THE PROBLEMS OF THE FIELD MAN.

Need of Soil Definition.

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The problems of the soil survey field man are proportional to the lack of knowledge of soils. In soil surveying as in any other field of endeavor where we deal with natural objects, the more we know about these objects the fewer problems offered in studying and classifying them. The field study of soils, as a separate science, is a comparatively recent development. It is a science that has come into being largely through soil survey work, but the art of soil mapping is as yet far from perfection. The reason is obvious. Our field knowledge of soils is as yet too limited, in spite of the great progress that has been made in recent years.

The criteria by which soil units are separated, identified and described are not as yet clearly defined. In fact, the soil survey work has not been properly understood or appreciated because the factors which are used in the classification of soils have never been accurately stated. Different factors are given varying prominence by different surveyors, and the separation of soils is often not upon parallel lines or lines of equal significance. Origin, mode of formation, color, physical properties are some of the factors variously stressed by different workers. There is yet, too much vagueness in the minds of most soil men as to what characteristics or peculiarities should be considered in recognizing soil differences. Textural differences have been well defined and are easily determined. In fact some of the separations which are now being made have been carried to such a degree of fineness that there is very little, if any, appreciable agricultural differences between some of the classes. (ex. sandy loam, vs. loamy sand).

But how about such characteristics as color, arrangement of soil horizons, structure of soil material (compaction, porosity, etc.) and the segregation of iron? To these characteristics no such exact divisions or limitations have been applied as to the textural, although they are of equal and even greater importance in soil differentiation. It should be agreed that the structure of the soil is of more importance than color in soil differentiation. Color is influenced more or less by local conditions but the structure of the soil is an expression of the cumulative effects of all the agencies of weathering. In general, each horizon of the soil profile should have a thickness of at least three inches before it is recognized as a soil characteristic for differentiation. Soils with imperfectly developed horizons should be distinguished from those that show distinct stratification. Compaction is a characteristic that must be held distinct from permeability in soil identification. In all soil grouping any variation in the number, texture, color, arrangement and compaction of the different horizons must be considered a soil difference. Mottling as a characteristic in soil definition has received varying degrees of attention.

* In the absence of the author this paper was read by Mr. H. G. Lewis of the U. S. Bureau of Soils.

These and many other factors must be clearly defined and arranged as to their relative importance for soil identification. In the present system of soil mapping a standard as to color and the various physical properties has been adopted for each soil unit or more particularly for each soil series. A comparison of this standard to the soil unit as mapped, frequently shows a wide variation. It is to be expected that the ideal of a type as held by one man will not always be identical with that of another surveyor. Also, because of the variability of soils, a certain range of variation must be allowed for each soil unit, but such variations should not be fundamental soil differences. (Ex. in loess region all black soils sometimes called Marshall, although sub-soil varies from friable brown silt loam to compact, stiff gray clay.) New men in particular, and even experienced men when working in new territory, generally have difficulty in determining the factors (aside from texture) that should be recognized as giving rise to soil differences. There is as yet a lack of uniformity of conception as to color and the relative importance of structure. The relation of these characteristics to topography, drainage, and chemical composition must be better understood. To attain this end, greater consideration must be given to studying the soil as it is---its profile, its structure.

In the soil mapping of the past, the identification and grouping of soils was considered mainly from the viewpoint of forces that have acted to develop the soil rather than from the viewpoint of actual differences in soil itself. Thus we now speak of glacial soils, loessial soils, etc., and consider each group distinct from the other, although, each may have soils that are practically alike in all physical and agricultural characteristics. There is need of a clearer defining of characteristics that give rise to soils differences. With greater and more definite knowledge of these factors the soil survey men will have less trouble in identifying and establishing the various soil types and soil series, and what is of more importance, the soil mapping will be done on a more consistent and uniform basis.

Personal Problems.

The soil survey is a comparatively young institution with a relatively small number of workers. This condition is largely responsible for the small number of experienced men who must act as instructors. (The majority of new men are left to absorb the method of soil mapping from contact with the older men in the Bureau). The nature of the field work is so rigorous that it appeals primarily to young men, and few reach middle age before having abandoned soil surveying for less strenuous or more remunerative labors. Many take up soil surveying for the opportunities of travel it affords, and are not vitally interested in the work itself. All this has resulted in a rapid turnover of workers, so that there are few old men, but many new ones, and this at a time when soil surveying is in its formative stage.

The result has been that many of the soil surveyors have never received adequate training. It is the opinion of the writer that rarely does a new man do reliable and accurate work without at least two years of experience. The inadequacy of old men to train the beginners has resulted in much poor work, and in many cases delayed the attainment of efficient mapping by the beginner. It may not be possible for soil survey organizations to give preliminary training to new men before sending them to do field work. But greater effort should

be made to place the new man with experienced men for two or more seasons. Moreover, only such of the older men should be selected as leaders that are recognized for their careful work and for their willingness to make an effort to impart their knowledge to the beginner. It should also be the function of the Soils Departments in the Agricultural Colleges to train men for soil survey service.

