullocks rather than to the ploughman. The gouging action of the point in the furrow sole jerks the shaft and the shock is transmitted to the bullocks' necks. The draught of the plough is also considerably increased. With a short beam, the pitching of the plough would offer a plainer warning that something was out of order and the discomfort of handling the plough in this condition would probably induce the ploughman to investigate the cause. The short beam, also enables the landside to function to its full extent and keep the plough bottom running straight despite the small sideways deflections of the line of draught due to the deviations of the bullocks from their straight course. With a long shaft, the plough bottom must follow every lateral or vertical movement of the bullock yoke and the quality of its work is considerably impaired. The plough should be in perfect balance at the end of its rope much in the same way as a kite remains in equilibrium at the end of its string. The rigid pole defeats the purpose of most of the essential features of plough design which contribute to that perfect balance so essential to the production of good work, minimum draught and ease of handling.

Chilled shares on account of the nature of the iron cannot be sharpened by heating and hammering out like steel shares. The only way they can be sharpened is by grinding on the upper side on an emery wheel or grindstone until a bevel edge appears. Soft centre steel shares require considerable care in sharpening. Care should be taken that only the portion of the share which is to be pounded out is heated and only as much as can be hammered should be heated at a time. The body of the share should remain

cool to prevent warping and disturbing of the fitted edges. The hammering should be done from the upper side with the bottom of the share flat on the anvil. This keeps the cutting edge down and works the hard steel of the upper layer over the soft steel layer in the centre thus preserving for the share a hard cutting edge. Care should also be taken not to dent the share on the upper surface when hammering. Solid steel shares may be sharpened by drawing out in the same way and though there is no upper layer to be carefully worked as in the soft centre share, it is better to do the hammering on the upper edge as there is less danger in this way of mis-shaping the share edge. A piece of steel may be welded on the point or on the wing if there is not sufficient metal in the share to be drawn out. Only the part of the share which requires drawing out should be heated and only just sufficient heat should be applied to put the metal in condition for working. Working the share at a high heat destroys the quality of the steel.

Soft centre steel shares should be rehardened after setting to the correct shape. The entire share should be heated uniformly to a cherry red and then dipped into a tub of clean cold water with the cutting edge down. Shares of solid high carbon steel should not be hardened all over as there is a danger of their breaking in work. Only the point and cutting edges should be treated. Mild steel and similar low grade material, of which many of the steel ploughs made in this country are built, is, of course, not capable of being hardened. Soft centre steel may be left very hard as the hard brittle outside layers are protected by the tough central layer of low carbon steel.

The disc plough has altogether a different effect upon the ground than the mouldboard plough. The mouldboard plough turns the soil with a crunching, pinching, pulverising motion, while the disc turns the soil with a rolling motion. The rolling motion of the disc plough leaves the soil in a looser condition than the mouldboard plough, hence the soil is better able to absorb moisture after disc ploughing. The mouldboard, however, does a better quality of pulverising and turns a better furrow in light sandy soils, weedy stubble fields and grass lands where the mouldboard plough has no difficulty in scouring. Often the ground becomes too dry and hard to be successfully turned with a mouldboard plough. The disc will do good work in ground in this condition. The edge of the disc cutting the soil is constantly changing in position as the disc rotates and for this reason the edge will retain its sharpness a great deal longer than the edge of a share. This fact has a lot to do with the superiority of the disc

plough in hard ground. The disc works with great success in black waxy soils where the mouldboard plough has great difficulty in scouring. Scrapers can be fitted to the discs and scouring difficulties are overcome. The disc plough also operates to advantage in very loose ground and in stony and rooty land. An advantage of the disc plough is that when it is desired to do deep ploughing better results can be secured by having each disc cut a narrow slice. Whether one cuts a wide or a narrow slice with the disc it always does an equal quality of work, whereas cutting too wide a furrow with a mouldboard plough leaves an unploughed strip and in cutting too narrow a furrow the soil is not properly pulverised. The principle of draught of a disc plough is entirely different from that of a mouldboard plough. The shape of the share and mouldboard of a mouldboard plough causes the bottom to be pulled into the ground. The disc plough must be forced into the ground by weight and draught combined. The disc plough despite its rolling motion does not pull any lighter than a mouldboard plough in turning over the same volume of ground.

NOTE ON THE CULTIVATION AND MANAGEMENT OF GRASSLAND AT THE HOSUR LIVESTOCK RESEARCH STATION: MADRAS PRESIDENCY

BY

R. W. LITTLEWOOD AND H. NARAHARI RAO

The Livestock Research Station, Hosur is situated on an elevation of 3,000 feet above mean sea level with good climatic conditions all the year round. The locality has an average annual rainfall of 25 inches most of which is received during the North East monsoon. The place is also favoured by the South West Monsoon for sowings.

The total acreage of the farm is 1633·35 acres out of which 800 acres are reserved for hay each year. The pastures reserved for hay are usually closed for cattle from July to December but are open for grazing during the remaining months. If the rains fail in August and grass becomes dry, cattle are allowed to graze paddock after paddock in quick succession till the break of the North East monsoon.

Grazing. Efforts are taken to see that grazing is alternated in the cropping scheme each year so as to give the land rest at least once in every two or three years. Rainfall plays considerable importance in the management of grassland here, but the success or otherwise of the management depends not so much on the total amount of rain received, as on its distribution through the year. During periods of prolonged drought, the paddocks that are ordinarily closed for cattle are opened for grazing.

The bulk of the area is covered with Spear grass (*Andropogon contortus*) but some special pastures are under Rhodes grass (*Chloris gayana*) and *Kolukkattai* grass (*Pennisetum cenchroides*). Spear grass thrives well on all kinds of soils in this tract, does not require much moisture, grows erect with fairly good leafy growth, resists drought conditions more than any other grass and provides some grazing even in bad seasons. It responds to the slightest shower and grows quickly. It makes very good hay just before flowering and is also suitable for making ensilage when made under proper care and supervision. The grass is so slender that for silage making it ought to be cut between 6 and 7 a.m. when

the dew is on, raked and carted immediately to the silo pit. No time should be allowed for the grass to dry inside, otherwise poor quality silage is produced. Rhodes grass, an introduced variety, is suited for low lying heavy soils. It has got a profuse leafy growth, grows 3 to 4 feet high and makes very good hay and ensilage. This grass seldom thrives on elevated lands and much less when the land gets dry. Remount Officers have stated that this is not a good grass for horses as it causes skin trouble. *Kolukkattai* grass was introduced two or three years ago on this farm and so far it has done well. It is a succulent variety with plenty of leaf and yields heavily. It makes good hay and ensilage. The grass was introduced as a substitute for Spear grass, as the latter has the disqualification of developing awns which are very disagreeable from a feeding point of view as they penetrate the mucous membrane of the mouth, causing ulcers and abcesses. It is a promising variety and attempts are being made each year to put more area under this grass. About 100 acres have established themselves up to the present.

There are also various other grasses that appear in the pastures, the important of these are given below:

Andropogon annulatus and Andropogon caricosus. These thrive well in low lying paddocks and are being encouraged wherever possible by sowing seed.

Andropogon pertusus is a perennial slender grass which is able to resist drought conditions. One peculiarity about it is that it thrives well in paddocks where cattle constantly graze.

Digitaria sanguinalis var. ciliaris and *Digitaria sanguinalis var. extensum*, are also good grasses that grow as a mixture with spear grass. The seeds are collected and sown to improve the pasture.

The following are the important operations carried out on the grassland at Hosur.

Manuring. Manuring usually begins about March and continues up to May. The correct system of manuring grassland would be to apply partially fermented, slow acting manures, the idea being that the root system of indigenous grasses being perennial do not require the readily assimilated plant food which is necessary for a cultivated crop of short duration. The manure that is applied to the grassland is intended to last for at least three or four years, whereas for a cultivated crop which remains on the land for a short duration, it is necessary to apply a readily available manure.

Manuring improves grassland considerably. It not only improves the outturn but also the quality of grass. It increases the light coloured, coarse foliage grass to a rich, dark, succulent one. Farm yard manure, at 20 cartloads per acre is usually carted and spread immediately on the grassland. The manure should not remain in heaps as the grass under them becomes burnt and this would leave a number of circular bare patches all over the land. A chain harrow is passed soon after application, as it breaks down the big lumps of manure and in a way incorporates it with the soil. It is very essential that the farm yard manure should be thoroughly spread, otherwise the pastures might become tufted and coarse in some places. Although the correct system would be to apply 'raw manure' to the grassland, the system usually followed on this farm is to apply a year-old rotted farm yard manure which not only spreads easily and evenly, but also ensures the destruction of weed seeds. Another difficulty is that in dry weather 'raw manure' falling in large lumps would kill the grass under it.

It is also necessary that grassland should receive occasional dressings of lime, as this helps to improve the quality of the grasses and the texture of the soil. Slaked lime is used at the rate of 3 cwts per acre and is spread about June—July. A dressing of bonemeal and superphosphate in the proportion of 3 : 1 is also applied on a still wet day. If spread on a windy day some of the bone dust and super will be blown away.

Ant hills. Ant hills come up in the grassland after the summer rains. These used to be dug out and the queen ants killed. This is a costly item of work. A new method introduced is to pump cyanide dust into the holes and block up all openings and this kills off most of the ants. Ant hills are not allowed to grow; as soon as a mound is seen, the dust is pumped in and this has been found sufficiently effective. If they are neglected, they become a source of great damage to mowing machines and injury to cattle, besides becoming a safe abode for snakes.

It is observed that the nests are numerous and deep in paddocks which have soft deep soil whereas they are not many in paddocks which are gravelly underneath. One reason that contributes to the increase of ant hills in the grassland is that when the droppings of cattle are left in lumps the white ants breed below them and eventually form nests; Chain harrows are passed over the land which has been grazed the day before in order to break up the clods and aerate the soil. This also produces an even distribution of the droppings which results in more uniform growth. Another

advantage is that they no longer serve as breeding grounds for pests.

Gatta bunding. Gatta bunding is a method by which the land is divided into plots by means of earthen bunds. They are made by ploughing with a deep plough such as the Sabul Plough and forming ridges. When doing this, the natural direction of the water course and the slope of the land are taken into consideration. Bunding conserves moisture, stops soil erosion and prevents the manure from being washed away. The plots are big on level land and small on steep land.

Cultivation. The importance of harrowing cannot be too greatly emphasised for grasslands. Even under ordinary conditions, it is quite essential that harrows should be used on grassland at least once in a season. It is beneficial in the way that it prevents tufty and coarse herbage.

From May onwards every rain should be taken advantage of and grubbers or cultivators should be used which tear up the soil up to 1 to 2 inches and at the same time care should be taken to see that they are passed along the contours. This operation is very important as the grubbers break open the hard surface soil, disturb the root system and allow the rain water to soak well in the soil giving a stimulus for the grass to develop fresh roots and tillers. It also creates more room for the young grass to grow.

Legumes. The grasslands at Hosur are unfortunately devoid of any pasture legumes and attempts are being made to introduce *Phaseolus semi-erectus* and other legumes. *P. semi-erectus* which was sown in 1927 has just come up and at present it is not known if this will make a good mixture. Clovers were introduced this year but they all perished due to the prolonged drought.

Another operation connected with grass cultivation is to keep the land clean of weeds. It is the experience in this farm that every endeavour has to be made to concentrate all available labour for weeding the pastures soon after the summer showers and July rains as it is found that the seeds germinate then; if they are thoroughly cleaned, there will be less difficulty later on. If it is found that the whole area cannot be weeded before the seeds develop, scythes are used to cut the weeds before seeding takes place.

The grass growing season is August, September and October. The heaviest yields are produced if the rains are received during these months, as seen from the statement below.

Year	Rainfall Inches	Yield per Acre lbs.
1924–25 ...	30·30	1546
1925–26 ...	29·37	1024
1926–27 ...	15·60	717
1927–28 ...	33·81	1781
1928–29 ...	27·98	726

Late rains, however much, result in poor yields, the grasses flowering and seeding when about a foot high. If the rains are heavy during the growing season, the yield is also heavy; otherwise the crop is poor.

Harvest. The outturn and quality of the hay largely depend on the judgment exercised regarding the correct time of cutting the grass which is a matter that can only be gained by practical experience. It is a matter of great importance, that all grasses, whether for consumption in the green state, for silage or for hay, should be cut before they seed. There is no difficulty in the case of green grass and silage as their utilisation does not depend on the weather, but in the case of hay every precaution must be taken in selecting the time for cutting, as nothing does more harm to hay than rain.

From a financial point of view it is economical to cut grass in its green stage as all animals thrive well on green feed. In places where it is not possible to secure green feed always, recourse must be had either for making silage or hay.

