NOTE BY Mr. J. S. FURNIVALL ON THE SYSTEM OF SOIL CLASSIFICATION IN UPPER BURMA.

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ANALYSIS AND INDEX.

SOIL CLASSIFICATION IN UPPER BURMA.

1. *Introductory outline of proposals.*—The object of the present proposal is to suggest the desirability of reconsidering the purpose, utility and methods of soil classification in Upper Burma Settlements. At present the Settlement Area is divided into Primary Tracts, these are subdivided where necessary into Assessment Tracts, in each of these the cultivation is separated into Main Kinds, and the soil on which each Main Kind of cultivation is practised is distributed into classes. Acre rates of assessment are then proposed on each soil class, these according to the theory of settlement are based on the nett produce of each soil class as indicated by the yields obtained in the course of crop measurement experiments. In the earlier settlements tracts were large and Main Kinds few But the more recent settlements indicate an increasing tendency to the multiplication of Assessment Tracts and Main Kinds. Not only does this increasing complexity add to the difficulty of framing and considering assessment proposals, it is even more to be deprecated on the ground that it multiplies the difficulties of revenue collection These difficulties are obvious and have been recognised by settlement officers. That despite their recognition of these disadvantages they should find such complexity essential to their proposals is a strong argument that it is inherent in the agricultural conditions of Upper Burma. One simplification is possible. The necessity for classifying soils has not as yet been proved, the abolition of this process will facilitate the work both of Land Records and Settlement. An examination of assessment proposals shows that within the limits of the same Main Kind in the same tract the results of crop measurement ordinarily indicate but little difference between the average annual outturn of the various classes, while it is always admitted that to arrive at these results some manipulation of the figures has been necessary. This lack of contrast between the various classes is doubtless partly due to the difficulties inherent both in classification and crop measurement. Within the limits of a settlement report it is not easy to show how far such difficulties have been surmounted, the widely different rates proposed for soils, which seem on experiment to differ little in fertility, indicate that these difficulties are in some degree responsible for the lack of contrast But the reports show that they can not wholly be responsible. It is a commonplace of settlement in Upper Burma that the outturn depends *firstly* on good fortune, *secondly* on good cultivation and only in the third place and in a minor degree upon the soil. The lack of contrast between the outturns of various classes may therefore be ascribed in large measure to the physical conditions of Upper Burma which, except over a long period, nullify the results of the most careful classification. This is not the only reason why classification is of little use. Every settlement report shows that the land is greatly subdivided, that generally speaking each man has a patch of good land and a patch of bad, and that it is a matter of comparative indifference whether he is assessed Re. 1-8-0 per acre on the good land and As. 8 on the poor, or Re. 1 on good and poor alike. Further, the assessment is levied by a staff at once overworked and underpaid, and people who escape the caprices of the season are still liable to those of the surveyor. And in practice, despite the theory of settlement outlined above, the outturns by soil classes are not used as the basis of assessment. A variety of considerations determine the assessment to be levied, acre rates are chiefly utilised for distributing the assessment within the tract.

These considerations apply in two cases, *firstly* where the cultivation is precarious, *secondly* where the surface of the country is uneven. In both these cases the variety of crops and of conditions adds to the difficulty of classification and diminishes its utility. In a large part of Upper Burma both these factors are combined. The present proposal is therefore that in such cases while Assessment Tracts should be small and Main Kinds numerous that within the limits of the Main Kind there should ordinarily be no classification of the soils. It is in fact a reversal of the procedure hitherto adopted, but although it is a reversal it is in accordance with the tendency which has gradually developed with the accumulation of experience. Classification of the soil has hitherto been regarded as a

matter of course, the multiplication of Main Kinds and Assessment Tracts by each succeeding settlement officer has been regarded as requiring justification. It is now proposed that the multiplication of Main Kinds and Assessment Tracts should be regarded as a matter of course, but that classification within the Main Kind should require justification either by difference of outturn or by some pronounced economic or agricultural distinction.

Before discussing them in detail it will be convenient to summarise these considerations. In Upper Burma soil classification adds greatly to the complexity of both settlement and land records work and enhances the cost and labour of revenue collection. It is therefore to be deprecated except where clearly proved to be necessary. At the same time even approximate accuracy is very difficult of attainment, and crop measurement is so difficult that the results hardly support even an accurate classification. While after the classification has been carried out and the rates based thereon have been accepted the physical and economic conditions, and the instruments for applying the rates are such as to render the classification nugatory. These points are dealt with *seriatim* in the following paragraphs.

2. *Difficulties of classification, (a) already recognized.*—Some of the difficulties of soil classification in Upper Burma have already been recognized both in the Settlement Instructions and in Settlement Reports. Thus in the instructions (paragraph 185) the caution necessary in applying crop measurements is noticed. In addition to this, however, there are three fundamental difficulties, the inexperience of the classifying staff, the continual necessity for comparing incommensurable qualities, and the inapplicability of local standards.

The inexperience of the classifying staff is commented on by Major Owens (paragraph 62) "all our men came from Shwebo where there is very little *ya* land, and were very much at sea at first." It is also suggested by Mr. Hardiman (paragraph 205) "in this Province a scale of relative values for all dry soils has yet to be framed." The difficulty of comparing one variety of soil or irrigation with another was Mr. Hardiman's justification for introducing numerous Main Kinds. And the inapplicability of local standards is referred to both by Major Owens and by Mr. Keith. According to the former the classification of the villagers is "too minute to be followed when the business in hand is to internally divide into appropriate soil classes tracts which contain large numbers of villages." The latter comments on "their ignorance of any soils save those of their own village," and other difficulties in the application of local standards are also suggested by certain of his remarks. Thus he notices the great variety of soils and crops and the value attaching to security either by adaptability to different crops (paragraph 152) or the difference of season (paragraph 158).

(*b*) *Inexperience of classifiers.*—To any one with experience of settlement work in Lower Burma one of the most noticeable differences between the personnel of an Upper and a Lower Burma party is that in Lower Burma the classifiers are experts: in Upper Burma they are not. In Lower Burma, so far as my experience goes, a soil classifier of ordinary intelligence with five years' experience is at least as likely to be right as an European officer with one. In Upper Burma a classifier of the longest standing is always liable to blunder badly, and less likely to be right than an European officer recently appointed to settlement. Reflection shows that after all this might have been anticipated. In Lower Burma the classifiers are continually dealing with the same crop on similar land under similar conditions: it is experience that counts. In Upper Burma they are continually meeting with new crops and new country. As noted by Major Owens the men of this party (who in Sagaing were too junior to classify) had little experience of dry lands in Shwebo, in Pakôkku the principal crops were millet and late sessamum, in different parts of this district they are cotton, early sessamum and nut. Even where there is a general similarity the conditions may be reversed from one village to another. It is not experience which tells but general intelligence.

(*c*) *Comparison of incommensurables.*—In fact, it is hardly accurate to say that classification is within the limits of general intelligence. What really is

needed is prophetic vision. This is pointed out by Mr. Hardiman in his statement that until the end of settlement "it was not known by what amount the best unassisted black soil was better or worse than the red." In a scientific classification there can be no comparison except between qualities of the same order, in the practical work of settlement it is continually necessary to compare qualities of different orders, of which the common measure is until the end of settlement undetermined, and sometimes undeterminable. In this district black soils as a rule grow millet and red soils sessamum, inclusion of these two varieties within a single class involves an assumption as to the conclusions which it is one of the objects of settlement to establish by experiment: it involves in fact beginning at the end. Although the distinction between these two varieties of soil is perhaps the most obvious and the comparison of them on a common basis the most difficult other distinctions are only less obvious and other comparisons only less difficult.

This can best be illustrated by a brief account of the varieties of soil and cultivation found within this district. Generally speaking the soils are either *Red* or derived therefrom by denudation or deposit. Over the greater part of the district wherever the surface is level a thick layer of *Red Soil* is found lying above a bed of gravel or sandstone. Where the surface is hilly the upper slopes have been denuded of this red soil which, carried down into the valleys, forms stiffer soils of darker colour. Where the slopes are gradual the broad valleys consist of light red silt or sand (*myeni-the-wun* or *myeni-nin san*), and the upper levels retain a covering of red soil. Where the slopes are more severe the soils of the valleys are stiffer and darker (*myeni-myenet*, *myenyo*) and the upper levels are so far denuded of red soil that it is mixed with the underlying sandstone or gravel, often taking on a yellowish tinge (*myeni-kyauksalit myewa*). Where the sides are even steeper the valleys consist of black silty loam or clay (*non-myetha*, *myenet-si*) and the upper levels on bare gravel or sandstone (*Kyauk-sa-lit*, *Kabba*). In many cases the slopes are terraced and the silt held up. Under this treatment even sandstone (then termed *p'ok-non*) becomes productive.