Hay and its preparation. Grass becomes hay when it is dried, cured and partially fermented in stacks. We cannot correctly class any dry grass as hay when it has not undergone the process of curing or fermentation. Good hay must be free from dirt, must have an agreeable sweet smell, possess a light greenish colour, and be pliable and soft to touch.

The best time for cutting grass for hay would be when it is in shot blade or just before or at the time of flowering. It is only at this stage that the grass is succulent, tender, green and highly nutritious. At Hosur the cutting of grass for hay usually commences about the latter part of October and early November. At this time of the year the days are generally cloudy with occasional showers. All available labour should be concentrated

and the work of cutting, raking and cocking pushed on in order to cover the maximum area. Every endeavour should be made to make hay as quickly as possible.

Cutting. It is preferable to cut the grass when it is dry, otherwise the machines will clog. Howard and MacCormic mowing machines are used on this farm and each machine covers 4 to 5 acres per day horse driven ; bullocks do 3 to 4 acres per day.

It is necessary that the machines should be handled by skilled men who know the working and mechanism of the machine. Each driver should provide himself with an oil-can filled with lubricating oil and a spanner. The bearings should be oiled very often and all nuts carefully examined, and should be tightened if they are found to be loose. Machines should not be left out in the rain. A boy usually goes in front of the machine to guide the mower as there may be obstructions such as stones and ant hills which damage the knives. The mowing knives should be kept sharp, it is better to have trained men kept on the spot sharpening knives. To save time and labour it is also important to see that the machines are driven straight, otherwise, strips of uncut grass are left behind.

Hay teading. The tedder is worked when hay is to be made quickly, without much handling. It is driven by a horse and the draught becomes fairly heavy when a thick layer of grass has to be tossed. This admits air and sun into the grass and dries it quickly and at the same time it produces a uniform curing. This prevents the top portion of the grass from being exposed too long to sun and at the same time exposes the bottom layer of grass to sun and air. Hay can be tossed by forks instead of tedders but it should not be knocked about too much as it damages the hay and loss incurs. Sometimes it has become possible to make hay in one day, i.e., the morning cut grass will be tossed, raked and cocked in the same evening. Horse drawn tedders do 7 to 8 acres and those drawn by bullocks 5 to 7 acres per day.

Hay Rake. This is another labour saving machine used for collecting hay before cocking. Horse drawn rakes about 10 feet wide will rake about 12 acres per day and bullock drawn ones 8 acres.

Cocking. The next process after raking is cocking. The cocks should be high and shaped conically to assist rain water to run off quickly. The hay remains in cocks for about a week or until such time as it becomes convenient to stack it. Hay which has been exposed to heavy rains after being cut has no aroma, is

dark, and does not weigh as much as good hay. A lot of the goodness is washed out of it. If the hay in cock becomes wet through rains it should be exposed to sun immediately and recocked although the quality of hay is affected. Before stacking, the cocks at random are to be examined thoroughly by inserting the hand into them. If there is too much heat which means the presence of excess moisture, the hay should be spread, exposed to the sun and recocked.

Stacking. Stacking is essential not only from the point of storage for hay by itself, but it affords the dry grass to be converted into hay after sweating. The site should be on dry raised ground and centrally situated to the area in which the grass is cut, as this saves a lot of labour, time and expenditure. There is no necessity to have a platform constructed for the stack, as the damage, if any, is not so heavy as to justify any expenditure on this item. The hay is stacked on the ground itself, and built up to about 10 feet with the aid of hay forks; after this an elevator to raise the hay is necessary.

The hay elevator is a simple, labour saving machine, which, when working, has an endless chain with spikes, rotating round an inclined plane, it has gear arrangement connected to a shaft pole, to which a pair of bullocks is yoked and driven round in a circle. The hay is forked into the hay receptacle, which is at the bottom of the inclined plane and on the rotating movement of the endless chain, the hay is lifted with the aid of the spikes and dropped on the top of the stack. The stack can be built up to the desired height of 20 to 22 feet or so. It is essential to feed the elevator constantly by drawing the cocks from the field. Depending on the lead, it will be necessary to have 10 pairs to pull the cocks to the stack and 10 men for stacking—4 men to feed the elevator, 2 pickets and 4 men for stacking.

In stacking, the grass should be laid layer on layer, the sides and ends should be kept fairly well out until the stack is of the desired height. Care should be taken not to increase the overlapping on the sides and ends too much. The middle must be kept well filled at the same time. An hour before finishing the day's work, it is advisable, to put plenty of hay in the middle of the stack so that if it rains, too much water does not soak into the stack. When the stack is of the desired height (18 to 20 feet) topping should be started. This is done by manœuvring each successive layer as it is laid, until the ridge is reached. That is, the top is sloped off to either side like the roof of the house. The

slope should be steep enough to carry off rain water quickly. All the stacks should not be made in one place. On account of the risk of fire it is far better to put them in different places. The stackers should be trained men. Stacking is an art by itself requiring considerable experience and skill. No damage to stacks has been recorded at Hosur through white ants or rats and there are plenty of both on the farm. The size of the base of the stack has to depend on the quantity of grass to be cut; a rectangular shape is preferable. If one has plenty of grass to convert into hay it is a mistake to make small stacks, as there is much more loss from dryage through the sun and warm winds and outer surface damage by exposure, in small stacks. The larger the stack, the less the loss. Whilst making the stack and after its completion, it is advisable to rake down the sides and pull out the loose hay so as to make the stack look well. A trench about six inches deep and a foot wide can be dug round the bottom of the stack to prevent water getting under the stack. If the stack is built in a field, it is a good thing to put a heap of sand right round it so that if the grass catches fire, the stack is protected to a certain extent.

Thatching. If the stack has to stand out in the rains for a year or so, thatching is necessary. Good straw or rough tank grass can be used for this purpose.

Measurement of stacks. The contents of a stack can be ascertained fairly accurately by measurement. Measure the length and breadth of the stack at the base, the middle and round the eaves, take the average by dividing by three, multiply the average length by average breadth and by height from base to the eaves. For the upper portion, measure length of ridge and the eaves, take the average length and the width at the eaves, next measure the height from eaves to ridge, divide by two and multiply all three together. Add together the totals of the upper and lower portions for the cubical contents of the stack.

The weight depends on the various factors such as the quality and fineness of the hay, the amount of pressure according to the height of the stack and the length of time the stack has stood on the ground. At Hosur it is found that Spear grass does not compress as compactly as fine grasses. Stacks after they are made begin to sink and the density increases, so the weight per cubic foot of a stack, one week old, will be much less than the weight of a cubic foot of hay from a stack three months old. We have found that a cubic foot of spear grass hay, which has been stacked for two months weighs about 4 lbs.

Cutting Stacks. Hay can easily be cut in trusses with the use of a hay knife. A cooly starts on the ridge, rakes off about 1½ yards of thatch and commences to cut downwards, trusses about a yard wide and he continues this width to the ground and when this is all cut and carted, he takes another width of a yard and cuts down to the ground again so that if rains come, not much hay is exposed.

Aftermath. This is the name given to the grass, after the grass has been cut for hay and carted away. Cattle can be turned on to graze this a week or so after the hay has been carted. It gives a good grazing for another month or so.

Comb for Spear grass. This is a simple implement and is very useful in haymaking if the grass is chiefly spear grass. It collects the spears from the grass and its efficiency increases as the awns become mature. In most cases its efficiency is about 80 to 90 per cent. It consists of an iron comb with teeth about 6 inches long attached to a rectangular iron frame work with two small wheels and a seat for the driver. The comb is 7 feet long with iron teeth, having an inter-space of ¼ to ½ inch. The framework has an arrangement to adjust the height at which the comb should pass, which depends on the growth of the grass and also another arrangement to adjust the angle at which the comb should work. This is easily drawn by a pair of bullocks and is able to comb on an average 8 to 10 acres per day depending on the level of the ground. If the grass is thick, the awns choke the comb and they have to be removed very often, otherwise the teeth will be bent. The awns should be removed from the comb at regular intervals and immediately removed from the field lest they become mixed up with the hay.

GRASSLAND AND CATTLE IMPROVEMENT

BY

R. W. LITTLEWOOD AND H. NARAHARI RAO

Grassland and cattle improvement go hand in hand especially if a herd of 50 animals or more is maintained. Young growing stock require plenty of exercise; if they are turned out to grass, they naturally get this. In a district like Hosur where rainfall is distributed over six months or so, where in some years showers are received from April to November, concentrates can be reduced considerably and money saved in cooly labour carting, etc.

Cattle should be turned out to graze after the first showers, when the young grass is about 3 to 4 inches high. The system of close rotational grazing must be followed and the stock kept in one paddock. After ten days, the stock should be moved to another paddock and so on. Sheep may follow cattle in certain fields as they eat closer than cattle. Chain harrows are passed over these fields each day to break up and spread the droppings.

For close grazing $\frac{3}{4}$—1 acre per animal is enough as all the grass is eaten and no patches left. At Hosur we allocate about 1 acre per adult animal for grazing and the remainder is utilised for hay production. Fencing is not necessary if two or three boys are engaged to stop the cattle wandering out of the paddock. We consider Spear grass in its young stage quite good for young cattle and cows in milk. Our young stock seem to thrive and grow on a concentrated ration of 1 lb. cake and 1 lb. rice bran.

STUDIES IN THE COST OF PRODUCTION OF CROPS

We are indebted to Mr. D. G. Munro for a series of accounts he has forwarded on costs of production of sugarcane and paddy. We heartily approve of his suggestion to make the publication of studies on crop-production a normal feature of this Journal and gladly commence with sugarcane. We hope to publish similar articles in future on important food and industrial crops of this Presidency as time permits. We are aware that details given in the present article could be condensed to a large extent but feel that we may not carry with us our readers who may be eager for such information. We would therefore request them to give us the benefit of their views about the necessity for full details being made available. The accounts appearing in this number are of sugarcane crops in two localities. These were not raised under ideal conditions and have suffered from causes which have been detailed in the course of the account. They, however, serve to indicate the directions where improvement is possible. We would request our readers to send in similar accounts on crops of value and relate their own experiences so that fuller knowledge may be gathered of such crops grown under varying conditions of soil, climate, season and economic status of the ryot. (Ed. M. A. J.)

I

* Name of Crop: Sugarcane. Area: 3·00 Acres.

Village: Vellalur (Coimbatore Taluk).

Survey No. of field: Portions of 691 and 701.

General notes. The crop was cultivated jointly by two partners, each contributing his share of capital and labour for the cultivation of the crop. They had, besides the sugarcane, other individual interests. Each had his own set of permanent coolies and cattle which were put in for the sugarcane crop whenever required. A common cooly was also maintained on Rs 10 a month; but this cooly was very often taken for work elsewhere when there was no work in the sugarcane field. Each of the partners had his own betel garden in Vellalur and Singanallur. One of them cultivated in addition (with a different partner) crops of Cambodia cotton, Tenai, Fodder cholam, etc. He was also trading in betel leaves in which connection he was regularly away from headquarters for nearly half of every week, visiting shandies in Palghat. This ryot was the active partner all the same. The other partner owned a coconut tope and managed the same in addition to the betel and sugarcane. This ryot died in July during the year. Work in the fields was to a very large extent supervised by the wives of the two partners. Other members of the families of the two ryots took little interest in the management of affairs.

Three pairs of bullocks were used in the fields; but one out of the two was a cart pair intended mainly for going to shandies for betel trade. In allowing for depreciation for the bullocks the value of this shandy pair was not taken into consideration. The permanent coolies of the individuals were

* Names of ryots omitted, but can be ascertained from the Editor.

changed a number of times during the year and they were paid at rates Rs 7 to Rs 12 per month. For purposes of cultivation their daily wage has been taken as 7 annas.

The field under sugarcane is compounded wetland, the soil being clay loam and considered medium rich in quality. It was commanded by two mhotes from a common well provided with four mhotes.

Figures for preparatory cultivation were taken down as given by the ryot. The cost is likely to be a little higher than the actuals because of the difficulty of getting at correct information regarding the exact amount of permanent labour expended.

Manuring was not done as the crop followed Betel vine.

Planting was not done properly because of channel water not being available at the time. Majority of the setts were not properly pressed into the soil and required to be covered later. Blanks also occurred for the same reason as well as due to grazing by sheep penned by the neighbour in his field.

Fencing done was not quite thorough and a certain amount of jackal damage was noticed and after cultivation was also slipshod. Only one earthing and one weeding were done. The weeding was not thorough. A certain amount of weeding was done by family labour which has not been charged.

From start to finish irrigation for the crop was scanty on account of failure of water in the irrigation source. Supply from the well was also defective for nearly two months. Two pairs—mhoting continuously were not able to irrigate the crop adequately.

Onions were planted late and had to be harvested early. Bulbs were not developed properly and sufficiently. Its yield and quality were poor. The cleaning and sale was done by women in the house during leisure hours and this work has, therefore, not been charged for.

Milling of canes was started early and cubes were first made. But the jaggery was very bad and could not be marketed. There was, therefore, a break in the middle for eighteen days. When resumed the cubes previously made and crop subsequently cut was all converted into balls. The whole of the jaggery was sold away at Rs 30–31 per pothi of 310 lbs.

Lease term expired with the end of the sugarcane crop and final levelling of land was done by owner of the field as the tenant was slack in this respect. The owner charged him Rs 15 for this work and this amount is shown in the account.

On the whole, the cultivation was of a low standard and did not receive much personal attention on the part of the ryots. The profits are, therefore, poor.

Cost of Cultivation etc.

Items of Expenditure	Cost per plot			Cost per acre		
	Rs	A	P	Rs	A	P
Preparatory Cultivation	145	0	0	48	5	4
Seeds and Sowing	275	1	0	91	11	0
Fencing and after cultivation	101	5	0	33	12	4
Irrigation	305	6	2	101	12	9
Harvesting, cleaning, etc.	222	1	0	74	0	4
Depreciation on two pairs of bullocks—valued @ Rs 130 and 120 @ 10 per cent for 6 months	12	8	0	4	2	8
Depreciation on tools, implements, etc., (lump sum)	25	0	0	8	5	4
Rent on land	315	0	0	105	0	0
Total ...	1,401	5	2	467	1	9

Cost of Produce and profit

Name of produce	Per Plot			Per Acre		
	Produce	Value		Produce	Value	
		Rs	A P		Rs	A P
1. Jaggery @ Rs 30 and 31 per pothi of 310 lbs. ...	14,880 lbs.	1,463	4 10	4,960 lbs.	487	12 3
2. Whole canes ...	41	4	8 0	14	1	8 0
3. Sugarcane setts ...	13,000	52	0 0	4,333	17	5 4
4. Onion bulbs ...	25 *Vallams*	5	0 0	8⅓ *Vallams*	1	10 8
Total ...		1,524	12 10		508	

Net profit { Per Plot ... Rs 123 7 8
Per Acre ... Rs 41 2 6

* *Vallam* = 2 Madras measures.

Details of Cultivation and charges

Date	Particulars of work	Labour: Family	Labour: Permanent		Labour: Casual			Cost		
			Pairs	Men						
		4 as	6 as	7 as	8 as	5 as	4 as	Rs	A	P
1928	*Preparatory Cultivation*									
June and July	Breaking ridges and filling up trenches ...							90	0	0
	Levelling ...							10	0	0
	Ploughing ...							20	0	0
	Forming ridges and channels ...							10	0	0
	Trimming bunds ...							15	0	0
	Total ...	Figures as furnished by the ryot from his accounts						145	0	0
	Seeds and Sowing									
	Carrying setts and planting ...	...	8	18	...	...	60	25	14	0
	Cost of 80,000 setts (own) @ Rs 2–8 per 1,000 ...	...	...	...	...	...	...	200	0	0
		...	...	1	27	...	...	13	15	0
Aug. 1 —28	Covering exposed setts ...	...	...	...	...	...	6	1	8	0
11—16	Planting Onion bulbs ...	...	...	...	...	...	...	1	4	0
	Cost of 1 bag (25 vallams) onions ...	...	...	...	...	...	10	2	8	0
27	Filling up blanks in canes ...	...	...	...	...	...	...	30	0	0
	Cost of 12,000 setts @ Rs 2–8 per 1,000 ...	...								
	Total ...	...	8	19	27	...	76	275	1	0

Details of Cultivation and Charges—*(Continued)*

Date	Particulars of Work	Labour: Family	Labour: Permanent		Labour: Casual			Cost		
		Women @	Pairs @	Men @	Men @		Boys @			
		4 as	6 as	7 as	8 as	5 as	4 as	Rs	A	P
1928	*After-cultivation and fencing*									
Aug. 23	Burning wild cane on bunds	...	...	½	...	...	...	0	3	6
„ 24	Trimming bunds	...	...	...	4	...	...	2	0	0
Sept. 16, 17	Weeding	...	...	...	...	...	19	4	12	0
Oct. 3, 5, 6, 21 and 22	Earthing up	...	...	5	49	33	...	37	0	0
Sept. 6–12	Planting wild Castor stumps and fencing with thorns—collected locally	...	...	5	...	...	...	2	3	0
Dec.	Bringing 4 rolls by one of the partners from Pallacheri, while returning from Parai after sale of betel leaves (net free of rent from a friend)	Spare time labour not charged.								
	Hire on own cart sent to Pannimadai (17 miles) with one of the partners a permanent cooly for wire net, ⅔ normal rent for being own cart	...	...	...	...	...	...	3	0	0
	Brokerage to a blacksmith for arranging loan of wire net.	...	...	...	...	...	...	1	0	0
	Hire on 2 empty carts sent to Walayar for fence posts ...	...	...	...	...	...	...	1	0	0
	Carting bamboo-posts (19th evening to 22nd morning) accompanied by owner's son and a friend (2½ days) ...	...	2½	2½ (plus 8 as exp.)	...	...	...	2	8	6
	Cost of 200 bamboos @ Rs 4 (¼ cost only debited here).	...	...	...	...	...	...	1	0	0
	Fixing wire net posts, etc. inclusive of cutting hooked pegs for same	...	...	12	13	...	...	11	0	0
	Hire on 6 rolls wire net brought from Pannimadai for 6 months only at Rs 6 per mensem	...	...	...	...	...	...	36	0	0
	Total ...	...	2½	25	66	33	19	101	11	0

Details of Cultivation and Charges—*(Continued)*

Date	Particulars of Work	Labour: Pairs @ 6 as	Labour: Men @ 7 as 8 as	Cost Rs	A	P
	Irrigation					
1928						
July 21–24	Irrigation	...	2½ ...	1	1	6
Aug. 15	Do	...	1 2	1	7	0
,, 27	Do	...	1 2½	1	9	6
Sept. 5	Do	...	1 ...	0	7	0
,, 22	Repairing mhote parts and irrigation	1	2 ...	1	4	0
July 29 and Sept. 28	Mhoting and irrigations ...	265	437 ...	298	9	0
	Channel watch in January 1929 ...	...	... ...	1	0	0
	Total ...	266	444½ 4½	305	6	2
	Harvesting cleaning, etc.					
Oct. 21, 22 1929	Lifting Onions	...	... ...	1	14	0
July–Aug.	2 pongal presents to milling coolies (Rs 5 plus Rs 3) ...	...	... ...	8	0	0
	Carting mill, pan, etc. ...	1	1 ...	0	13	0
	Hire on mill pan, etc., for 35 days (without jaggery moulds) ...	...	... ...	22	8	0
	Milling charges (5 pothies @ Rs 2, 4 pothies @ Rs 1–12–0) and rest free (for Pongal given) ...	...	... ...	81	12	0
	Cutting 13,000 setts at 4 annas per 1,000	...	... ...	3	4	0
	Pairs for milling 70 own pairs and hired pairs on 16 pothies at Rs 2 per pothi	70	70 plus hired pairs	88	14	0
	Levelling ridges after harvest ...	...	... ...	15	0	0
	Total ...	71	71 ...	222	1	0

II

Name of crop: Sugarcane. Area: 2·00

Village: Vellalur (Coimbatore Taluk).

General notes. The cultivator had besides the 2 acres of sugarca additional area of 3½ acres of own land and half an acre of rented lan his own land he raised crops of paddy, tenai and fodder cholam. The land was under betel.

The ryot had two sons, a wife and a daughter-in-law to work in the He maintained a pair of old bullocks and a young pair just broken to Before the planting of canes he had two permanent coolies—both bo Rs. 6–8–0 and Rs. 4 respectively per mensem. For two months beginning he worked without any permanent coolies when again he e one on Rs. 12 a month.

The ryot lived in his field and served to watch the crops and personally to all works. The other members of the family lived village. The family members worked freely in the fields. Whenev put in a full day's work their wages were reckoned at annas 8 for m annas 4 for women; part time family labour was assessed at half the rates on the merits of each item of work. The permanent cooly is c at 7 annas per day and cattle at 6 annas per pair. No depreciatic allowed on bullocks—the depreciation on the old pair being conside balance the appreciation on the young pair.

The soil was red loam. The field is commanded by two mhotes the common four mhote well.

Previous crop in the field was paddy. 10,000 sheep were penne which a dressing of nearly 100 cartloads of tank silt was applied as ma the crop. Land was ploughed four times. Canes from his own previo were cut and planted.

Planting was late and the crop was poor even from early stag subsidiary crop of onions was also raised. The field became very wee two weedings were done. This, however, was not thorough. No was done. The crop was earthed up only once. There was defective supply in the tank and well irrigations were not adequate. With his tw he had to irrigate also his betel and other crops for which he had o borrow a pair from his eldest son who has severed his connection w family. The irrigation bill was very high on these counts. Harvesti milling of canes was done by contract labour as is usual in the l Jaggery was made into balls and was fair in quality better than the p of others in the localities. Harvest of onions was done entirely by labour on shandy days in small lots. The labour has not been charged sheet. Final levelling was not done as the stubbles were left to ratoon

Cost of cultivation, etc.

Items of Expenditure	Per Plot			Per Acre		
	Rs	A	P	Rs	A	P
Preparatory cultivation ...	31	11	0	15	13	6
Manures and manuring ...	91	12	0	45	14	0
Seeds and sowing ...	214	14	0	107	7	0
After cultivation ...	43	12	0	21	14	0
Irrigation ...	285	15	6	142	15	9
Harvesting, cleaning, etc. ...	149	14	6	74	15	3
Assessment on land ...	17	14	1	8	15	0
Depreciation on tools and implements (lump sum) ...	25	0	0	12	8	0
Total ...	860	13	1	430	6	6

Cost of Produce and Profit

Name of Produce	Per Plot		Per Acre	
	Produce	Value	Produce	Value
				Rs A P
Jaggery ...	11,200 lbs.	1,096 4 0	5,600 lbs.	548 2 0
Cane setts ...	3,500	14 0 0	1,750	7 0 0
Onions (*Vallams*) ...	63	11 13 0	31½	5 14 6
Total ...		1,122 1 0		561 0 6

Net profit per acre ... Rs 130 10 0.

Details of Cultivation and Charges

Date	Particulars of Work	Men @ 8 as	Pairs @ 6 as	Men @ 7 as	Boys @ 4 as	Rs	A	P
1928	*Irrigation*							
August 15	Irrigation ...	3	11	13	...	1	8	0
August 27	Do ...	2	4	4	...	1	0	0
September 4	Do ...	2	...	1	...	1	0	0
September 23 to October 1	Do ...	6½	11	13	...	13	1	0
October 7, 8	Do ...	2	4	4	...	4	4	0
November 25	Do ...	13	...	1	...	1	15	0
December 18 to 21 and 24 to 26	Present to 'Nirkatti' ...	...	...	...	...	1	0	0
December 27 to 30 and January 3, 1929	Do ...	13	13	6½	...	15	7	6
January 7 to 12	Do ...	12	12	6	...	13	2	0
January 15, 16, 18, 19, and 21, 23	Do ...	14	14	7	...	15	5	0
January 24 to 26	Do ...	8	6	4	...	8	0	0
February 1929	Supplemented by channel water	42½	41½	20½	...	45	6	6
March ,,	Irrigations ...	45	45	22	...	49	0	0
April ,,	Do ...	40	40	20	...	43	12	0
May ,,	Do ...	39	39	21	...	43	5	0
June ,,	Do ...	9	9	4½	...	9	13	6
July ,,	Do ...	4	...	6	...	4	10	0
	Total ...	258	247½	139½	...	285	15	6

Details of Cultivation and Cl

Date	Particulars of Work	Men @ 8 as	Pairs @ 6 as	Men @ 7 as	Boys @ 4 as	Rs	A	P
1929	*Harvesting, Cleaning, etc.*							
August	Pongal present for milling coolies ...	...	...	...	...	5	0	0
	Milling charges on 35 pothies at Rs 2. (Contract work).	...	...	...	...	70	0	0
	Extra coolies for carrying canes to mills ...	...	...	...	18	4	8	0
	Bullocks for the milling ...	20	40	20	...	33	12	0
	Bullocks hired at Rs 1-12-0 per pothi on 12 pothies	...	...	...	...	21	0	0
	Hire on mill and spare for 20 days @ 12 annas	...	...	...	...	15	0	0
	Returning mill to owner (Mill, etc., were brought and installed by another ryot using them previously in the same place) ...	½	½	¼		0	10	6
	Total ...	20½	40½	20¼	18	149	14	6

THE INDIAN SCIENCE CONGRESS, ALLAHABAD, 1930

The seventeenth session of the Indian Science Congress was held at Allahabad from the 2nd to the 8th January both days inclusive. The attendance was as usual large and representative of the different scientific activities in all parts of India.