The red soil is, as in the broader valleys, protected against drought by an admixture of sand (*myeni-the-wun*) or if as on the level uplands protected by a covering of sand (*myeni-gan-the-bon*), is recognised as good soil, both fertile and secure. In the north of the district where *myeni-the-wun* predominate it grows early sessamum, *pegya*, *kunbyaung* and cotton. In the south of the district it grows early sessamum, *pe-bizat*, *kunbyaung* and nut. Continuous cultivation has a marked effect upon fertility. The terraced variety of sandstone is not essentially different but probably less secure and except under cotton perhaps less fertile.

To this general rule however, that where the surface is level the soil is red, there are exceptions. In the vicinity of Popa, along the river bank and in the Pyinsi paddy plain there are stretches of *Black Soil*, the first apparently volcanic, the second alluvial and the third *lacus trine*. Scattered among the hills are similar depressions of smaller area while the bottoms of the deeper valleys have points in common with them. On such soils the usual crop is *sanbyaung*, while a further difference consists in the possibility of continuous cultivation on the black soils.

Besides these two varieties *Silt Soils* are found distributed over the district formed either by inundation, deposit or erosion. Although differing in some points according to the manner of formation they have much in common. They resemble the red soils in their adaptability to different kinds of crops, having even a wider range, while they resemble black soils in lasting power and in their suitability for *sanbyaung*.

It will be noticed that this analysis is in effect that which Mr. Hardiman arrived at in the Chindwin, where he included silt soils with red. There is however in this district, as in Magwe, another type of soil—*Waterlogged Sand*. It is found only in the south and in adaptability to different crops resembles the red soils but while not perhaps so lasting as the best of these is even more secure and more responsive to careful cultivation.

Omitting the *po'k-non* variety there are therefore four types differing from one another in Lasting Power, Security, Fertility, Adaptability to different crops

and Responsiveness to cultivation. Within the limits of any single tract it is not unusual to find three of these types. Although the types themselves are not strictly sharply defined, and although within the limits of each type better and poorer can be recognised, the difference between types of soil is both greater and more definite than the difference between the better and poorer classes within the type. Ordinarily however soil classification omits to notice the difference of type and proceeds straight away to difference of class Thus it becomes necessary to balance the lasting power of one variety against the adaptability of another and the security of a third.

With dry lands, in Myingyan at least, no further differentiation into types is needed. But on rice land the classification is still further complicated by the nature, quality and quantity of the water-supply. The most obvious and important distinction is into irrigated and non-irrigated.

In Myingyan the following varieties of irrigated land are found, irrigation by Inundation, Flow, Lift and Tank.

Inundated lands include both early and late Paddy.

Flow Irrigation may be from a stream, either perennial or occasional, from a marsh or from a spring. In the first case the stream may be diverted by a sand embankment, or carried through a permanent channel with occasional viaducts of bamboo troughs. The crop thus irrigated may consist of early or late Paddy, or of both.

For *Lift Irrigation* the water is obtained either by inundation or from a stream, surface or subterranean. The crop is always early paddy, but a second crop from some fields is obtained by flow irrigation.

Tank Irrigation includes all cases where water is stored in a reservoir, whether obtained from an occasional stream, or assisted by a spring or consisting merely of the drainage of the catchment area. The crop is always late paddy.

In accordance with recent practice it has been a principle of the present settlement to classify for difference of soils, and to separate into Main Kinds differences of water-supply In classifying these irrigated lands little difficulty has therefore been experienced in the co-ordination of different qualities. Only in two cases does it arise. No Alkaline Main Kind has been provided, and it is sometimes necessary therefore to compare land receiving a good supply of salt saturated water with land receiving a poor supply of salt free water. The other case in which difficulty occurs is more commonly experienced when good soil and poor water has to be balanced against poor soil and good water.

Of non-irrigated lands, however, the classification is less simple. Five types are recognised. The sharpest distinction is into *Waterlogged* and *Dry*. There is only one type of *Waterlogged* land, it corresponds to the waterlogged sand type of upland soils. These rice-fields can be annually cultivated, are almost certain to yield a crop but even in the best years the crop is poor. The dry lands comprise four varieties, Narrow Valley, Deep Valley, Shallow Valley and Level Plain.

Narrow Valleys (*Taung-gya-yo*) consist of a strip of paddy bordered by precipitous sides rarely cultivated and often barren even of shrub growth. The fields are usually small, the valley rarely more than two fields wide and often difficult of access, cultivation therefore being at a disadvantage. The soil is silt, often of an inferior variety (*taung-gya-non*). There is rarely a large catchment area but sometimes in the upper reaches the rainfall is aided by a spring. Without a spring they are uncertain unless there is rainfall in the immediate neighbourhood and in the event of a single heavy storm they are liable to be destroyed by flood. If the silt soil is not markedly inferior the absence of good uplands, characteristic of such neighbourhoods, induces the cultivator to attempt a catch crop of early sessamum, while occasionally on the richest fields if the water can be kept out a crop of tobacco may be cultivated. Some of the highest yields of rice are found on land of this type.

Deep Valleys (*Yo*) consist of a broader line of paddy land lined by fertile uplands. Some of the fields at least are usually large. The soil is usually a rich silty loam deposited from the adjacent cultivated upland The catchment area may be extensive. Early sessamum is rarely grown before a paddy crop, but if

the water can be kept out there is an increasing tendency for such lands to be brought under cultivation with dry crops.

Shallow Valleys (*Sut* or *Sut-yo*) consist of valleys with lower sides and usually broader bottoms. The central strip of paddy is lined on either side not with *ya* crops but with rice fields receiving water only from the slopes. The soil is usually clay and dry crops are rarely grown except in a black soil area where the scarcity of other land for sessamum compels the cultivator to grow it on his rice land.

Level Plains (*Byin*) consist of the more level lands. They embrace a large variety from shallow pans of clay, uncultivable except with paddy and unfertile under that, to the catchment area of tanks and gradual inclines and dried up lakes. It is usually unresponsive to dry cultivation but the better land may in dry years yield millet or if water can be kept away be grown with chilly

In comparing these rain-fed lands of the same type the same difficulties crop up that have been noticed in the case of irrigated lands, some receive alkaline water, some do not, sometimes the soil is poor and the water good and sometimes the reverse obtains. When, however, it is a question of comparing one type with another, the difficulty is intensified. The only satisfactory and scientific method of classification would be to classify each type by itself, and at the end of settlement amalgamate such types as it was found could be assessed at the same rate. This is rendered impossible by numerous practical difficulties and it is necessary therefore to lay down rough assumptions based on information given by the cultivators.

(*d*) *Inapplicability of Local Standards.*—But on the numerous occasions that it is necessary to have recourse to the opinion of the cultivators it is apparent that local standards are inapplicable Comment in general terms on their unsuitability has frequently been made. But no Settlement Officer, so far as I am aware, has fully analysed in his report the implications involved in Direction No. 168 (*2*) that classification should be in harmony with popular ideas. This omission may easily be comprehended. Not only might such analysis involve undue prolixity but a settlement report is not ordinarily the place for discussing the principles of settlement they should be determined before the report is drafted. The considerations set forth below are not therefore to be regarded as new discoveries; they must certainly have appealed to every Settlement Officer in Upper Burma during the course of classification. The direction that classification should harmonise with local opinion involves two assumptions, *firstly* that the people value their land according to the principles adopted for assessment, *secondly* that from village to village within the tract the conditions are so homogeneous that the standards of one village will be in rough agreement with those adopted by the next. Neither of these assumptions is borne out by experience. The basis of local valuation does not accord with the principles of settlement, nor within the limits of a single village is it consistently applied, and in the second place the value of one village will be re-valued in the next.

(i) *The Local Basis*—Generally speaking it may be laid down that a classification for the purpose of assessing acre rates on soil classes according to their productivity under standard crops does not of necessity coincide and is often opposed to the comparative valuation adopted by the people. What the cultivator regards as the better land is often that which should be the more leniently assessed. In theory the criteria of the Settlement Officer for the purpose of classification are *fertility* and *cost*, fertility being estimated by the outturn under standard crops in particular years. To the people *lasting power*, *security*, *adaptability* to different crops, *response* to cultivation, are equally important while *fertility* and *cost* they reckon differently. The different results obtained in practical effect by the application of these different standards can most conveniently be illustrated by concrete instances.

Lasting Power is the quality held in most esteem. Land annually cultivable is preferred to land which over a period of years will yield the same net profit but must be left fallow half the time. As regards rice land this factor is almost negligible, but on uplands it occasions very real confusion. An acre of blacksoil

will yield three baskets of millet annually for four years, an acre of red soil will yield three baskets of sessamum one year and thirty of nut the next, and then for two years be fallowed. The net profit over a period of four years may be considered equal. But on several grounds, the most important being the possibility of annual cultivation, the cultivator will prefer the former. An assessment levied on the outturn in cultivated years ought to be twice as heavy on the latter.

Security is another valued quality, it embraces two distinct ideas. In one aspect it is not greatly different from lasting power. Land is reckoned secure if it affords a prospect of frequent cultivation, it is also reckoned secure if whenever cultivated it affords a prospect of at least moderate success.