Rao Sahib V. Ramachandra Rao, Government Entomologist, Mr. G. N. Rangaswami Ayyangar, Millets Specialist, Mr. V. Narayanaswami Ayyar, Systematic Botanist and Rao Bahadur B. Viswa Nath, Government Agricultural Chemist, were the representatives from the Agricultural Research Institute, Coimbatore.

Col. S. R. Christophers, C.I.E., O.B.E., K.H.P., F.R.S., I.M.S., F.A.S.B., Director-General, Central Research Institute, Kasauli was the general President of the Congress.

The Sectional Presidents were:

1.	*Agriculture*	...	George Clarke, Esq., C.I.E., F.I.S., F.C.S., M.L.C., Director of Agriculture, *Lucknow*.
2.	*Mathematics and Physics*	...	Professor B. Venkatesachar, M.A., Professor of Physics, Central College, *Bangalore*.
3.	*Chemistry*	...	Professor P. V. Mitter, M.A., Ph.D., 92, Upper Circular Road, *Calcutta*.
4.	*Zoology*	...	Dr. S. L. Hora, D.Sc., F.L.S., F.Z.S., Indian Museum, *Calcutta*.
5.	*Botany*	...	Professor P. Parija, M.A., B.Sc., Professor of Botany, Ravenshaw College, *Cuttack*.
6.	*Geology*	...	Dr. David Penman, D.Sc., F.R.S.E., M.I.M.E., Principal, Indian School of Mines, *Dhanbad*.
7.	*Medical and Veterinary Research*	...	Lt.-Col. R. Knowles, B.A., M.R.C.S., L.R.C.P., I.M.S., F.A.S.B., Professor of Tropical Medicine, Carmichael Hospital for Tropical Diseases, Central Avenue, *Calcutta*.
8.	*Anthropology*	...	The Rev. P. O. Bodding, M.A., F.A.S.B., *Mohalpahari, S. P.*
9.	*Psychology*	...	Dr. A. S. Woodburne, M.A., B.D., Ph.D., Madras Christian College, *Madras*.

The Presidential address of the section of Agriculture and notes on some papers of interest to practical agriculturists presented to the Agricultural section are given below:

SOIL IMPROVEMENT IN RELATION TO CROP PRODUCTION

BY

G. CLARKE C.I.E., F.I.C.

I ask your permission to direct your attention to some aspects of soil improvement in relation to crop production. I propose to pass in brief review some of our problems and then to touch on the work to which my colleagues Khan Sahib Sheikh Mahomad Naib Husain, Rai Sahib S. C. Banerjee and myself have devoted a number of years at the Shahjahanpur Research Station. My subject is directly connected with the supply of the first necessity of life, namely, food. By what methods is the world going to continue to feed its growing population? It is increasing at the rate of nearly 20 millions a year, and it cannot be suddenly checked. Can food be found for all these extra mouths, or will the pressure on our land resources become unbearable, and end in disaster? That is the colossal problem facing the world in the next few generations. It must be met either by a continual expansion of cultivation, or an intensification of production on land already cultivated.

How do we stand in India in respect to these questions? I have proceeded in a somewhat empirical fashion to ascertain the relation between population and arable land. I have selected, in making my estimate, the figures used in international statistics, the total area sown and the current fallows. I have deducted the area required for the production of exported cotton, food grains, oilseeds, jute and tea which account for about 80 per cent of the value of our exports. This estimate is admittedly rough and must be regarded as suggestive rather than as an exact measure, but it is sufficiently near to illustrate my points.

I have taken the year 1922–23 following the census year 1921, and the year 1925–26. In 1922–23 the total area sown in that part of India for which agricultural returns are made was 327 million acres, 61 were fallow, making a total of 388 million acres. From this may be deducted as producing exported material for cotton 14, for foodgrains 9, for oilseeds 5, for jute 2, for tea 0·6 million acres, or 31 million acres in round numbers. So that 357 million acres are left to supply the requirements in home produced food and other essential commodities of the 297 million people who live in the territory covered by these figures, viz., 1·2 acres per unit of population.

A similar calculation for 1925–26 gives the same result. I have selected for a summary comparison the United States of America and France, two countries possessing points of resemblance to India. In both, as in India, agriculture is of predominant importance. In the United States 356 million acres are in cultivation. Sixty-five million producing exported material may be deducted from this, leaving 291 million acres of cultivated land devoted to supplying a population of approximately 112 million, or 2·6 acres per unit of population. The dominant characteristic of American economic life has hitherto been abundance of land resources. France, a country which is largely self-supporting, has 36·3 million hectares of cultivated land for a population of 39·3 million, approximately 2·3 acres for each head of the population.

In considering these figures we have to allow for the fact that the vegetarian diet adopted by our people is more economical of the resources of the soil than the diet of the people of the United States and France. Living is

cheap in India, but when all has been said that can be said, we are left with the plain fact before us that we have one half the area of cultivated land for a unit of population.

The past experience of the world shows that as long as new land of the necessary quality is available, increased food will be obtained less by increased skill and expenditure on old land than by taking up new land. Our map has shown for several decades well over a hundred million acres in the British Provinces of India classified as culturable waste. Why is not new land coming into cultivation? I cannot give a complete answer. No such process can be observed in steady operation on a scale sufficient to raise the 'per capita' area of cultivation to a level which will meet our food requirements. Some recent settlements in this province show an increase in cultivation of only 1 to 3 per cent in 30 years, while in others the area is stationary. For a number of reasons the area of culturable waste gives an unreal conception of our resources. Much of the land thus classified includes areas physically capable of being employed for crops only when our need is so extreme that considerations of cost of utilization are relatively secondary. Fifty per cent we know is situated in Burma and Assam, out of the sphere of action of our chief agricultural races. A great deal is in Tarai tracts where health reasons prevent extensive settlement. Land is coming under the plough, to some extent, in the villages of the Sarda canal area in these provinces, and will do so elsewhere as irrigation schemes mature, but in India, as in other parts of the world, new land of the necessary quality for food crops is no longer easy to find.

This brings me to the first part of my argument—the necessity of increasing the acre yield of land now under the plough if an ample supply of food and the home grown necessaries of life is to be assured to the Indian worker, and his standard of living raised above subsistence level. It is a difficult problem but it is not insoluble.

When I considered this matter some months ago, I asked myself three questions:

(1) What factors are in our favour, and what are against us, when we begin to intensify our cultivation?

(2) Will the knowledge and experience of other countries help to accelerate our progress? What new knowledge do we need?

(3) What is the quantitative measure of the result we may expect?

I propose to give you the answers that suggested themselves to me, based on conditions in these provinces where my experience has been gained.

We have in our favour two things. In the first place soil that is easy to manage and quickly responds to treatment, and secondly agricultural workers attached to their calling and possessing a strongly developed land sense which, by some curious twist in our make up, can only be acquired in childhood. We shall not come up against a shortage of agricultural workers of the kind that is hindering development in Australia and Canada. In these countries a high degree of skill has to be directed to economy of labour by the use of machinery and labour saving devices. In India our efforts will have to be devoted to economising land. We are better placed than most countries as regards the primary essential for increasing production per unit of land, namely, man

power. You may ask me, 'What is delaying our progress with two such assets?' This opens up a wide sociological study. I believe ignorance and a larger share of ill-health than should fall to the lot of an average being play a part. The stimulus required seems to be education of a rural type. I cannot, however, pursue this issue, and return to my agricultural text.

We have to contend against difficult weather conditions and short growing seasons requiring early maturing and specialised varieties of crops. The Howards, in the *Development of Indian Agriculture*, describe graphically the effect of the monsoon on the soil and on the people. It is indeed the dominant factor in rural India.

We shall always at intervals experience years of short rainfall and this gives additional force to my argument for increasing the acre yield in favourable seasons by improved soil management if we are to avoid starvation. Much has been done to intensify yields without any commensurate increase of labour on soil improvement by the introduction of more heavily cropping varieties. I need only quote as examples wheat and cotton in the Punjab and wheat and sugarcane in the United Provinces, which are adding crores to the cultivators' income. Indian conditions, however, test the skill of the plant breeder very severely and further steps in improvement in this direction are not going to be easily won.

I now pass on to that part of my subject which has greater interest for a scientific audience than some of the stubborn facts I have placed before you. I mean the consideration of some aspects of recent work on soil improvement and the lines on which enquiry may be directed in India.

Since Boussingault introduced the method of exact field experiment in 1834, research on the soil and the conditions of crop growth has been continuous in Europe and America. The methods of approach have become more exact with each advance in pure science. We, therefore, start our work on soil improvement in India with tools ready made. Investigations carried out in other countries have given us the principles involved and often the technique of methods of research. Our work for the moment is to apply them to conditions where soil processes differ widely both in intensity and time of occurrence, from those of temperate climates. I have been impressed by the desirability of applying to our problems a conception developed in recent years by the Cambridge and Rothamsted workers, which has given a new and wider significance to the field experiment. The final yield gives us no indication of what happens during the plant's life or how it responds to factors operating at successive stages of growth. The modern method makes quantitative observations of crops throughout the period of growth and examines the results by statistical methods. This is nothing more than reducing to exact measurement and scientific treatment the observations which every practical farmer makes but does not formulate. The advantage is obvious. Information covering a wider range than the old type of field experiment can be obtained in a few years, instead of taking generation. You will remember that Lawes and Gilbert waited twenty years before discussing the results of their experiments. The field experiment lasting twenty or more years no longer fulfils our requirements. We want results in a reasonable time, accompanied by proof of their reliability, which will tell us not only the final yield but how that yield is obtained.

This leads up to another conception, namely, the critical periods of crops which will repay closer quantitative study in a country characterised by singularly short growing periods and rapidly changing conditions. By critical period I mean the relatively short interval during which the plant reaches the maximum sensibility to a given factor and during which the intensity of that factor will have the greatest effect on yield. These periods seem to be associated with some phase of growth in which the plant is undergoing modifications demanding the rapid formation and movement of food material. Italian workers have found that the twenty days before the crop comes into ear constitute an important critical period for wheat in relation to humidity and soil moisture. If during this period these factors are in defect of the minimum needed for the normal development of the plant, the crop will be small even if there is abundance throughout the rest of the vegetative period.

Our observations at Shahjahanpur indicate that two periods in the growth of sugar-cane have special significance: (1) May and early June when the tillers and root system are developing and (2) August and September when the main storage of sugar takes place. A check received at either of these permanently reduces the yield. The acre yield of sugar is positively and closely correlated with the amount of nitrate nitrogen in the soil during the first period, and with soil moisture and humidity in the second period.

Food crops pre-eminently demand combined nitrogen. You will remember how Sir William Crookes startled the world 30 years ago by the statement that the wheat eating races were in deadly peril of starvation owing to the rapid exhaustion of soil nitrogen. The age in which he lived had become accustomed to abundant supplies of cheap food from the great plains of the American continent. Fertility accumulated since the glacial period of luxuriant plant growth and bacterial activity suddenly became available for exploitation, and was plundered at an appalling rate by rough and ready methods of cultivation. Nitrogen was disappearing from the soil out of all proportion to the amount recovered in the crop. The extraordinary fertility of some of these new regions is shown by the data recorded by Shutt, an acre of soil to a depth of one foot containing from 20,000 to 25,000 lb. of nitrogen. This figure may be compared with the amount of nitrogen in an acre foot of soil in these provinces, which lies between the limits of 1,000 to 3,000 lb. I shall refer to this again shortly.

Crookes was almost the first to realise that there was a limit to cheap production from new land, but his forecast was too gloomy. He visualised the exhaustion of the chief granary of the western world within a generation or two. In some important respects he misapprehended the problem. He did not know as we know that other agencies step in and stop the plunder of the soil before it has gone too far. It is only under improper methods of cropping and cultivation that permanent soil deterioration is a real and dangerous phenomenon. Land properly handled does not become exhausted. Much of the land of Europe has been cultivated since the days of the Romans or even earlier. It is, if anything, more fertile than ever. In India we have in existence a method of farming which has maintained for ten centuries at least a perfect balance between the nitrogen requirements of the crops we harvest and the processes which recuperate fertility.

When we examine the facts, we must put the Northern Indian cultivator down as the most economical farmer in the world as far as the utilization of the potent element of fertility—nitrogen—goes. In this respect he is more skilful than his Canadian brother. He cannot take a heavy overdraft of nitrogen from the soil. He has only the small current account provided by the few pounds annually added by nature, yet he raises a crop of wheat on irrigated land in the United Provinces that is not far removed from the Canadian average. He does more with a little nitrogen than any farmer I ever heard of. We need not concern ourselves with soil deterioration in these provinces. The present standard of fertility can be maintained indefinitely. This is not my text. Production must be raised if we are to live in reasonable security and comfort.

In one respect Crookes was right. He foresaw that the intensification of production required more combined nitrogen than the limited supplies furnished by the distillation of coal and the nitrate deposits, to counter-balance the colossal wastage which civilisation and urban life bring about. The fixation of atmospheric nitrogen was, as he put it, vital to the progress of civilised humanity. This problem has been solved in the last ten years and is one of the remarkable achievements of applied science. It could have been solved sooner if money had been forthcoming for long range research, but it took the war to bring us to our senses. Thirty years ago the fixation of 29·4 grams of a mixture of nitrogen and oxygen at the expenditure of one horse power was recorded as a scientific achievement. In 1928–29 the estimated production of nitrogen compounds by synthetic processes was equivalent to 1·3 million metric tons of pure nitrogen, or over 6 million long tons of Sulphate of Ammonia, which can be sold at prices low in comparison with the prices of agricultural produce. We are entering on an era of nitrogen plenty which is bound to react favourably on the world's food production. One of our problems is to find out how we can make use of this discovery in India. The probability is that the full benefit of fertilizers will be realised only on land reasonably supplied with organic matter.

I may be allowed here to sound a note of warning. Great as are the possibilities offered by synthetic nitrogen compounds there is danger in adjusting our standards of living to increased production based entirely on imported fertilizers. They may be cut off suddenly by international disturbances. The war is too near an experience and the promise of universal peace too uncertain to ignore this side of the question altogether. It will be but a wise precaution to establish their manufacture in India when the correct way of using them has been worked out, their value demonstrated and a demand created.

Our problem is more complex than the simple addition of nitrogen compounds to the soil. We have to face under peculiar conditions of climate the question of controlling moisture, organic matter and air supply in the soil, of regulating the supplies of nitrogen so that it may be available in the right form and quantity when the plant most needs it, so that none may be wasted, and to make use to the utmost of those processes by which nature supplies nitrogen free of charge. These problems centre round the changes which organic material undergoes in the soil and the nitrogen transformations which accompany them.

We have two methods of soil improvement possessing enormous potentialities for increasing crop production and so simple in operation that they can be used by everybody:

(i) the preparation of quick-acting manures from waste organic material

(ii) the use of green manure crops.

I do not propose to discuss recent work on the first method. The practical details have been worked out thoroughly by the Howards at Indore, and by Fowler, Richards and their co-workers at Cawnpore. A paper on this subject is going to be placed before you by Dr. Fowler. I will not anticipate what he is going to say beyond remarking that the results which he has allowed me to examine, place in your hands a method of the greatest value for increasing the outturn of rabi crops which require in this province a quicker acting manure than that provided by turning in a green crop.

We have been working for some years at Shahjahanpur on the utilization of green manure for sugarcane. We have ploughed in on an average of three years observations, 218 maunds per acre of sanai (*Crotolaria juncea*) which adds 50 maunds of dry organic material and 75 lb. of nitrogen to each acre. We have succeeded in raising crops of 850 maunds per acre without the addition of any fertilizing agent other than the sanai produced by the land itself.

Our method of soil treatment is to bring about the early stages of decomposition in the presence of ample moisture. The rainfall after the sanai is ploughed in is carefully watched. If it is less than 5 inches in the first fortnight of September the fields are irrigated. In this way we secure in most of our soils an abundant fungal growth as the land slowly dries. We prevent large accumulations of nitrates in the autumn, which may be lost before the sugar-cane is sown and concentrate the nitrogen in easily decomposable organic form in mycelial and microbial tissue, until it is wanted in mineral form in the spring.

Throughout the experiments we have made estimations of nitrate. The accumulation of nitrate reaches its maximum in May and June just before the first heavy rain. At this time the crop is about $\frac{1}{3}$ grown. We have not observed any subsequent large formation of nitrate up to the completion of growth in October. The final yields are in proportion to the mineral nitrogen present in the first period and this suggests at once the importance of available nitrogen in the early stages of the growth of sugarcane. This view is by no means a new one. It has recently been developed by Gregory at South Kensington and Rothamsted, who found that barley absorbed 90 per cent of its total nitrogen when it had made about one-third of its growth. If it is substantiated by further work and found to apply to all crops it gives a clue to several improvements in soil management.

In our studies in connection with the intensification of sugar-cane cultivation we have been influenced by American investigations and methods, more specially those of the workers led by Waksman, who have studied the decomposition of cellulose and dead organic material in the soil. They have shown that the structure of the carbonaceous energy material in the soil largely determines the type of decomposition and the nitrogen trasformations. If moisture and temperature conditions are favourable, the decomposition of cellulosic energy material, the chief constituent of green manure, is mainly accomplished by fungus activity resulting in the formation of large quantities of mycelial tissue and the removal of nitrogen temporarily from the

reach of higher plants. The synthesised material is later decomposed by other micro-organisms forming mineral nitrogen and humic material, and a definite period of time is required to complete these changes. A large volume of work has been published in the last five years. It explains much that was obscure regarding the utilization of green manure in India, particularly the time factor to which Howard drew attention many years ago.

I now approach the last and most difficult part of my task, to estimate the increased production we may look for by the application of scientific methods to our agricultue. What I am going to say will be more readily understood if I give the production of wheat in a few countries for the crop sown in 1926, which was, on the whole, a good year throughout the world. It is as follows:

United Provinces Irrigated			...	12·2 mds. per acre.
,,	Unirrigated		...	8·2 ,,
Canada	...	...	...	13·2 ,,
U. S. A.	...	...	...	10·7 ,,
France	...	...	...	13·0 ,,
Germany	...	...	...	17·5 ,,
Great Britain	...	...	...	22·5 ,,
Belgium	...	...	...	26·3 ,,

A glance at these figures shows what an immense potential increase of production is open in many countries, especially in America and India. The physical possibility or perhaps even the limit of production in the United Provinces is shown by the yield obtained at the Shahjahanpur Research Station. In 1926 it was 28·8 maunds per acre. In the last 11 years, including two in which the wheat crop was a partial failure, 243 acres have yielded 5,945 maunds or 24·4 maunds per acre. Soil and climate do not impose a serious restriction on production. We cannot, however, take one striking instance of large yields achieved on a small acreage under favourable conditions as the basis of an estimate of the future production of the country as a whole. The actual level in any country is bound to be behind the ideal; no matter how well developed educational and propaganda machinery may be.

It is safer, if such a course be possible, to consider average results obtained in countries which have been compelled to employ intensive methods; but we have no adequate basis of comparison with our conditions. There is no example of a tropical or semi-tropical country in which scientific methods have been applied over a wide area by independant and unsupervised workers.

Sugar-cane cultivation in Java is often quoted as an example of what can be done. It illustrates the combined effect of strictly supervised labour and scientific methods on about one million acres of land, carried out with the object of gaining the highest possible interest on Dutch capital. It does not illustrate what we are aiming at in India—agricultural improvement initiated and carried through by the people themselves, as the result of education and uplift, on 300 million acres.

Let us examine the course of events in Europe and America and learn what we can from them.

In mediaeval England the yield of wheat was 7 maunds per acre. When the consolidation of holdings was completed by the enclosures in about the last quarter of the eighteenth century the yield rose to 14 maunds per acre. It remained at this level until 1,840 when a further advance was made possible by the use of better methods and the introduction of nitrogen fertilisers. By 1870 the yield had risen to 20 maunds per acre.

In America low yields and a growing industrial population are causing uneasiness. By studying agricultural conditions in other countries the conclusion has been reached that 47 per cent represents a possible all round increase of production on the present cropped area. Experts do not agree as to the probable increase in the next few decades. This is placed between the limits of 10 and 30 per cent. These figures are based on considerations of labour. This, as I have said, scarcely enters into our problems in India. We have more people employed in agriculture per unit of cultivated land than any other country, with the possible exception of China and Japan.

The improvement of sugar-cane cultivation extends over 260,000 acres in the United Provinces and gives some indication of the possible course of events. The yield of the unimproved crop in a year of average character is 350 maunds per acre. We pass through four definite stages of improvement:

(1) Better cultivation of the old varieties, yielding 450 maunds per acre.
(2) The introduction of heavier cropping varieties accompanied by a further improvement in cultivation, yielding 600 maunds per acre.
(3) The introduction of some fertilizing agent, such as green manure, yielding 800 maunds per acre.
(4) The intensive cultivation of heavy cropping varieties, yielding 1000 maunds per acre.

The increase over the normal production is 28, 71, 128 and 185 per cent. I believe if such simple modifications of practice as the use of green manure crops and composts made from waste material, were applied to all our arable land, production would be more than doubled; but this means that every cultivator would be conducting his operations in a scientific manner—a state of affairs not yet reached in any country. The point is that it is not to be expected. We must allow for the inertia which will retard the general adoption of improvements in so large a country as India. After giving due weight to this and taking into consideration the abundance of our labour resources and the extraordinary response of our soil to better treatment, it is reasonable to believe that within the next two or three decades we may increase the all round out-turn of our cropped land by 30 per cent in normal seasons. But I assume that much more money will be spent on scientific research and extension work in villages than is now spent.

I hope I have said enough to show that soil improvement in India is worth an effort. It requires generous expenditure from the national exchequer, and there is no better investment, for it gives, to use the words of Huxley, an immediate return of those things which the most sordidly practical man admits to have value. We are working in times well suited for agricultural development. Indifference is giving way. There is a stir throughout the countryside. We can call the movement what we like, but the plain fact is that men are no longer satisfied with a life which provides only hard work and

barely enough to eat. Many things are being suggested, but they deal more often than not with preliminaries to social well being, and leave untouched the vital problem of producing more food. In the end the scientific worker will come to the rescue, and the solution will be reached through the experiment station.

NOTES ON SOME PAPERS PRESENTED BEFORE THE SCIENCE CONGRESS

Dr. Gilbert J. Fowler and his collaborators presented the results of their further experiments on the preparation of organic composts with special reference to the economic use of urine in the manufacture of composts and the part played by the 'activator' in the fixation of atmospheric nitrogen. The authors have found that while cow's urine is an important agent for facilitating fermentation, it appears to play no part in the fixation of nitrogen. On the other hand, there is evidence that the presence of 'activator' induces quick rotting and also fixation of nitrogen. Experiments at Coimbatore have also shown distinct evidences of fixation of atmospheric nitrogen during the fermentation of waste organic matter but the extent of fixation appears to depend on certain carbon-nitrogen ratio in the material.

In a paper dealing with studies on soil Actinomyces, Mr. P. K. De of Bangalore records his observations on the role played by Actinomyces in the decomposition of complex organic matter in the soil. Three strains, viz., *Actinomyces scabis, A. chromogens and A. albosporeous* were studied. Of these, the last one was found to be the most active using up the different carbohydrates, the intensity of attack being in the following order—starch, glucose, cane-sugar, arabinose and cellulose.

Messrs. L. S. Nigam and H. N. Batham of the United Provinces examine data obtained in different countries of the world on the seasonal variations in the nitrate content of the soil along with those of the authors. The conclusions drawn are:

(1) the greatest accumulation of nitrates takes place during summer months and the least during winter.

(2) there seems to exist a close relationship between the fluctuations of nitric nitrogen content of soils and different seasons of the year.

(3) the solar activity which appears on the earth in the form of different seasons of the year appears to be a most important factor in controlling the nitrifying bacterial activity in the soil.

The movement of water and soluble salts in the soils with repeated doses of irrigation water at the Agricultural Research Station at Sakrand formed the subject matter of a paper by Mr. V. A. Tamhane and his collaborators. Smaller doses of irrigation water given more frequently leached out soluble salts better than larger doses of irrigation water at longer intervals. For instance, two inches every ten days was more effective than three inches every fifteen days. In the presence of appreciable amount of calcium salts in these soils, sodium salts are leached to a greater degree than calcium salts;

and of the sodium salts, sodium chloride is most easily leached out from the surface soil layer.

Messrs. N. V. Kanitkar and G. M. Bapat from Poona reported results of experiments to determine the surface run-off of rain water during monsoon season of 1929 at Manjri Dry Farm Experiment Station. The difference in run-off and erosion under three different treatments of soil were studied with one definite gradient of three in hundred. The area of each plot is one-eightieth of an acre, and each plot is separated from the other by a partition of galvanised plane iron sheet fixed 9 inches deep in the soil on three sides. A masonry tank is built at the lower end of each plot in which water and silt are collected after each day's rain. Of a total rainfall of 17·06 inches between 1st June and 10th October, 1929, received in sixty-three days, only on eleven days the rains caused run-off of water and soil erosion. The largest run-off was from the ploughed plot, the harrowed and untreated being next in order. The difference was more marked at the beginning but later on all plots behaved very similarly. The quantities of water lost by run-off varied from 34 to 38 per cent of the total rainfall of the season and nearly 50 per cent of the useful rain.

The quantities of silt removed were highest in the ploughed plot, untreated and harrowed coming in order.