On paddy land grown with paddy these two aspects of security are often but not necessarily found together. Some paddy land there may rarely be an opportunity of planting but when planted a crop may be reckoned on with certainty. One of the best and largest stretches of paddy land in the district remained unculti vated in 1910, a bumper year. Next year when all the paddy round was failing this land yielded some of the best outturns of the settlement. Such cases however are exceptional, and ordinarily the only difficulty in comparing paddy lands of the same type is that between lands yielding a good crop if successful and land yielding a moderate crop with certainty. One plot for instance will yield 45 baskets one year, fail the next, and remain unplanted in the third : another plot will yield 15 baskets each year. The cultivator will prefer the latter ; the former should be assessed at higher rates. On uplands there is the same difficulty. A protected red soil may yield annually three baskets of sessamum, a clay soil in years of heavy rain may yield 5 to 7 but the latter will often fail and often remain unplanted. The former needs manure, the other not. In the year that the clay soil is successful it can pay at least as high a rate, but the cultivator will prefer the former.

Adaptability is a feature of security. Certain paddy lands can also be grown with dry crops, such will be preferred in local valuation to other land more fertile under paddy but less secure against the fortunes of the season. This to some extent is eliminated by classifying the land in both these aspects, but in so doing we are posing the cultivator an abstract question which does not ordinarily enter into his comparative valuation of the land. On uplands this adaptability is even more important. A cultivator will prefer land which gives him a double chance of cultivation with early sessamum and beans to land which though profitable under late sessamum is dependent on the fortunes of the later rains. Their assessment should depend on their relative fertility under these different crops.

Fertility the cultivator judges by criteria different from those of settlement. To some extent his judgment is affected by the fact of his cultivating largely for home consumption : this feature is dealt with subsequently. Apart from this he estimates fertility by the yield of land under all crops customarily grown in the locality. However wide may be the range and however prolonged the period of crop selection it cannot within the course of settlement be so wide or so prolonged as to afford material for a decision on this point. The soil must be judged by its suitability to selected standard crops.

Adaptability to Different Crops is a feature both of Security and Fertility and has already been dealt with.

Response to Cultivation which to the Settlement Officer may be a reason for reducing the assessment is to the cultivator a reason for esteeming land more highly.

Cost of Cultivation.—The cultivator reckons differently from the settlement officer. While often prodigal of labour he is chary of expense. If one yield gives 3 baskets of sessamum and another 30 baskets of nut the settlement officer will make out an account in favour of placing a higher assessment on the latter. General experience during the present settlement tends to show that the cultivator finds the former yield more profitable.

These considerations may be summarised. The basis of assessment is the net produce in a particular year, the basis of local valuation is the net profit over a long period. In a hilly district with an uncertain rainfall the two are obviously incompatible. But the settlement officer is obliged to make the attempt of

arriving at the former by means of the latter; the data which he uses are suitable for a Fixed Assessment; he utilises them to arrive at a Fluctuating Assessment.

(ii) *Inconsistency of Application.*—But the cultivator does not apply his own criteria consistently. Primarily this is due to the present transition from an economy in which home consumption was the chief end of agriculture to one of commercial agriculture. His values are not yet accommodated to the changed conditions. Millet soils for instance are often prized because they render the cultivator independent of the market, while more often they retain a fictitious value from the days when there was no market to depend on. Rapid alterations in the scale of prices has rendered cotton more profitable than sessamum. Some of "the best" lands in Natogyi have only been brought under cotton within the last few years. Under sessamum and millet they are far superior to other lands, but under cotton although very fertile with good fortune they are liable to damage both from drought and waterlogging Thus a marked difference in their favour has been converted possibly into a disadvantage. Similar difficulties are found in comparing lands suitable for nuts and sessamum. The spread of chillies, red bean and dhall have also affected hereditary values. This need for a re-valuation is not solely to be attributed to commercial changes, the spread of *Strigea Lutea* has seriously affected the profitable cultivation of millet.

Thus the actual values of different varieties of land are altering rapidly and largely from year to year, traditional standards are upset and to the new ones the cultivator is not yet accustomed, while in some cases the new factors have not been long enough at work for a new valuation to be determined. The cultivator is not therefore always in a position where he is able to apply his own criteria, and it can only be expected that he should be inconsistent in applying them.

(iii) *Local Variations of Value.*—Under these circumstances it is clear that even if in two villages agricultural and economic conditions are exactly similar, this affords no guarantee that their inhabitants will hold similar soils in the same degree of estimation. Rarely however is there any such close resemblance between two adjacent villages; in a hilly country it often happens that one village more closely resembles another ten miles away than any intervening village. Difficulties of comparison frequently arise on this account. In one village there are deep valleys with inferior red soils half way up the slopes and sandstone heights, these will be graded in three classes. In the next village there are broad valleys with red soil on the slopes and on the crest a red or yellow soil containing gravel. These also will be graded in three classes. It is difficult to tell whether the second class of the former village is better than the best or poorer than the poorest soil in the latter. This is a problem which often calls for solution in the north of the district. In the south there are level uplands separated from one another by a mile or two of broken hill, on each three classes may be recognized, but all three classes of the one may be better than the best land of the other.

Even greater confusion perhaps is caused by economic differences. In one village paddy land is plentiful and uplands have a scarcity value, in the next village where upland soils are plentiful the relative values of the different varieties of upland will not be the same as in the former village. In one village black soils predominate and even poor red soils are highly valued and carefully cultivated, in the next the conditions are reversed. In one village trade facilities or a supply of water has attracted a dense population, land is scarce and rarely fallowed: in an adjacent village cattle breeding may be an important source of income and land abundant. In one village toddy palms are numerous and cultivation careless, in the next the population attracted by the toddy industry may have compelled the people to cultivate intensively. One crop may oust another owing to the labour demand for both of them not being available. All these instances are from actual experience. The Density of Population, the area available for cultivation, the supply of cattle and the labour demand of toddy or other crops are factors little less potent as regards fertility than differences of soil. Sometimes as noted just above in the case of toddy the same factor acts in opposite directions in different villages.

And these are not merely differences of relative valuation: they are reflected in absolute fertility. With a scanty population, long fallow and an abundance of manure a light soil may yield four baskets of sessamum. Where owing to density

of population the soil is continually worked not only will it be held in less esteem than heavier soils but its actual yield may be diminished by a half. Even where there is not this difference is absolute fertility the different attention given to the same varieties of soil in different villages has a marked effect upon the crops.

Classification therefore in an Upper Burma district is a matter of considerable difficulty. It may however be suggested that nothing more is wanted than a rough approximation, and that the test of net profit over a long period, subject to the modifications above noticed, does in fact approximate with sufficient nicety to net productivity in years of cultivation for it to be adopted as a satisfactory basis of soil classification that the classification for a fixed and for a fluctuating assessment should be identical. This however is an assumption, and, as shown by the numerical illustrations above given—which are by no means exaggerated—it is an assumption by no means according with experience. It is necessary then to examine how far it can be justified by the result of experiment in the measurement of outturns.

3. *Crop Measurement* (*a*) *Principles.*—There are two alternative principles on which experiments can be conducted. According to the one method the object is to *illustrate* and *justify* the classification adopted, by selecting fields and outturns which may be regarded as typical of the classes framed in this case the difference between the yields of the different classes as shown by experiment serves no better purpose than to indicate the difference which in the opinion of the Settlement Officer ought to obtain between them. Crop measurement conducted on this principle needs but few experiments, nor is it necessary that the experiments should be continuously repeated on the same field For assessment purposes, however, it is open to the objection that approximations to the results finally obtained have been assumed from the beginning of the operations.

On the alternative method the object of crop measurement is to *test* the validity and utility of the classification. For a scientific test of this nature the observance of four conditions is essential. The selections must be *numerous*, the experiments *continuous*, and each plot so far as possible *suitable* for selection, and *representative* of the class in which it is ultimately placed.

The prime essential is that the selections should be *numerous*. In a hilly district with precarious rainfall outturns vary greatly according to season, soil and cultivation. Only by a large number of experiments can it be ensured that abnormal results do not affect the general average.

Continuity of experiment is however of equal importance. Over the whole period of rotation the total produce of two fields may be the same, but one will give a better yield of millet, the other making good the deficiency under cotton: a selection of the former under millet and the latter under cotton will convey an erroneous impression as to the produce of both fields. Again, different soils react differently to different seasons, with a timely but moderate rainfall a black soil may yield a bumper crop of cotton, with a heavy rainfall the soil will be water-logged and the bushes run to leaf. The attention also which a crop receives varies with its place in the rotation; during the first year after fallow the crop will benefit by timely sowing and careful weeding, in the last year of the series it will be the latest sown and the crop be left to struggle with the weeds on the chance that the yield will pay the cost of seed and gathering. If the selection is shifted whenever the outturn is less than might have been anticipated the result is falsified.