Messrs. B. Viswa Nath and S. Kasinathan at Coimbatore have studied the effect on the soil complex of continued applications of Sodium Nitrate to swamp paddy soils. They find that continued applications of Sodium Nitrate do not alter the cationic composition of the clay-complex and the beneficial effects of manure to its powers of flocculating the soil colloids.

Mr. T. S. Krishnan of the nutrition section of the Imperial Department of Agriculture at Bangalore, presented results of silage investigations, the substance of which was that in silage protein digestion was low and fibre digestion was high. The low protein digestion in silage is low probably because of the destruction of the more easily digestible protein during fermentation. This view is supported by the losses of protein during fermentation observed in the experiments carried out at Bangalore and this finding is confirmed by the work at Coimbatore. Silage is advantageous for growth production and its high efficiency may be due to the easily available carbohydrates and minerals.

Of the papers on Agricultural Entomology, the following interesting ones may be mentioned:

Messrs. Hussain and Wahid found *Dialeurodes citri* and *D. elongata*, *Aleurocanthus spiniferus* and *A. woglumi* the most serious species of whiteflies damaging Citrus in the Punjab. (In South India *A. spiniferus* is usually the most injurious species.) Life history notes are given, and the chief form of damage is said to be due to the great loss sustained by the plants by the heavy drain on their lifesap caused by the continuous exudation of 'honeydew' by the scales. Though an infestation is not marked by the usual signs of curling, discoloration or drying of the leaves or shoots, attacked trees are said not to bear any fruits and if any are borne, they are insipid. The pest has been controlled by spraying.

In a second paper, Mr. Hussain deals with the relation of the Cotton Whitefly—*Bemisia gossypiperda*—on the disease causing cotton failures in the

Punjab. Although the whitefly infestation is very widespread in the Cotton areas, he has reason to believe that the disease—which is marked by a premature reddening of the leaves, shedding of flowers, buds and leaves, and the bolls remaining soft and opening prematurely—is independent of whitefly attack.

Dr. T. V. Ramakrishna Ayyar contributed a paper dealing with certain insects associated with scale insects and pointing out the importance of making a study of their mutual relationship in economic work. Mr. T. K. Venkatakrishnan recorded his observations made at Coimbatore on the life history of the Jasmine Bug—*Antestia cruciata*. Mr. Y. Ramachandra Rao gave an account of the introduction of the Australian Ladybird—*Vedalia cardinalis*—for controlling an outbreak of the Fluted Scale—*Icerya purchasi*—on the Nilghiris. The scale was first noted in 1928, occurring on various food-plants—chiefly the Wattle—and bade fair to spread to and destroy fruit cultivation on the Hills. Cutting and burning of the infested patches was tried but without any results; and in view of the success recorded in California and other countries by the importation of the Ladybird, supplies of this insect were obtained and multiplied in cages in a breeding laboratory and distributed in the places of infestation.

There were in addition some papers dealing with the subject of lac as studied in the Lac Research Institute, Namkum. Results of various experiments conducted there, by way of pruning the host-trees, by analysing their chemical constituents and by carrying out analysis of the lac-insects at different stages, in connexion with the problem of increased lac production, were set out therein.

The Zoological section also contained a few Entomological papers of economic interest. In addition to a few papers on the observations on the life-history of the lac-insect, there were two papers on Thrips. One by Dr. T. V. Ramakrishna Ayyar—dealing with a new species of *Aelothrips* from the Koilpatti Farm in South India, while the other, by D. S. Chowdhury, Cawnpore, was a very interesting one dealing with the Bionomics of *Thysanoptera*. It gave the results of observations made by the author on the influence of temperature and the relative moisture content of the atmosphere on the degree of infestation of fruits of *Eugenia jambolana* by a Tubuliferous Thrip noted at Cawnpore.

NOTES AND COMMENTS

We were privileged during January to welcome Sir T. Vijiaraghavachariar who came to Coimbatore with the express object of acquainting himself with the activities of the Madras Agricultural Department in general and to gain first-hand information regarding the work done at the Research Institute.

Under the auspices of the Union, Sir T. Vijiaraghavachariar, Vice-Chairman of the Imperial Council of Agricultural Research, delivered a lecture on the evening of 20th January 1930, on the origin, constitution, objects and the working of the Imperial Council of Agricultural Research. A detailed account of the Imperial Council of Agricultural Research has already been published in the January number (Vol. XVIII. No. 1). That portion of his speech pertaining to this has not been touched upon here. In discussing the relationship between the Imperial Council and the Provincial Government, he emphasised that the former does not in any way interfere with the latter but would supplement any of the activities in the provinces upon request from them. He also stated that in regard to financing of research schemes requests from official and non-official agencies, institutions and individuals will have equal consideration without any preferential treatment and grants made on the merits of each case. He finally emphasised that in future no useful scheme of research which has any bearing on the agriculture of the country will be held up or turned down on the ground of non-availability of funds.

In the course of the discussion that followed, Mr. T. A. Ramalingam Chettiar suggested for the consideration of the Council the need for initiating and encouraging research on markets and marketing conditions in India.

While we are at this we may point out that one direction in which the Imperial Council of Agricultural Research can assist the Government and private institutions, is by the maintenance of an up-to-date library. We are aware that the Council contemplates doing this, but what we suggest is, that in order to increase the usefulness of the library sufficient number of copies of all books and publications not ordinarily purchased by other institutions, may be stocked, so that simultaneous indents for one and the same volume may be complied with at the same time.

On the 21st morning, Sir T. Vijiaraghavachariar visited the Research laboratories where the work of each section was explained to him by the officers in charge, and Sir Chari bestowed considerable time to acquaint himself with the several items of investigation in progress at the Institute.

On the 22nd, Sir Chari visited the Paddy Breeding Station, the Millets Station and the Cotton Breeding Station where he was welcomed by the respective officers and shown the details of the specialised lines of work done in these stations. The great interest he exhibited in going round the laboratories and breeding stations for collecting first-hand knowledge regarding the activities of the Institute and to ascertain the progress of work done, his appreciation of the results achieved and his readiness to realise the difficulties and disappointments which sometimes confront the research worker, revealed a keenness of vision and sympathy which was inspiring to those with whom he came in contact. The officers of this College and Institute will always look

forward with pleasure for further visits from this worthy representative of India's agricultural interests.

The readers of our journal may be interested to learn that from November 1929 onwards, the familiar Sugar Journal *Planter and Sugar-Manufacturer* of New-Orleans—formerly published under the name of *Lousiana Planter*—will be combined with the Journal *Sugar* formerly the *Beet Sugar Gazette* of Chicago and appear under the title *Sugar* published at 153, Waverly Place, New York, U.S.A.

The next session of the Indian Science Congress will be held in Nagpur in January 1931. Dr. Sewell will preside over the Congress and Sir T. Vijiaraghavacharya over the Agricultural section.

The Sixth All-India Veterinary Surgeon's Conference was held at Madras on the 27th December 1929. The Hon'ble Mr. M. R. Seturatnam Ayyar, Minister for Development, in opening the conference referred thus to the treatment of cattle diseases in India. 'In recent years we find epidemics in cattle levying a heavy toll. Such epidemics were not known in the past nor was mortality among cattle so high. Scientific methods were being adopted to combat the growing epidemics and in spite of all precautions there has not been a very appreciable decrease in mortality. In ancient India treatment of cattle diseases might have been crude, but all the same it was very effective. In this connection I would advocate research into the old system and the incorporation wherever possible in the new year a more advanced scientific system such of those specifics which were used in the treatment of cattle diseases. We find that in the system of *Ayurveda* there are certain specifics which experience has taught us to be effective in arresting the growth of certain diseases in the human system. My belief is that there is something valuable and worth copying in the whole system. Some of you who are enthusiastic in knowing the old methods will do well to do research work and I am sure your efforts would not after all be in vain.'

The North-Arcot District Co-operative and Industrial Conference was held on the 4th January at Vaniyambady under the presidency of Mr. R. K. Shanmugam Chettiar, M.L.A. The Hon'ble the Minister for Development emphasised the necessity for the formation of more non-credit societies particularly stores. The President drew attention to the continued increase of overdues in our societies and diagnosed the cause as lack of appreciation by members, of the difference between long term and short term loans. Credit societies based on short term deposits should restrict themselves to the granting of short term loans while loans for longer periods in rural areas should be dealt with by land-mortgage banks.

PROGRESS OF AGRICULTURE IN MADRAS

Government's Review of Director's Administration Report for 1928-29

[*We reproduce below the Review by Government in G. O. No. 2034 dated 19th November 1929 of the Administration Report of the Director of Agriculture, Madras for the year 1928-29. Ed. M. A. J.*]

The Government have read with interest the account of the various activities of the Agricultural Department presented by Mr. Anstead in the annual administration Report for 1928-29.

The event of importance in the year under review is the publication of the report of the Royal Commission on Agriculture. The Government have proceeded to take action on these recommendations by the appointment of an Agricultural Advisory Committee to examine how far effect can be given with advantage in this Presidency to the recommendations of the Royal Commission and also by sanctioning the comprehensive scheme of re-organization of the department submitted by Mr. Anstead to enable it to expand on a systematic plan of progressive development. The Government have generally accepted the re-organization scheme in principle and have sanctioned an expenditure of Rs. 72,400 during 1929-30 for making a very substantial beginning and it is hoped that this would strengthen the resources of the department in tackling the important problems of research and propaganda.

As usual the demand for collegiate education continued to be on the increase though this cannot be said of middle school education. The middle school at Taliparamba alone functioned during the year under review and the Government hope that the other schools referred to in the last year's review, will be opened and commence work soon.

Economic research to improve the quality and outturn of paddy continued on the same lines as in previous years at the four paddy breeding stations and the possibilities of hybridisation and selection were further examined. The Government are glad to note that the study of sowing at different seasons has been completed and that good progress has been made with the investigations of the possibility of obtaining the maximum food value in respect of the new selections.

Work on sugar-cane, cotton and other dry crops continued on the normal lines and steady progress is recorded in the increasing area under the improved strains evolved by the department. There is an ever-increasing demand from the ryots for seeds evolved by the department and this is a good indication of the fact that the ryot is appreciating the usefulness of the department. The creation of the post of 'Oil-seed Specialist' will permit of due attention being given by the department to this important industrial crop. The new millet station which is proposed to be opened next year at Adoni is expected to give an impetus to work on dry crops.

The mycological and entomological sections continued investigation of the fungoid and parasitic causes of plant-diseases. It is satisfactory to note

that three disease-resistant varieties of paddy have been found and that the fungus responsible for the boll rot and seedling blight of cotton has been located to be in the seed coat. The most important feature of entomological work during the year was, however, the discovery of the notorious fluted scale *Icerya purchasi* on the Nilgiris and in order to successfully combat it, its natural parasite, the Vedalia beetle, was imported and released.

Steady progress is recorded at the four cattle stations. The number of Government bulls placed at stud outside Madras has risen appreciably and premia are being given for the maintenance of 36 stud bulls by the ryots.

The department took advantage of the various fairs and exhibitions held during the year for purposes of demonstration. The propaganda work of the department received facilities during the year with the advent of the motor exhibition units which are able to reach the ryots of out-of-the-way villages. The Government wish to stress the importance of this branch of activity of the department in as much as the results achieved by the other branches can be passed on to the ryots only through propaganda and demonstration.

The agricultural and co-operative departments worked in harmony and the loan and sale societies worked successfully in the matter of supplying pure seeds of improved strains produced under departmental supervision.

Special attention has been paid to the green manure problem and synthetic farmyard manure, and the recent sanction of the 'subsidized manurial scheme,' it is hoped, will place the department in a position to give definite advice in regard to the economic use of fertilizers.

The Research Engineer has designed a drill which is likely to become a standard implement.

The programme of work drawn up for 1929-30, which is largely a continuation of work already commenced, is approved.

The aim of research stations being mainly the evolution of disease-resistant strains, progress is necessarily slow and great deal has yet to be done in the effective tackling of the blast disease of paddy, mosaic disease of sugarcane, boll rot and seedling blight of cotton and the wilt disease of betel vine and ground-nut. Government hope that the introduction of the present comprehensive scheme of reorganization and development of the department will greatly help it in its endeavour to be useful to the ryots and the agricultural interests in this Presidency.

THE MADRAS PARK FAIR EXHIBITION

The Annual Park Fair and Exhibition was held during the Christmas week in the S. I. A. A. grounds, Madras. The Department participated in the exhibition, as usual, and the Agricultural Stall formed one of the chief attractions in the grounds. It provided an excellent fare of interesting and instructive exhibits to the visitors.

A number of cleverly drawn charts explained to the visitors, the need for proper manuring of the land, the wealth that lay hidden in waste products, the importance of tillage and cultivation, the usefulness of improved Agricultural implements and pointed out to them the ways of extricating themselves from the vicious circle of indebtedness, poverty and bad crops. Ploughs of various kinds, among which were included the improved models recently designed by the Research Engineer, seed drills of various kinds, *guntakas* and a model of Sindwahi furnace formed the chief exhibits on the implement side.

A small area of paddy, a strip of guinea grass, and a few Kasargod coconut seedlings grown *in situ*, gave a realistic agricultural touch to the show. Among the various other exhibits in the agricultural section the following are worthy of special mention: samples of synthetic Farm yard manure, fruits from the Burliar Government Gardens, cane varieties from Palur Agricultural Station, Potato varieties from Nanjanad Station, the giant tapioca roots from Malabar, and a bunch of coconuts obtained from a manured tree at Kasargod Farm.

The Paddy Section exhibited a few well chosen show cases which explained in a clear manner the intricacies of plant breeding and the samples of improved strains so far obtained from the Breeding Stations.

Attractive coloured posters formed the chief feature of the Entomological Section. The visitors learnt to their dismay that to the already long list of insect terrors in South India, three new names were added, namely the jasmine bug, the betel vine bug and the notorious fluted scale of the Nilgiris. A model beehive proved a source of immense interest to the visitors.

The posters and show cases exhibited by the Mycological Section, not only explained the nature of the numerous ills to which the South Indian Crop plants were heir to, but also suggested possible remedial measures. The *Mahali* disease of Areca nuts, stem bleeding disease of coconuts, mildew disease of Grape vine, and the smut of cholam are examples of diseases which have been successfully controlled by easy and practicable methods.

His Excellency the Governor visited the grounds on the 31st and spent nearly 45 minutes in the Agricultural stall.

GLEANINGS

Solidified C O_2

Solid Carbon dioxide, the by-product gas obtained in the fermentation tanks of distilleries, is now an article of commerce in America. It is described as a 'perfect refrigerant', and will soon be available for sale for general and household purposes. It is obtained by cooling to 114° below zero and the process of doing so is said to be simple and economical.—*The International Sugar Journal, December 1929.*

Sulphate of Ammonia

A process has been developed by Dr. M. R. Tern for the manufacture of this fertilizer in which sulphur dioxide, made by roasting exhausted gas purification mass, is oxidised to sulphur trioxide in an electric arc, and this SO_3 allowed to react with ammonia gas in an electristatic plant, whereby the sulphate of ammonia is separated. The salt produced is said to be pure white, and in a condition exceptionally suitable for broadcasting; the plant is very simple; it can be installed without great expense in any gasworks; and the cost of production is said to be decidedly lower than that of ordinary by-product sulphate.—*The International Sugar Journal, December 1929.*

Citric Acid

This vegetable acid, heretofore obtainable only by extraction from juices of citrus fruits, is now being obtained at the rate of about 2 tons daily in the United States by the fermentation of sugar solutions. It is also being made from beet molasses in Germany by a process based on German Patents 434, 729 and 461, 356. This production, though admittedly a difficult one, is nevertheless a perfectly feasible technical operation. It is certain sooner or later to exert an influence on the price of the natural acid.—*The International Sugar Journal, December 1929.*

Eradication of Sugarcane 'Mosaic' in Natal

Both European and Indian planters in Natal have complied with the regulations for the destruction of Mosaic diseased sugarcane and for the replacement of susceptible varieties by Uba. Some difficulty has been experienced in the elimination of Agaul variety to 'Mosaic'. Mosaic was discovered on an indigenous perennial grass *Setaria sulcata* and infection successfully transmitted from this host to Sugarcane. Steps are being taken to eradicate the grass from the vicinity of cane fields.—*Review of Applied Mycology.*

Fish oil as an adhesive in sprays

As a consequence of experiments conducted over a period of years including tests with different qualities carried out in 1926 and 1927 it has been decided that the quantity of lead arsenate powder used for the extermination

of Gypsy moth (Porthetria dispar L) and general control work can safely be reduced from 6¼ lb to 5 lb per 100 gallon of U. S. Gallon of water if fish oil is added as an adhesive. The spraying season can also be somewhat lengthened as spraying operations can be begun when the foliage is small with good results. A few experiments have indicated that fish oil is also a good adhesive for use with Bordeaux mixture or a combined lead arsenate and Bordeaux. Fish oil should be added to the spray mixtures at the rate of 4 oz. by weight to each pound of lead arsenate powder or insoluble matter used.—*Review of Applied Entomology.*

Cutworm baits

In tests carried out in Mississippi during 1928 with cutworm baits in which the insecticides were used at the rate of 1 lb to 50 lbs of bran the average mortality secured was 95 per cent with Paris Green, 536 per cent with sodium fluosilicate mixed dry and 44·8 per cent with dissolved sodium fluosilicate. A bait containing 1 lb Paris Green to 50 lb wheat bran moistened with water is therefore recommended to be applied broadcast at the rate of 10 lb dry weight to the acre. The bait should be distributed in the late afternoon a day or two before plants are set in fields where cut worms injury is expected.

The uses of Nickel in Engineering

Nickel is largely used in electrical industry, owing to its high melting point, in making parts of wireless valves, and the electrodes of sparking plugs. In mechanical engineering, alloyed with other metals it increases their strength and toughness. Nickel-steel alloys are used for making large steel forgings, and in casting among other things the bar-framing of locomotives. In heat-resisting steels it prevents the corrosion of the steel up to temperature 600–700° C. Nickel-chromium alloys are now largely used for electrical heating purposes. Nickel alloyed with copper increases the tensile strength of the latter from 21 to 45 tons per square inch. When alloyed with iron, nickel has the property, when present to the extent of 25 per cent of destroying the magnetic properties of iron; but a higher percentage of nickel restores these properties, and the Western Electric Company of America has established that after heat-treatment of high-content nickel-iron alloys the magnetic qualities are ten to thirteen times better than the best soft iron. It also has much effect in diminishing the hysteresis loss. These properties are of much use in submarine cables, where great permeability is desirable to ensure quick working. The alloy is insulated from, but wound round, the copper conductor, and prevents the interference of stray currents. An alloy of 35 per cent nickel, 35 per cent cobalt and iron, known as 'Perminvar,' shows great constancy of permeability.

Nearly 90 per cent of the nickel used in the world, is produced in Canada.

A new spray for Scale insects on Citrus in Egypt

Citrus in Egypt is severely attacked by scale insects, particularly *Chrysomphalus ficus*, Ashm, and although hydrocyanic acid gas has proved very effective against them, it is liable to scorch the foliage and cannot be applied by unskilled labour. Moreover, fumigation must be carried out at

night and cannot be used on trees that have overlapping branches or are otherwise difficult to access. In temperate climates scale insects are usually controlled by Resin and Paraffin washes which being injurious to foliage can only be applied during winter months and a modified wash was therefore made by dissolving 1 part of resin in 3 parts of castor oil by heating over a flame and emulsifying this solution in 50 parts of water containing 1 part of strong ammonia. This emulsion can be sprayed with any ordinary machine and on exposure to air the water and ammonia evaporate leaving a thin film of varnish on the surface of the leaves which remains sticky for three or four weeks even under tropical conditions and proves fatal to both scale insects and mealy bugs. The varnish seals up the female scales and prevents any possible migration of the young. No effect on the assimilatory functions of the leaf has been observed, and the spray was applied with complete success on very heavily infested trees of Sweet orange. Ten days after spraying not a single living scale could be found and there was no sign of damage to the foliage. Spraying may be done at any time between March and October so as to leave sufficient time for the fruits to outgrow and adhesive varnish, which if applied later would cause inconvenience in handling. It may be applied by unskilled labour and may be used before an infestation has become severe enough to justify fumigation.—*Review of Applied Entomology.*

Cactus in Madagascar

Writing in *Science* (July 12, 1929), C. F. Swingle calls attention to the interesting history of the prickly pear (*Opuntia dilleni* and *O. ficus-indica*) introduced into Madagascar about two centuries ago. The plants throve in the more fertile regions and became a pest. In the arid parts of the island they became the most important economic plant, furnishing not only food and drink for man and beast, but impenetrable barricades around fields and villages. Unfortunately, cochineal insects were introduced, and they have exterminated the cacti, a serious calamity to the Antandroy tribe. An effort is being made to use cochineal-resistant species to replace the susceptible species that have been eradicated.—*Journal of Heredity.*

How to make 'Dustless' Duster

Get three tablespoonfuls of linseed oil and mix in a quart of Kerosene in a bottle, cork and keep for use. After shaking the bottle well, wet a suitable cloth with this, wring out any surplus fluid and hang the cloth in a breeze to dry. Use this for all wood-furniture. A little of the kerosene and oil, put on the floor rag keeps the floor clean, when one has not the time to stain and polish them.—*Journal of the Jamaica Agricultural Society.*

The International Convention of Plant Protection

At the International Diplomatic Conference for Plant Protection, opened in Rome on 16th April 1929, the representatives of the contracting countries agreed, subject to ratification, to adopt the legislative and administrative measures necessary to secure common and effective action against the introduction and spread of plant diseases and pests. Such measures should be specially directed towards (1) the supervision of areas under cultivation, nurseries, gardens, green houses, and other establishments supplying the trade,

with plants and parts thereof, lists of which will be periodically prepared by each of the contracting countries; (2) the notification of the appearance of plant diseases and pests and the specification of the districts affected; (3) the means of prevention and control of plant diseases and pests; (4) the regulation of all kinds of transport and packing of plants in order to prevent the use of any material liable to spread diseases or pests; and (5) the establishment of penalties for infringement of the prescribed regulations.

Each country adhering to the present Convention will establish an official plant protection service, to execute the measures indicated above, including in its scope the foundation of an institute for scientific, technical and applied research and investigation in microbiology and agricultural pathology and zoology; and further, a special branch of the above, responsible more particularly for inspection of the areas under cultivation, the distribution of information regarding plant diseases and their control, the inspection of plant consignments, and the issue of phytosanitary certificates, etc. The health certificates should be conformed to the model attached to the present Convention, and the cases in which such certificates are required should be reduced within the stictest limits compatible with the safeguarding of the crops of each country.

The contracting countries agree to take all necessary steps for the prevention and control of plant diseases and for the supervision of imports, especially of those from countries which are still without official plant protection services. Each country reserves its right of inspection and quarantine of plants and (in exceptional cases) of prohibition of importation, even where the consignments are accompanied by health certificates. Reasons for such a measure should be declared, and should be based only on the genuine necessity of protecting home crops against infection by diseases or pests known to be present in the country despatching the consignments. In cases of disagreement regarding the interpretation of this or other clauses of the Convention or if a country wishes to challenge the prohibition of imports coming from its territory, the International Institute of Agriculture may be approached with a view to bringing about a settlement. For this purpose arbitration by a technical committee of experts appointed by each of the States concerned and by the Institute will be carried out and a report submitted by the Institute to the countries concerned, complete liberty as to further action being reserved to the Governments. The contracting countries are requested to ratify the Convention at the earliest possible date.—*Review of Applied Mycology.*

Ringworm of the Feet

Mycological studies are in progress on the fungi (chiefly *Trichophyton interdigitale*) isolated from cases of ringworm of the feet which occurred in 52⅓ per cent of the men and 15⅓ per cent of the women who had entered the University of California in the autumn of 1928. Many of the students come from India, China and Japan and it is thought probable that the ringworm fungi have been introduced from these countries.—*Review of Applied Mycology.*

QUERIES AND ANSWERS

[*The Editor of this journal will be glad to receive queries on subjects of Agricultural interest and will endeavour to answer them through the columns of this journal for the benefit of our readers.*]

I. Q. I understand that plantains are being very successfully grown in wet lands in the Godavari delta, and wish to try it in my lands at Tenali. I have a good well fitted up with a mhote for irrigation in the hot weather. What variety shall I try? Please give me any instructions necessary to raise a garden successfully.

A. You may try Karpura-chekkarakeli which is the most popular variety in the tract. Your land has to be well-drained, i.e., it should be at least one foot above the level of the neighbouring paddy fields or the maximum water level of the nearest drain. Planting has to be done between November and January. For further particulars, see Bulletin No. 93 of the Madras Department of Agriculture.

II. Q. Many of the fruits on my orange trees are dropping down after they have grown up fairly well. No injury is apparent, but, when a fruit is pressed, minute holes through which juice cozes out are found. The local gardeners say, the damage is due to 'mosquito' bite. Can you kindly suggest any remedy?

A. The damage is obviously due to certain species of fruit sucking moths. The moths by means of their stout probosces or beaks bore into the rind at night and suck the juice. As a result of this, bacterial contamination occurs, the fruits rot and fall to the ground. The caterpillars of this moth breed only on the leaves of a common creeper known as Tinospora (Telugu-Tippateega). The destruction of this food plant will therefore reduce the pest considerably.

The fruits can be directly protected from the moths by bagging them when half-ripe. Any moth-proof bag or cover may be used for this purpose. In the Circars, small palmyra-leaf baskets are used for protecting the fruits.