Suitability of selection is desirable. The crop may have been sown earlier or later, received more or less manure, been more or less thoroughly ploughed, be nearer or farther from the village. And so far as possible it should be *representative* of the class in which it is placed, not near the border of a soil block, on soil homogeneous with the surrounding soil.

Other precautions are advisable; but these it is unnecessary to detail, the foregoing considerations will suffice to indicate that the scientific test of classification is no easy matter to arrange.

(*b*) *Observance of Four Conditions.*—It will immediately be patent on reflection that these conditions are incompatible. If the selections are to be suitable and representative they must be made by experts, and if made by experts

they cannot be numerous. Even the former two conditions are not easy to observe. The maximum limit to the number of selections under any crop depend *firstly* on the number of reapings which any crop reaper of ordinary capacity can reasonably be expected to supervise in person, and *secondly* on the number of crop reapers available. Where there is considerable diversity of conditions careful organisation is necessary to ensure that there shall be a sufficient number of selections of all the crops ordinarily grown in all the localities where they are of importance. In different parts of Myingyan throughout the year there is some crop being gathered. From May to August there is early rice along the river in the north and scattered over a considerable area in the south of Kyaukpadaung. From the extreme north to the extreme south early sessamum is an important crop the harvest extending from the beginning of July until October. From the middle of September until the end of the year the plucking of cotton is in progress also from the extreme north to the extreme south. At the end of September there is a short maize harvest in three tracts in two townships, while nut is gathered from October to March; at the end of October the gathering of upland rice in two separate tracts opens the main winter harvest, being followed at the end of the month by the rice in narrow valleys which is not yet finished when the bulk of the rice crop ripens, the reaping of this continues throughout December and January coinciding with *Lu* in the south of the district and introducing the harvest of millet and late sessamum which continues during the first half of February; by this time the pulse season which has opened with *penauk* in November is in full swing, the *bizat* characterising the south of the district ripening in the end of January and the red bean of the north beginning rather later and not being finished until well on in March, when nothing more requires attention but the *tasè* and *chaungdein* crops; these however carry on the season until the first rise floods the river or the first rains flood the streams and the early paddy of next season is ready to be reaped Besides the crops here mentioned, in a few scattered localities chilles and gram require attention.

When however it is necessary to arrange for the annual reselection of the same fields the work of organisations is magnified. Wide as is the range of selection the cultivators often grow crops which cannot be included, or portions of the single field of the former year are under two different crops, or crops are sown together on the same field, or the field is fallowed. The time of reaping and the proportion of fields under any single crop vary greatly with the season. Of nut for instance there are three seasons for sowing, separated by two months between each. With early sessamum although the intervals are not so wide there are also three seasons. In the latter case the time of reaping is partly independent of the rain. During the first year of cultivation, a short lived variety is grown; during the ensuing years, when the land is in part exhausted, the cultivator grows a longer lived and later reaped variety. With suitable rains the proportion of selections under nut, sessamum or cotton may be more than doubled and what has in one year been easy work for one man may become more than two can manage. While annually fields grown with the same early crop may be under three different varieties in the cold weather and one man suffice to carry on the work which in the rainy season called for three. This is not the only effect of rainfall, not only may any single crop as a whole be a month earlier or later on account of earlier or later rain but in any single village a chance shower may advance the crops a month beyond those of the adjacent village. Even the eccentricities of the Burman calendar upset the calculations of the cultivator with regard to seed time and of the Settlement Officer with regard to harvest.

Difficult, however, as is continuity of experiment under such conditions it is doubly important that it should be attempted. Not only is it the sole means of ascertaining the actual normal outturn of the selected fields during the period of settlement, but it minimises the greatest difficulty in the conduct as distinct from the organisation of experiments. Suitability of selection requires both expert knowledge and discretion, by continuity of experiment we eliminate to some extent the element of choice. In actual selection even with sufficient knowledge to choose wisely there of necessity, is bias. By continuing with old selections and reducing the number of old selections the accidental qualities which may originally have

determined its selection are ruled out, the inherent qualities remain. Apart from deliberate bad cultivation by the occupant the outturn in the second year is much more likely to represent a normal outturn than that of the year in which the field was originally chosen.

(*c*) *Precautions taken.*—It is unfortunate perhaps that little or no information has, as a matter of practice, been vouchsafed in settlement reports by which it may be gauged what precautions have been taken and how far these difficulties have been surmounted. It is not even clear on what principle crop measurement has been conducted. In the earlier settlements little attention seems to have been paid to number and continuity, and the alternative principle, taking the results as *illustrations* rather than *tests* seems to have been adopted. This, although not apparent from the reports themselves, is but a fair presumption from a remark made by Mr. Corby Wilson on page 5 of the introduction to the Myingyan settlement report. Here he states that in Minbu, Magwe and Meiktila the outturns given for cotton, sessamum and millet represent the outturns where these crops are sown first in the rotation. Where, as in Mônywa, experiment has been confined to a limited number of staples, it is obvious that they can only have been continuous in such cases as the selected fields were grown with the selected staples. And in general perhaps it may be presumed that where the selections are not numerous there has been a considerable degree of new selection every year. Where, however, the selections are numerous it is not clear how far or on what principles resort has been made to new selections. In theory, however, crops yielding less than one-quarter of the normal are not assessed, and it may be gathered that new selections have been substituted wherever the old selections have not appeared to the selector sufficiently productive to select. So far as this has been done the principle of continuity has of course been overlooked.

But it has been noticed that even the first condition of continuity, a large number of experiments is not easy to ensure. Perhaps a minimum of five selections in not less than two years is the lowest number from which deductions as to the normal yield of any crop can be confidently made. Certainly in Upper Burma where the variations both of soil and climate are so great no less a number will afford an adequate basis for assumptions, and even this figure does not allow sufficient margin for the exclusion of aberrant quantities. The Meiktila settlement was conspicuous for thoroughness of crop measurement in respect to the number of experiments. But even here this minimum was only attained in less than 35 per cent. of the series of experiments. There were in Meiktila including every Main Kind in every Assessment Tract 821 series of experiments representing different crops on different soil classes; in only 281 cases were the assumptions based on five or more selections in each of two or more years; this is rather less than 35 per cent. of the total; in 320 cases, or rather less than 40 per cent., experiments were conducted in two or more years but the experiments were less than five in number or, if five or more, only in one year of the series; while in 220 cases, rather more than 26 per cent., the figures were based on the outturns of a single year, and in 82 cases the basis of assumption was only a single outturn in a single year. (See Appendix I.)

If in Meiktila it proved impossible to conduct enough experiments to justify the assumptions it is unlikely that a sufficient number can be conducted elsewhere.

(*d*) *Examination of Results.*—One of the most noticeable features of crop experiment in Upper Burma is that despite the insufficiency in the number of the experiments it invariably proves necessary to reject a certain proportion. The Mônywa settlement was conspicuous for the small number of rejections. But owing to the lack of continuity rendered necessary by limiting the range of selection to certain standard crops it is not apparent, in default of further information, how far the necessity for rejecting aberrant outturns at the end of settlement was obviated by their rejection *ab initio*. If fields likely to yield "normal" outturns are selected every year few of the results will be abnormal but they may entirely fail to represent the normal outturn as this would have been shown by continuous experiment. In other settlements various standards have been taken for the different classes and all outturns falling above or below these limits have been

excluded, thus in Meiktila outturns "measurements were rejected if they fell short of a half of the probable outturn for the class of land and as too large if they were greatly in excess of the average run of measurements for the year." It is not clear how this criterion was applied in the cases where there were comparatively few experiments.

Despite, however, the exclusion of abnormal results the remaining figures do not always carry conviction as to the necessity for soil classification. In Meiktila the experiments on rice were particularly numerous. Apart from the question of continuity and so far as number goes in almost every class in every main kind in every tract they were both so numerous and so often repeated as to afford an adequate basis for assumption. In 35 cases there were four soil classes, in 42 cases there were three soil classes and in 13 cases there were two soil classes. In the 35 cases where there were four soil classes there was a difference between the lowest and the highest class of not more than five baskets in four cases, of not more than 10 baskets in 22 cases, of not more than 15 baskets in eight cases and of more than 15 baskets in only one case. In the 42 cases where there were three classes there was a difference of not more than five baskets in 14 cases, of not more than 10 baskets in 21 cases and of not more than 15 baskets in seven cases; in no case did the difference exceed fifteen. In the thirteen cases where there were two classes there was a difference of not more than 5 baskets in ten cases, of not more than 10 baskets in two cases and of not more than 10 baskets only in a single case; in no case did the difference exceed 15 baskets. Thus throughout the whole of the experiments only in one instance did the difference between the lowest and the highest class exceed 15, and in this case the difference was due to one experiment in one year and two experiments in another year. That is to say that in all cases where there was an adequate basis of assumption the difference between the lowest and the highest class was, in view of the importance attaching to season and cultivation, negligible. While in 17 cases the lowest class was not represented by the lowest outturn. (Appendix II)

In Mônywa a greater difference is perceptible between the outturns of the different classes. In three cases there is a difference between the lowest and the highest class of more than 15 baskets, in eight cases a difference of ten to fifteen baskets, in six cases a difference of five to ten baskets and in two cases a difference of less than five. But even here it may be doubted whether in view of the capricious rainfall classification was really necessary in the greater number of the tracts. One feature of interest, however is strikingly brought out in the Mônywa report. Comparing the rainfall crops with the irrigated lands the outturns of the latter show a marked differentiation into classes. Directly, that is to say, the water-supply becomes certain classification becomes necessary, so long as it is precarious classification is of doubtful value. (Appendix III.)

The Meiktila figures for dry crops bear witness to the same effect. There were four classes of sessamum in eleven cases, in only one did the highest outturn exceed the lowest by more than 100 per cent, in three cases by more than 75 per cent., in three cases by more than 50 per cent., in three cases by more than 25 per cent., and in one case by less than 25 per cent. There were three classes of sessamum in 21 cases; in two cases the highest outturn exceeded the lowest by more than 100 per cent., in three cases by more than 75 per cent., in five by more than 50 per cent., in five by more than 25 per cent., and in six by less than 25 per cent. There were two classes of sessamum in 31 cases, in one case the higher exceeded the lower by 100 per cent., in three cases by 75 per cent., in one case by 50 per cent., in nine cases by 25 per cent. and in seventeen cases by less than 25 per cent.

There were four classes of millet in ten cases; in four cases the highest exceed the lowest by 100 per cent., in four cases by 50 per cent., in one case by 25 per cent. and in one case by less than 25 per cent. There were three classes of millet in 25 cases; in five cases the highest exceeded the lowest by 100 per cent., in three cases by 75 per cent., in two cases by 50 per cent., in eleven cases by 25 per cent. and in four cases by less than 25 per cent. There were two classes of millet in 21 cases; the higher exceeded the lower by 75 per cent. in two

cases, by 50 per cent. in one case, by 25 per cent. in five cases and by less than 25 per cent. in thirteen cases. *Thus both as regards millet and sessamum in practically 70 per cent. of the soil classes the outturn of the highest class as shown by experiment is less than half as much again as the outturn of the lowest class.* (Appendix IV.)

A tabular abstract will perhaps facilitate the appreciation of these results:—

Meiktila Rice Outturns.

Number of tracts.	In which were	Difference between lowest and highest class.			
		0 to 5.	5 to 10.	10 to 15.	Over 15.
33	4 classes ...	3	20	8	2
47	3 classes ...	18	21	8	*Nil.*
12	2 classes ...	9	2	1	*Nil.*

Mônywa Rice Outturns, all Main Kinds.

Number of tracts.	In which were	Difference between lowest and highest class.						
		0 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 25.	25 to 30.	Over 30.
6	4 classes ...	...	...	...	...	...	2	4
25	3 classes ...	5	8	8	2	1	...	1
10	2 classes ...	3	2	1	2	1	1	...

Mônywa Rice Outturns, Rainfall only.

Number of tracts.	In which were	Differenc between lowest and highest class.						
		0 to 5	5 to 10	10 to 15.	15 to 20.	20 to 25.	25 to 30.	Over 30.
1	4 classes ...	...	...	...	...	...	...	1
14	3 classes ...	3	4	5	1	1	*Nil.*	*Nil.*
3	2 classes ...	...	1	1	1	*Nil.*	*Nil.*	*Nil.*

Meiktila Sessamum Outturns.

Number of soil classes.	Difference between lowest and highest as percentage.				
	Not more than				More than 100 per cent.
	25 per cent.	50 per cent.	75 per cent.	100 per cent.	
11 with four ...	1	3	3	3	1
21 of three ...	6	5	5	3	2
31 of two ...	17	9	1	3	1

Meiktila Millet Outturns.

Number of soil classes and kinds.	Difference between lowest and highest as percentage of				
	Lowest.			Not more than 100 per cent.	More than 100 per cent.
	25 per cent.	50 per cent.	75 per cent.		
10 of four	1	1	4	*Nil.*	4
25 of three	4	11	2	3	5
21 of two	13	5	1	2	*Nil.*

Further analysis reveals that in almost all the cases where the difference between the outturns of the lowest and the highest classes is considerable the basis of experiment was inadequate. This has already been noted as regards the rice yields. In the case of Sessamum in Tract I-S, Main Kind L-Y, the difference exceeds 100 per cent; there were only two classes and the outturn of one class was based on a single experiment in a single year. In Tract 4. N, Main Kind Y, there were four classes and except that the lowest class was based on a single measurement in a single year the basis of experiment was adequate. In Tract 16 E, Main Kind Y, the difference exceeds 100 per cent., but the outturn of the lowest class is based on the outturn of a single selection in one year only, and of the second class on the outturn of a single selection in two years. In Tract 20 N, Main Kind L-Y, both the lowest and the highest classes are only represented by a single selection in a single year. It is the same with millet. In four instances there were four classes with a difference of more than 100 per cent. between the lowest and the highest. In Tract 4 S the outturns of all four classes were based on 10 selections in one year and 11 selections in the next, while the lowest class was represented by a single selection only in a single year. In Tract 7 Main Kind Y, the four classes were represented by two selections in one year, six the next and 10 the next. In Tract 11, Main Kind Y, the basis of experiment except as regards the lowest class was adequate. In Tract 17 E, Main Kind Y, the outturns of three out of the four classes were based on the measurements of a single year.

These instances should be sufficient to elucidate the full importance of the Meiktila Settlement in respect of the theory of land revenue in Upper Burma. More perhaps than in any other settlement have the crop experiments been used to test rather than to illustrate the results of classification. How far the test of continuity was applied cannot be ascertained from the report, but certainly the importance of a number of experiments was realised. That the number was still inadequate has already been remarked. This however is not the point of most importance. The most important matter is that *the wider the basis of experiment the greater is the tendency for differences of outturn from class to class* to disappear: season and cultivation average out the differences of soil.

Besides number and continuity the other two conditions of experiment are that the selection should be suitable and representative. Settlement reports contain equally little information as to the precautions taken with regard to these. In every report, however, it appears that within a very small area there may be great varieties of soil, and that in the course of classification these varieties have been averaged into a single class: it does not appear how the selected fields thereby affected have been dealt with. This, however, is only one of many points on which information would be necessary if the experiments were to be taken as scientific tests of the productivity of the soil.

Perhaps the most convincing instance that where crop measurement is illustrative rather than experimental the results most be accepted with reserve, is shown by the two settlements of Minbu. In the earlier settlement *mye-ma* soils were placed in the first class under *ya* crops, lighter soils being placed in the

second class. At the re-settlement it was remarked that in the drier areas this distinction was not valid, and the lighter soils were placed in the first class, the *mye-ma* soils in the second. In both cases the classification was supported by the results of crop measurement.

(*e*) *Utility of Crop Measurement.*—It has been shown then both that it is impossible to conduct a sufficient number of experiments to test the classification of soils within the Main Kind, and that so far as the results obtained, do test the classification they do not justify it. It remains to consider the utility of crop measurement. This is apparent from an examination of the results of either the Mônywa Settlement or the Meiktila Settlement. In both these settlements there has been exemplified the tendency of Upper Burma settlement to multiply Main Kinds and Assessment Tracts. And while the crop measurements afford but doubtful confirmation of the classification of the soils, a very slight examination of them serves to justify the multiplication of Main Kinds and Tracts. In four tracts in Meiktila the lowest yield of sessamum was 4 baskets, in fourteen tracts the highest outturn was less than 4 baskets. In four tracts the lowest outturn of millet was 6·50 baskets, in six tracts the highest outturn was less than this amount. A comparison of the yields of L-Y and Y main kinds with Y Main Kinds gives similar results. The difference is from place to place and kind to kind not from class to class within the same kind in the same place. These differences moreover it is possible to test; it is the multiplication of classes which renders verification by experiment impossible.

4 *Utility of Classification.*—Assuming however that the classification is accurate and justified by experimental results it is convenient to examine what useful purpose it serves and how far it is in practice utilised. The purpose of classification is that the revenue paid on any crop shall be proportioned to the profit obtained from cultivating it. Supposing that all the land of any cultivator fell within a single class his profits would still depend on the fortunes of the season and his ability to cultivate. As noted by Mr. Keith "Land in a lower class frequently produces as good crops as land in a higher class, and in years of exceptionally good rainfall even better crops" (paragraph 138). Again "it is not the soil so much as the man who works it that counts" (paragraph 153). These opinions would I suppose be endorsed by any Settlement Officer in Upper Burma. With good fortune and good cultivation the highest assessment ever laid on dry land can be paid by all but the poorest, possibly even by the poorest soil. With bad fortune or bad cultivation even at four annas the best land is heavily assessed. However minute the classification and however intricate the machinery of relief every year, there will be within the district lands assessed to revenue which have already failed to recoup the cost of cultivation and others paying less than one per cent. of the net profit.