College News and Notes

The Christmas and New-year holidays marked a period of lull in the life of the College and Estate. Most of the students and a number of officers left for their homes on a well earned holiday. A good number of officers were on tour in connexion with the Madras Exhibition, Indian Science Congress, District tours, etc.; With the reopening of the College and Research Institute the normal activities of the two institutions have resumed with renewed vigour.

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The annual *Radha-Kalyanam* (Lord Krishna's marriage) which marks the culmination of the *Dhanurmasa-Puja* was celebrated on the estate with the usual ceremonies on Sunday, 19th January. The *Abhishekam* and *Puja* took place in the morning and were largely attended by the residents and a few visitors. This was followed in the evening by a *Harikatha Kalakshepam* and a grand procession round the residential quarters.

———

The construction of two additional blocks each containing 10 rooms and the usual adjuncts on the southern side of the existing 5th and 6th blocks will be hailed with satisfaction by the students and staff alike. Now that all the three classes have over 40 students each, there is a great deal of congestion in the existing hostel accommodation. Few residents of the College estate would have realised that there was insufficiency of accommodation in our hostel from the beginning of the year and it reflects great credit on our cheery and sporting lot of student friends who in characteristic fashion made the fac apparent to none but themselves.

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Mr. L. S. Subramanyan, assistant to the Imperial Mycologist, Pusa was in Coimbatore during the middle of January in order to acquaint himself with conditions of sugarcane mosaic and the wilt-disease of Bengalgram in Coimbatore.

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The Coimbatore branch of the Indian Officers' Association organised a garden party in the Coronation Park at which Sir T. Vijiaraghavacharya was the chief guest. The opportunity was availed of by the organisers to secure the services of Sir Chari who is a distinguished member of their ranks, an old Secretary and one of the poineers of the association to lay the foundation stone of a building which is to be erected in the Park to house the Association.

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The Principal and Staff of the Agricultural College and members of the Research Institute were at Home to meet Sir T. Vijiaraghavacharya. The party was held in the College Botanical Gardens and besides several officers of the department resident in Coimbatore, there were present some distinguished visitors from the town of Coimbatore. After a group photograph the party adjourned to a spacious lawn under the canopy of shade trees where the ring sat for a grand tea.

Weather Review

JANUARY 1930

Rainfall Data

Station	Actual Rainfall	Departure from normal
Gopalpore	...	—0·2
Vizagapatam	...	—0·5
Cocanada	...	—0·2
Masulipatam	...	—0·2
Kurnool	...	—0·2
Bellary	...	—0·2
Anantapur	0·1	...
Cuddapah	0·4	...
Nellore	1·5	—1·6
Madras	1·5	+0·1
Cuddalore	8·5	+7·0
Vellore	1·4	—0·1
Salem	0·2	—0·1
Coimbatore Town	0·2	—0·1
Coimbatore Res. Institute	0·3	...
Trichinopoly	1·5	+0·8
Negapatam	13·8	+12·1
Madura	0·6	...
Pamban	4·4	+2·3
Palamkotah	0·7	—0·8
Trivandrum	0·6	—0·1
Cochin	1·1	+0·4
Calicut	0·1	—0·3
Mangalore	0·1	...
Mercara	0·1	...
Bangalore	0·1	...
Kodaikanal	1·7	—1·2
Coonoor	1·9	—1·3

Pressure was below normal over the reporting area for the first six days of the month, and rose thereafter and was higher than usual till the 15th during which time a ridge of high pressure lay over the eastern part of the Presidency and occasioned low temperatures and fine weather. Thereafter pressure was nearly normal, falling towards the end of the month.

Weather was fine at the beginning of the month but unsettled conditions began to prevail on the 3rd of the month on the South Madras Coast. Rainfall appeared that day and continued till the 10th, and was nearly general in the South on the 7th, 8th, and 9th. Some heavy falls were reported during

that period, Negapatam reporting 3·5 ins. on the 7th, and Cuddalore 4·9, and Negapatam 3·8 ins. on the 8th. Weather was dry for the rest of the month over the whole of the reporting area. Total rainfall was in marked excess on the South Madras Coast where Negapatam was 12 ins. and Cuddalore 7 ins. in excess of normal. Rainfall was in defect elsewhere and absent from the Circars and Western Deccan.

Night temperatures were very low on the 1st, Gopalpore reporting 56° and Coonoor 37°. Temperatures rose towards the end of the month, the excess in Day temperatures being most marked in the Northern districts.

Winds were for the most part of the month from some Northern point and were normal in direction, Gopalpore however reported S. W. winds after the 15th of the month, showing that the Coastwise movement had started much earlier than usual there, owing, probably to the influence of Land disturbances over Upper India.

Report for the Research Institute Observatory

Absolute Maximum in Shade	92° · 5
Do Minimum in Shade	56° · 5
Mean Maximum in Shade	87° · 3
Do Minimum in Shade	64° · 5
Total Rainfall in Month	0 ·32 inches
Heaviest fall in 24 hours	0 ·27 „
Total Number of Rainy Days	1
Mean daily wind velocity	3 · 3 miles per hour
Do 8 A.M. velocity	2 · 7 „
Total Hours of bright Sunshine	263 · 7 hours
Mean daily hours of bright sunshine	8 · 5 „

Pressure was low before the period of rain and rising sharply reached the highest point on the 12th with the setting in of the fine bright weather. It declined towards the end of the month with the increasing temperatures.

Temperatures were low in the first half of the month, the lowest Minimum being reached on the 12th. Day temperatures rose after the 16th and rose above 90°. Diurnal variation was high and the difference between day and night temperature was 29° on two occasions.

Winds were from the North-eastern Quadrant except at the end of the month when convectional winds from the South-west began to appear in the late afternoons with high temperatures over the land mass north of Coimbatore.

Rainfall was light and was confined to two days during the period of general rains in the South.

Departmental Notifications

Appointments, transfers, leave, etc.

First Circle : Mr. A. C. Edmonds, Deputy Director of Agriculture, I circle, leave on average pay for 5 days in continuation of Christmas and New Year holidays. Mr. G. Jogi Raju, District Agricultural Officer to be in charge of current duties. Mr. B. Madhava Rao, Assistant Demonstrator, Aska, leave on average pay for 15 days in continuation of Christmas and New Year holidays. Mr. P. L. Narasimham, Assistant Demonstrator, Narasapatam, leave on average pay for two months and fifteen days from 15-1-30.

Second Circle : Mr. J. Suryanarayana, Manager, leave on average pay for two days from 3rd January, 1930.

Third Circle : Mr. Y. G. Krishna Row, on return from leave to be District Agricultural Officer, Nandyal. Mr. M. V. Raghava Rao, District Agricultural Officer, Bellary is transferred to Nandyal and Mr. Y. G. Krishna Row from Nandyal to Bellary. Mr. M. Satyanarayana, Demonstrator, Nandyal, extension of leave on average pay for one month and ten days.

Fourth Circle : Mr. A. Ramaswami Ayyar, Manager, Palur, extension of leave on average pay up to 23-1-30.

M. R. Ry. P. Janakirama Ayyar, Agricultural Demonstrator, St. Thomas' Mount, leave on average pay for two months from 1-2-1930.

Sixth Circle : Mr. K. Ramaswami Ayyar, Demonstrator, extension of leave on average pay on medical certificate for one month and 11 days, i.e., up to end of January 1930. Mr. M. Muthaya Nattan, Demonstrator, leave on average pay for 8 days from 3rd January 1930 in continuation of Christmas and New Year holidays. C. S. Sankaranarayana Ayyar, Demonstrator, Rajapalayam is transferred to Usilampatti *vice* Mr. C. S. Namasivoyam Pillai transferred to Rajapalayam.

Seventh Circle : Mr. K. S. Ramana Rai, Demonstrator, leave on average pay for two months from 25-11-29 on medical certificate. Mr. Narasimha Pattathan, Assistant Demonstrator, to be in charge of the sub-circle.

Eighth Circle : Mr. P. V. Raghavendra Rao, Demonstrator, extension of privilege leave up to 24th February 1930. Mr. V. S. Narayanaswami Ayyar, Demonstrator, extension of leave on medical certificate for two months from 7-1-30.

M. R. Ry. M. C. Krishnaswami Sarma, Assistant Agricultural Demonstrator, Attur, leave on average pay for one month from date of relief. M. R. Ry. T. S. Sundaram, Temporary Agricultural Demonstrator undergoing training at Salem is posted to Attur.

Live-Stock Section : Mr. T. V. Krishnaswami Rao, Manager, extension of leave on average pay on medical certificate for 2 months and 12 days and leave without allowance for 18 days in continuation. Mr. A. K. Annaswami Ayyar, Manager, leave on average pay for 10 days from 3-1-30 with permission to prefix Christmas and New Year holidays.

M. R. Ry. A. Venkatrangam, Farm Manager, Hosur, leave on average pay for one month from 5th February 1930.

Principal's Section : Mr. S. R. Srinivasa Ayyangar, Demonstrator, is appointed as Librarian, Agricultural College, Coimbatore, in the scale of 85-5-120. Dr. T. V. Ramakrishna Ayyar, Lecturer in Entomology, leave on average pay for 3 days from 21-11-29.

M. R. Ry. S. R. Srivivasa Ayyangar, Librarian, Agricultural College, Coimbatore, leave on average pay for 22 days from 2nd February.

Paddy Specialist's Section : Mr. C. V. Saravayya, Assistant, Maruteru, leave on average pay for 9 days from 3-1-30. Mr. A. Chidambaram Pillai, Manager, leave on average pay for 2 weeks from 18-1-30. Mr. C. Rajasekhara Mudaliar, Assistant, Aduthurai, leave on average pay for 12 days from 7-1-30.

M. R. Ry. A. Chidambaram Pillai, Farm Manager, Coimbatore, extension of leave on average pay till the 17th February 1930.

Government Mycologist's Section : Mr. K. M. Thomas, Assistant, leave on average pay for 8 days from 3-1-30 in continuation of Christmas and New Year holidays.

Government Entomologist's Section : Mr. M. C. Cherian, Assistant Entomologist, leave on average pay for one month from 20-11-29. Mr. J. A Muliyil, Assistant, leave on average pay for 8 days from 3-1-30. Mr. C. V. Sundaram, Assistant, leave on average pay for 8 days from 3-1-30. Mr. R. Narasimhachari, Sub-assistant, leave on average pay for 9 weeks from 1-2-30.

M. R. Ry P. S. Narayanaswami, B.Sc., Ag. is appointed as an officiating Upper Subordinate in the V grade *vice* Dr. C. J. George on leave or until further orders.

Cotton Specialist's Section : Mr. R. Chockalingam Pillai, Superintendent, Cotton Research Station, Coimbatore, leave on average pay for 4 months from 3-1-30; Mr. K. L. Ramakrishna Rao, Assistant, to act as Superintendent. Mr. L. Neelakantan, to be Officiating Assistant, V grade *vice* Mr. R. Balasubramanya Ayyar on other duty. Mr. G. Sundaresan, Assistant, leave on average pay for a fortnight from 15-1-30.

Government Agricultural Chemist's Section : Mr. T. Rajagopalan, Assistant, leave on average pay for 20 days from 6-1-30.

Government Systematic Botanist's Section : Mr. M. Ratnavelu, Sub-assistant, extension of leave on average pay for 13 days.

Principal's Section : Mr G. Krishnaswami Mudaliar, Lecturer in Animal Hygiene, Agricultural College, Coimbatore, to act as District Veterinary Officer, Madras for 20 days with effect from February 3, 1930 or from date of taking over charge.

Paddy Specialist's Section : Mr. A. Chidambaram Pillai, Farm Manager, extension of leave on average pay till 17th March 1930. Mr. C. V. Saravayya, Assistant, leave from 7th to 12th January 1930, cancelled.

Live-Stock Section : Mr P. K. Krishnan Nambiyar, Assistant Farm Manager, Hosur, posted to the Live-Stock Research Station, Chintaldevi.

First Circle : Mr. P. Lakshiminarayana, leave on average pay for 15 days from 20th January 1930.

Fourth Circle : Mr. A. S Nithyakalyani Reddi, Assistant Agricultural Demonstrator, extension of leave without allowances for 4 months from 21-1-30.

Sixth Circle : Mr. K. Ramaswami Ayyar, Agricultural Demonstrator, extension of leave on average pay for 15 days in continuation of leave already granted.

Seventh Circle : Mr. K. Seopi Haji, leave on average pay for 10 days from 26th February 1930. Mr. T. Gopalan Navar, Agricultural Demonstrator, Cannanore, leave on average pay for 15 days from 7th February 1930.

Eighth Circle : Mr. K. M. Venkatachalam Pillai, Assistant Agricultural Demonstrator, V grade on probation, is confirmed in his appointment.

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