The supposition however that all the land of a cultivator ordinarily falls within a single class is notoriously opposed to reality. Whenever a holding is divided among co-heirs as many new holdings are created as are necessary to provide each of the co-heirs with each variety and each quality of land contained within the holding, "so that 15 new holdings may be created as the result of dividing a single holding among five co-heirs if there are three distinct classes of land in it." (Mr. Keith, paragraph 81.) Nor does the multiplication of rates of necessity convey to the cultivator an impression of the greater equity of the assessment. Here again Mr. Keith may be quoted. "Scarcely a man knows the area of even one of his many holdings or its classification or the rate of assessment" (paragraph 137). My experience in this district does not lead me to accept this opinion without reservation, but it may be that the greater simplicity of the system here has encouraged the cultivator to acquaint himself with the rate of his assessment.

Both on physical and economic grounds therefore soil classification is useless as a means of distributing the assessment among individuals. And as a matter of fact it has never been attempted. In the Meiktila Settlement four annas was levied on soil classes of which the average annual outturn as shown by crop measurement ranged from 1·48 baskets to 3·53 baskets of sessamum. Other rates

showed equally little co-ordination with the outturns, they can best be illustrated in tabular form :—

Rate proposed for class.	Average Outturn for which Rate proposed ranges from	to	
·25	3·53	1·48	Appendix V
·38	3·67	2·13	
·50	5·56	1·66	
·75	4·91	2·50	
1·00	5·75	2·00	
1·25	5·63	3·17	
1·50	6·76	3·32	
1·75	5·26	4·61	
2·00	5·27	4·72	
2·25	5·29		

In Tract 5 the average outturn of the 4th class is 3·53 baskets it is assessed at four annas, in Tract 7 the average outturn of the first class is 2 baskets, it is assessed at one rupee. In Tract 17 W the average outturn of the 3rd class is 5·56 baskets, it is assessed at eight annas, in Tract 17 S W the average outturn of the first class is 5·29 baskets, it is assessed at Rs. 2·25. Such figures as these render it clear that soil classification so far as it has any use at all is only useful in so far as it facilitates the distribution of an assessment arrived at on quite other grounds than the results of crop measurement.

In conclusion there is one aspect of settlement, and that the most important, the practical application of the rates to the collection of land revenue, in which classification of the soil, so far from serving any useful purpose, is positively undesirable. Comparatively simple as is the present system in Myingyan its proper working is notoriously beyond the powers of the Land Records Department. Every unnecessary refinement defeats its own end by making the system more unworkable.

5. *An alternative system* —Before suggesting an alternative it may be perhaps as well to summarise the main objections to the present system. Unless Main Kinds are numerous the present method of classifying soils is unscientific because—

(i) it is continually necessary to compare incommensurable qualities, and

(ii) assume the results which it is attempted to establish,

(iii) in this we are dependent on the classification of the people,

(iv) who do not apply standards suitable to an assessment based on net productivity in years of cultivation, and

(v) do not apply their own standards consistently, and

(vi) who are not in a position to compare soils over a sufficiently wide area.

The result is incapable of scientific verification because it is impossible to conduct a sufficient number of experiments, and in no settlement has the utility of classification been proved or even tested. The classification is useless when completed because—

(i) outturn depends on good fortune and good cultivation rather than soil,

(ii) holdings are so much divided that each man usually owns patches representative of every variety and every class,

(iii) its application depends on an overworked staff.

If Main Kinds are numerous enough to eliminate the two first named objections, verification becomes even further removed from possibility, and the application even more difficult.

The alternative system which I now propose has the advantage of proceeding on scientific principles; instead of assuming from the beginning the ends which it is intended to establish and straining facts to accord with the assumptions, the ends are arrived at by experiment. Divide the settlement area into assessment tracts for all pronounced physical or economic differences. Divide these assessment tracts into main kinds for all types and varieties of cultivation found within them, and within the main kind only divide into soil classes in the event of a pronounced and immediately apparent difference of outturn, or for some distinct economic difference. At the end of settlement, before the maps are copied by the revenue surveyors amalgamate all such varieties of cultivation or main kinds and tracts as do not need differentiation for the purpose of assessment.

It will perhaps facilitate the comprehension of this proposal if it is illustrated from conditions in Myingyan. As regards irrigated rice lands the main kinds necessary have been detailed above. With the exception of tank irrigated lands the water-supply is of sufficient certainty to justify classification. But if I were proceeding anew I should introduce a Saline Irrigated Main Kind

At present Tank Irrigated Land is classified on the following principles. The larger tanks are second class, the smaller tanks and, if the people wish, the less well situated fields beneath the larger tanks are third class: tanks receiving an exceptional water-supply are first class and the poorest tanks are fourth class. If tank irrigated land is so poor that it cannot be assessed at a higher rate than third class rainfall it is classed as fourth class rainfall. I should however abolish this classification. It has often been represented that fields under small private tanks do better than fields under large tanks, because the owner is independent of outside interference with the disposal of his water. This criticism is justified by enough crop measurements for it to be clear that it has considerable force. I will return to Tank Irrigation after considering Rainfall.

Rainfall rice land is classified on the following principles. It is distinguished into the four types above mentioned, Narrow Valley, Deep Valley, Shallow Valley and Plain. The waterlogged variety was included unfortunately with the plain. The larger valleys and depressions in the Plain are placed in the second class, the shorter valleys are classed together with the ordinary level plain. The first class is reserved for valleys receiving an exceptional water-supply, these are mostly of the narrow valley type; the fourth class for fields damaged by alkaline deposit or shallow pans of unfertile clay, usually being less esteemed than the uplands of the same locality. But it appears that there is a much greater difference between type and type than between class and class. The distinction into types is not denoted by a symbol on the map. On the method which I now propose the distinction into types would be noted but the classification omitted. The only distinction of class which I would make is in the case of the fourth class. This I would deal with under the proposed system of classification by excluding it entirely from the rice land main kind. Where in area sufficient to notice it would be classified as *Ya*. Tanks would similarly be classified into Tank assisted Narrow Valley, Tank assisted Plain, etc

As regards dry land cultivation I would make a separate Main Kind for each variety of cultivation. At present we recognise five classes of land. First class consists of Good Silt. Second class consists of Good Black Soil. Third class consists of Good Red Soil, with which is included the Good Waterlogged Soil. The fourth class consists of Average Land under regular cultivation, the fifth class consists of land irregularly cultivated. Where any one of these classes is of inconsiderable area within a tract it is amalgamated with the nearest class, in only one tract are there actually five classes. The inferior qualities of any variety are compared with the better qualities of inferior varieties and classed accordingly. Thus poor silt (*non chauk*) might be classed either with Good Black Soil or Good Red Soil or even with Average Soil. I would abolish these classes and class into Main Kinds according to the crops ordinarily grown Thus in the tract where we have five classes the Good Silt grows either tobacco, *or* millet (*sanbyaung*) and late sessamum in rotation, the Good Black Soil grows millet (*sanbyaung*) annually the Good Red Soil grows millet (*kunbyaung*) late sessamum and nut, with occasional fallow, the Average Soil grows the same crops as the Good Red Soil with frequent fallow and the Irregularly Cultivated Soil grows catch crops of early or late sessamum, nut or pulse, Difficulties of classification occur in balancing the inferior silt soils against the other varieties, and similarly the inferior millet soils And it is quite possible that the third class can bear a higher assessment than the second, while the fourth class may not during the years of cultivation differ appreciably from the third. The first class is let either at cash rents usually for a period of four years, or else on mortgage tenancies, the second class is let on half share of the produce, and the third and fourth on either one-third share of the produce of cash rents. The inferior varieties of each type are usually let on the same system as the superior varieties of the same type: thus an inferior millet or Black Soil holding will despite its inferiority be let on one-half share.

By classifying these different soils we are pronouncing an opinion as to their assessable capacity which we shall not be in a position to test until the end of settlement. By classing into Main Kinds the different types and including their superior and inferior qualities we should be pronouncing no opinion as to their assessable capacity. By classifying into Main Kinds we should also be eliminating one of the classes, the fourth class would be included with the third.

Thus for uplands I would have in every tract at least Two Main Kinds; one comprising all those lands under regular cultivation, including such lands as received a normal fallow in the ordinary course of husbandry; and the other comprising all those in which cultivation was shifting, occasional or irregular. The former Main Kind would be subdivided into Main Kinds according to the varieties of cultivation practised: ordinarily there would be no more than one, or where black soils under millet and red soils under rotation were both found in appreciable areas two Main Kinds. But the Main Kinds would not be subdivided into classes, except for some sufficient reason not implying an assumption as to the yield. The advantages of the proposed system as regards simplicity will be immediately apparent Instead of the multitudinous rates and classes of the present system the surveyor would have *kwin* maps hardly, if at all, more complicated than those of Lower Burma The work of classification would be simplified to an even greater extent, we should be dealing with facts and not with fancies. The only method of arriving at a classification even approximately accurate at present is for the Settlement Officer to outline the classification in a large proportion of the *kwins*, for this classification to be filled in by a soil classifier and for the work to be tested by a section officer. In place of this procedure, which personally I feel to make undue demands upon the physical and moral powers of all concerned, the classification could be done almost entirely from the map.

The only drawbacks which suggest themselves seem to be based on a misconception of the utility and practice of the present system. That the present system is both impracticable and useless I have attempted to show above, and it is unnecessary further to labour the point. As is pointed out by Mr. Keith "The exact proportion of the net produce to be taken in any case must depend largely on circumstances many of which cannot be set out in writing or illustrated with statistics" It is not the fact that such and such a soil class yielded so many baskets of rice or sessamum which determines the assessment: it is commonsense. In a country such as Upper Burma it is impossible for Government to enter into direct and equitable relations with the individual cultivator. If more than a very remote approximation of tax to profits is required it must be effected through the medium of the village: where this cannot for any reason be effected it is necessary to be contented with an approximation less immediate. At present we are attempting too much and because we are attempting too much fall short of what is practicable. It would seem that by adopting the method now proposed while nominally attempting less we should be achieving more.

MEIKTILA SETTLEMENT.—*Statement showing tract by tract the experimental basis of assumed outturns.*

APPENDIX I.—REFERENCE PAGE 10.

Experimental Basis of Assumption.	Number of Instances: Tract by Tract.												
	1-N.	1-S.	2.	3-N.	3 S.	4-N.	4-S.	5.	6-N.	6-S.	7.	8	9-N.	9-S.
Only one experiment in one year only.	2	2	0	2	4	1	3	2	1	1	5	1	2	3
More than one experiment, but one year only.	3	2	2	5	3	2	0	5	1	2	1	8	4	8
Less than five experiments for two or more years.	7	9	9	5	6	5	12	5	6	5	13	9	8	6
Five or more experiments for two or more years.	12	10	12	11	5	18	3	13	12	16	1	5	6	2

Experiment Basis of Assumption.	Number of Instances: Tract by Tract.													
	10-E.	10-W.	11	12	13-N.	13-S.	14	15	16-W.	16-E.	17-N.	17-E.	17-SE.	17-W.
Only one experiment in one year only.	2	1	3	1	1	2	4	1	4	5	2	3	7	0
More than one experiment, but one year only.	13	3	3	4	6	7	2	3	2	0	2	6	5	5
Less than five experiments for two or more years.	8	8	9	14	5	12	13	7	16	10	5	17	9	11
Five or more experiments for two or more years.	6	8	7	9	3	4	9	11	10	7	2	8	3	9

Experiment Basis of Assumption.	Number of Instances: Tract by Tract.									
	17-SW.	18	10-SW.	19-S.	19-N.	20-N.	20-S.	21.	Experiment Basis.	Total.
Only one experiment in one year only.		1	3	1	0	4	5	1	Inadequate 65 per cent.	82 or 10 per cent.
More than one experiment, but one year only.	4	3	3	4	0	8	4	5		138 or 15 per cent.
Less than five experiments for two or more years.	10	12	7	3	4	13	13	9		320 or 40 per cent.
Five or more experiments for two or more years.	17	11	8	3	2	9	9	10	Adequate 35 per cent.	281 or 35 per cent.

MEIKTILA SETTLEMENT. RICE.—*Difference between outturn of lowest and highest class by main kind and tract.*

APPENDIX II.—REFERENCE PAGE 11.

Difference.	1N.		1S.		2		3N.		3S.	4N.		4S.		5		6N.		6S.		7	8	
	S.	M.	S.	M.	S.	M.	S.	M.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	M.	S.	M.
0—5	...	...	.	...	...	..	...	3	..	...	...	...	...	...	...	.	...	..		. .	3	..
5—10	...	...	6	...	3	4	...	...	4	3	4	3	3	4	4	..	4	3	4	...	..	..
10—15	3	4	...	3	...	...	2	...	...	...		..	...	..	.	3	.		...	4		4
More than 15	..	...	...	...	...	...	...	...	...		...	...	...	...	...	...	...	..	...	...	...	.

Difference.	9N		9S.		10E.				10 K S.		11		12				13N.		13S.			
	S	M.	S.	M	K.	K.S.	S.	M.	S.	M.	S.	M.	K.	K S.	S.	M	S.	M.	K.	K S.	S.	M.
0—5	4	3	4	...	...	..	...	3	3	3	..	...		3	.	3		3		.	3	..
5—10	...	.	..	3	..	3	...	...	...		3	4	3		4	...	3	...	2	..		3
10—15	..	...	...	...	3	...	4	...	.	. .	...	..	..	...	...	.	..	...	...	3	...	.
More than 15	...	...	...	...	...	...	...	..	...	...	..	...	...	...		...	..		...	.		

Difference.	14.			Total.			15		16W			16E.			17N.			17E.			
	K.S.	S	M	4	3	2			K S.	S.	M.	K S	S.	M	K.S.	S	M	K S.	K.S.	S.	M.
0—5	3	2	2	2	11	2	..	...	...	...	4	...	...		...	.	2	...	...	2	3
5—10	...		...	9	12	1	4	4	4	4	..	3	2	..	4	3	...		4	...	...
10—15		..	.	4	5	1	.	..	...	. .	...	...	...	3				4	...	...	...
More than 15	...	...	...	...		. .	...	...	...	.		...	...		...	...	...	...	...	...	...

Difference.	17S E.		17W.		17S.W.		18				19S W.				19S.		19N.		20N.			
	K.	K.S.	K.	K.S.	K.	M.	K.	K.S.	S.	M.	K.	K.S.	S.	M	S.	M.	S.	M	K.	K.S.	S	M.
0—5	3	2		..	...	2	...	...	3	2	...	...	...	2	...	2	...	2	...	4	...	...
5—10	...	...	4	3	3	...	...	4	...		4	3	3	.	3	...	3	...	...	...	4	4
10—15	..	...	..	.	...	..	...	...	...	...	...	...	.	..	..	. .	.	...	4	...	...	...
More than 15	...	...	..	...	...	...	4	...	...	..	.	..	...	...	...	..	...	...	..	...	..	...

Difference.	20S.				21		Total.			Column 1			Sum total		
	K.	K S.	S.	M.	S.	M.	4	3	2	4	3	2	4	3	2
0—5	...	...	...	..	...	...	2	3	8	2	11	2	4	14	10
5—10	...	4	3	...	..	4	13	9	1	9	12	1	22	21	2
10—15	3	...	...	4	4		4	2	...	4	5	1	8	7	1
More than 15	...	...	...	...	...	...	1	...	...	.	...	...	1	...	...

MONYWA SETTLEMENT RICE LANDS.—*Differences from Class to Class Rainfall in Black Irrigated in Red.*

APPENDIX III.—REFERENCE PAGE 11.

Difference between Lowest's Highest Class.	Tract II.		III.	IV.	V.		VII.	VIII.			IX.	X.			XI.			XII.	XIII.		
	M.	T.	M.	R.	R.	M.	R.	R.	I.	S.I.	R.	R.	M.	T.	R.	I.	P.I.	R.	R.	I.	P.I.
0—5 ...	...	...	...	...	...	2+	3	...	..	...	...	...	...	2	3+	...	...	...	...	...	...
5—10 ...	...	...	...	3	...	...	...	3	3	3	...	...	3	...	...	...	...	...	3	...	...
10—15 ...	...	...	...	...	3	...	...	..	...	...	3	2	...	...	...	...	...	...	...	...	...
15—20 ...	...	2	...	...	..	...	...	..	...		...	.	...	...	...	...	...	...	...	...	...
20—25 ...	...	...	2	...	...	...	...	...	...	...	..	...	...	...	...	...	...	3	...	...	...
25—30 ...	...	...	...	..	...	...	...	.	...	...	...	...	...	...	...	4	...	...	...	4	...
30+ ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4+	...	...	...	4

Difference between Lowest's Highest Class.	XIV.		XV.		XVI	XVII.		XVIII.		Total.		Tract XIX.				Tract XX.		XXI.	XXII.		XXIII.
	R.	J.	R.	I.	R.	R.	I.	R.	I.	R.	Others.	R.	I.	M.	T.	R.	I.	R.	R.	I.	R.
0—5 ...	...	...	...	...	...	...	2+	3	3+	3	4	...	...	...	3	...	...	...	...	...	...
5—10 ...	3	...	...	...	..	...	...	...	...	4	3	2	...	...	...	...	...	...	...	2	...
10—15 ...	...	...	...	...	..	3	...	..	...	4	...	..	...	3+	...	...	...	3+	3	...	3
15—20 ...	...	3	..	...	3	...	...	...	...	1	2	...	...	...	...	2	...	...	...	...	...
20—25 ...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...
25—30 ...	...	...	...	...	...	...	...	...	...	12	2	...	...	...	...	...	2	...	...	...	...
30+ ...	...	...	4	4	...	...	...	...	...	1	3	...	3	...	...	...	...	...	...	...	...

Difference between Lowest's Highest Class.	Total.		Previous Total.		Sum Total.	
	R.	Other.	R.	Other.	R.	Others.
0—5 ...	...	1	3	4	3	5
5—10 ...	1	1	4	3	5	4
10—15 ...	3	1	4	...	7	1
15—20 ...	2	...	1	2	3	2
20—25 ...	...	...	1	1	1	1
25—30 ...	..	1	...	2	...	3
30+ ..	...	1	1	3	1	4

Abbreviations.—R.=Rainfall. M.=Mayin. T.=Inundated. I.=Irrigated. S. I.=Pipe and Spring.

PERIYAKULAM SETTLEMENT.—*Dry crops. Difference tract by tract, between outturns of lowest and highest classes shown as a percentage of outturns of lowest class.*

Difference.	1-N.		1-S.		2		3-N.		3-S.		4-N.		4-S.		5		6-N.		6-S.		7		8		9-N.		9-S.		10-E.		10-W.		11		12		
	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	
1	2		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	
Not more than 25 per cent. ...	2+	...	...	...	2+	...	2	..	O	...	...	...	O	..	...	...	O	...	...	...	O	...	2+	...	O	...	2+	...	...	...	...	...	2	...	O	...	Millet.
From 25 per cent. to 50 per cent.	...	3	2	3	..	...	...	3	...	3	...	4+	...	..	...	...	...	3	..	4	...	...	...	...	...	..	...	2	3	...	2	3	...	...	...	3	
From 50 per cent. to 75 per cent.	..	...	...	...	...		...	...	...	4	...	...	...	...	...	4	..	...	...	...	...	...	...	4	...	3	...	...	...	3	..	...	...	...		...	
From 75 per cent. to 100 per cent.	.	...	...	...	...	...	...	...	..	...	..	...	...	..	2	...	...	...	3	...	...	...	.		...	...	..	...	...	...	..	...	...	4	...	...	
More than 100 per cent. ...	.	...	...	...	...	3	...	...	...	...	3	...	...	4	...	...	...	...	...	...	...	4+	.	...	...	...	...	...	...	...	...	...	...	...	...	...	
Not more than 25 per cent. ...	...	...	...	3	...	...	...	...	2+	...	...	..	...	...	2	...	O	...	...	...	O	..	2	...	...	3	2+	...	...	...	2	...	O	...	...	2	Early Sesamum.
From 25 per cent. to 50 per cent.	...	...	...	...	2	..	2	4+	...	...	2	..	...	...		...	...	..	2	...	...	4	....	4	2	..	..	3	3	...	...	2	...	...	3	...	
From 50 per cent. to 75 per cent.	.	..	...	...	...	3	...	...	..	3	...	...	...	3	...	...	...	4+	...	4+	...	..	...	...	...	...	...	...	...	3	...	...	.	4	...	...	
From 75 per cent. to 100 per cent.	2	3	...	..	...	...	..	...	.	...	.	...	2	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	.	...	.	...	
More than Rs. 100 per cent.	...	...	2	..	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

Difference.	13-N.		13-S.		14		15		16-W.		16-E		17-N.		17-E.		17-S.E.		17-W.		17 S.W.		18		19-S.W.		19-S.		20-N.		20-S.		21		Abstract.		
	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	LY.	Y.	4	3	2
1	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Not more than 25 per cent. ...	O	2	2+	3	...	..	...	...	...		O	...	...	...	..	...	...	...	2	3+	2	...	2	...	2	4+	O	O	3+	3+	2	...	...	...	1	4	13	Millet.
From 25 per cent. to 50 per cent.	...	...	...	...	2	...	3+	...	...	...		3	...		3		2	3+		..	...	...	...	...	...	...	...	...	...	...	...	...	3+		1	11	5	
From 50 per cent. to 75 per cent.	...	...	..	...	...	...	...	4	...	...		..	...	..	.	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	.	4	2	1	
From 75 per cent. to 100 per cent.	...	...	...	...	...	...	...	..	...	3	...		..	...		..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	O	3	2	
More than 100 per cent. ...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	4+	...	...	...	...	...	...	...	...	..	..	...	...	...	...	...	...	3	...	...	4	5	O	
Not more than 25 per cent. ...	2	...	2	...	...	3+	3+	...	2+	2+	2	...	O	...	2	4+	2	...	2	3+	2	...	..			O	2	O		3+	...	2+	O	...	1	6	17	Early Sesamum.
From 25 per cent. to 50 per cent.	...	3	...	...	2	...	...	...	..	...	...		..	...	...	...	...	3	..	....	..		2			...	...	...	...	...	...	...	...	3	5	9	
From 50 per cent. to 75 per cent.	...	...	...	...	...		...	...	...	...	..		...	2	...	..	..	...	...	...	...	.	...	...	...	...	..	..	...	...	...	...	...	3	3	5	1	
From 75 per cent. to 100 per cent.	...	...	...	4	...	...	...	4	...	...	...	...	...	...	...	...	..	...	...	...	2	..	3	...	...	...	...	...	...	...	3	...	...	3	3	3	
More than 100 per cent. ...	...	...	...	...	...	...	...	..	..	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	1	2	1	

APPENDIX V.—REFERENCE PAGE 15.

MEIKTILA SETTLEMENT.—*Comparison from Tract to Tract of Yields of Sessamum and Rates proposed.*

Tract.	1-N.		1-S		2		3-N.		3-S.		4-N.		4-S.		5		6-N.	
	Yield	Rate	Yield	Rate	Yield	Rate	Yield	Rate	Yield.	Rate.	Yield	Rate.	Yield.	Rate	Yield	Rate	Yield.	Rate.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Class 1	4·44	1·50	3·80	1·25	3·00	1·50	4·43	1·75	4·51	1·75	5·50	1·50	5·61	1·50	6·76	1·50	4·04	1·50
Class 2	3·16	·75	3·55	·75	2·00	·75	3·22	1·00	3·04	1·00	3·60	1·00	4·10	1·00	4·88	1·00	3·04	1·00
Class 3	2·70	0	3·22	·38	2·00	·38	3·87	·50	2·34	·38	2·83	·50	3·51	·50	3·97	·50	2·31	·50
Class 4	0	25	0	·25	0	·25	3·37	·25	0	·25	2·33	·25	0	·25	3·53	·25	2·61	·25

Tract.	6-S.		7		8		9-N		9-S		10 E		10-W.		11		12	
	Yield	Rate	Yield	Rate	Yield.	Rate.	Yield.	Rate.	Yield	Rate	Yield	Rate.	Yield.	Rate.	Yield.	Rate.	Yield	Rate.
1	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Class 1	4·17	1·50	2·00	1·00	4·33	1·25	4·60	2·50	3·70	1·25	4·24	1·25	3·47	1·25	3·86	1·50	3·17	1·25
Class 2	3·17	·75	1·50	·50	4·01	·75	4·19	1·50	3·58	1·00	3·60	·75	2·50	75	3·73	·75	3·30	75
Class 3	2·17	·50	1·71	·25	2·59	·38	4·10	75	3·54	50	2·69	·25	0	·38	2·26	·38	...	·38
Class 4	2·48	·25	1·45	0	3·43	·25	0	·25	·25	·25	0	·25	0	·25	2·05	·25	...	25

Tract	13-N		13 S		14		15		16 W		16-E.		17 N		17-E		17 S E	
	Yield	Rate	Yield.	Rate.	Yield	Rate.	Yield	Rate.	Yield.	Rate.	Yield.	Rate.	Yield.	Rate.	Yield.	Rate.	Yield.	Rate
1	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Class 1	3·59	1·25	4·80	1·50	4·72	2·00	5·63	1·25	5·18	1·7	·26	1·75	4·81	1·25	3·32	1·50	3·67	1·50
Class 2	2·07	75	4·73	1·00	3·91	1·00	4·28	·75	5·75	1·00	3·85	·75	3·10	·75	3·26	1·00	4·01	1·00
Class 3	4·52	·25	3·07	·38	3·92	50	3·77	·50		·50	2·42	·50	.	·38	2·65	50	2·92	·50
Class 4		25	2·45	·25		·25	3·20	·25		·25		·25		·25	2·81	·25	...	...

Tract	17-W.		17 S W		1 S		19 S.W.		19-S		20-N.		20-S.		21	
	Yield.	Rate.	Yield	Rate.	Yield	Rate.	Yield	Rate	Yield.	Rate.	Yield.	Rate.	Yield.	Rate.	Yield	Rate.
1	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Class 1	5·27	2·00	5·29	2·25	5·26	1·50	5·48	1·50	3·75	1·25	3·65	1·00	3·24	1·25	...	3·00
Class 2	4·87	1·00	2·90	1·00	4·33	·75	.	1·00		...	4·30	·50		·75	3·96	1·50
Class 3	5·56	·50	0	·50	1·90	38	..	·50	...	...	3·35	·25	...	·25	2·55	·75
Class 4	..	·25	0	·25	..	25	...	·25	...	...	..	·25	...	·25	...	·25