It is unfortunately true that beginning soil survey men have not always received good training. The ideals of the new man are formed from the man in charge of the party. If the latter does careless work, knows little about soils, or over emphasizes features that are of minor importance in soil mapping, the chances are that the new man will adopt similar methods and may never outgrow them. For example, in the survey of a certain Missouri county the party consisted of an experienced Bureau man, and a state man, a beginner. It was the opinion of the older man that a spotted map,--one that showed many small and irregular areas,--was indicative of accurate and detailed work. The soils in the county are rather uniform over large areas, i.e. the same type frequently covers several square miles. Moreover, the region is largely undeveloped and cannot be traversed in detail. The soil map would indicate that the soils of the county are very complex, that there are many small variations and that these are most numerous near the roads. It is obvious that with such training the new man got some very erroneous ideas as to soil mapping. Fortunately, he was a bright fellow and within a year or two overcame his early handicap and developed into a good soil surveyor.

Another party, also in Missouri, did much of the soil mapping in their room. The forenoons usually were spent going over a section of country, but the mapping, i.e. the platting of the soils, was done after they got home. A good memory is essential to a soil surveyor, and no doubt these men had it, but an examination of the soil map shows that in a number of instances their memory failed them.

There is a tendency that is all too common among many field men to give too much attention to the merely mechanical part of soil mapping and too little time and thought to studying the soils. In the majority of areas surveyed it is necessary to construct a base map. In order to have an accurate base map, the traverse work must be done carefully. The desire to have good closures particularly in long traverses, frequently takes so much of the surveyor's interest that he gives little attention to the mapping of soils. He loses sight of the primary object. In effect he is a cartographer rather than a soil surveyor. (For example, a field man in Missouri made a traverse approximately 20 miles in length--at the same time mapping the soils. In traversing the last 2 or 3 miles he became so interested in having a good closure, that he failed to make a single soil examination and only indicated such soil boundaries as were due to topographic differences.) Others study the map more than the soils. The desire to construct an attractive map is frequently at a sacrifice of accurate soil mapping. These tendencies could be overcome in part if the field men were supplied with accurate base maps so that all their attention could be given to the mapping of the soils. Base maps must be accurate, otherwise they are useless. The newer topographic sheets generally are very satisfactory.

Relation of the Soil Survey Organization to the Field Man.

The nature of soil survey work requires that the field men are widely

scattered in small groups or pairs. They are not closely connected to the central organization, and they stand alone in a field of activity that is not always understood or appreciated. They are denied the stimulating influence that comes with association of fellow-workers, and their work is not under sufficiently careful surveillance of the organization that employs them. These conditions, to a very large measure unavoidable, have a tendency to lessen the enthusiasm and loyalty of the field men for their work. Soil surveyors as a class have shown a professional devotion that in many respects is remarkable. The majority of field men feel, however, that their relation to the central organization is too impersonal. Greater enthusiasm would be inspired if occasional comments were made on their work--good work commended and poor work criticised. More frequent visits by inspectors and others engaged in soils work is suggested. This would promote a better esprit de corps.

With greater enthusiasm there will come a deeper interest in soil study. Soil surveyors feel that they have not yet been taken into the confidence of Experiment Station workers. They feel that their effort is not looked upon as being of equal importance or as scientific as that of the laboratory worker. I think we should insist that the field study of soil is as scientific as that of laboratory studies. A recognition of this fact is essential to the development of soil science. There is need of a more "scientific spirit" among field men, and this spirit should be encouraged by the soil survey organizations. When such a spirit exists, it is inevitable that good soil mapping will be done.

THE FIELD MAN'S GREATEST PROBLEMS.

By A.E.Taylor, Scientist in U. S. Bureau of Soils.

The work of the field man lies largely in the preparation of a map, showing the location of the various soils in a given area, and a report describing these soils.

It is particularly desired that a detailed map and report of an area will give to the reader a comprehensive and clear description of the soil conditions for each forty acre tract. To produce a map of this quality it is necessary that the field man should come in close contact with the soil, preferably walk over it, in order that he can be reasonably certain as to its character on practically every acre. The distance between foot trips should be governed by the frequency of soil changes. Where soils run rather uniform one might walk across the area about every quarter of a mile, but where they are very changeable it would be better to cross the area about every forty rods and do much zigzagging so as to be sure of the location of soil boundaries. Accuracy of location is an absolute necessity in mapping the boundaries between soil types.

Coming in contact with all of the soils of an area would be useless unless the field man recognizes differences in the character of the soil material. He should study, most assiduously, many soil sections, making his observations as searching and exhaustive as is possible for him under the circumstances. Because of a failure to observe important differences in the soil sections, it has, in cases, required more work to revise than to do the mapping in the first place. For instance silt loam soils having lower subsoils ranging from rather friable silt loams to hard, compact silty clay loams have been mapped as the same type. Farmers knew there was considerable difference in the agricultural value of these soils, and many of them, if asked, would have pointed out the difference in the lower subsoils.

Field men should make inquiries of the county agents and better farmers as to their soil difficulties. Sometimes a satisfactory solution is unknown. The difficulty may be of a nature that the field man by a comparative study of soil sections in relation to productiveness, a study of the various methods or experiments already tried out or by other lines of investigation, might throw new light upon the solution.

Good soil mapping is always characterized by consistency. Inconsistency in mapping labels work as unreliable. It is a good habit for a field man to frequently revisit different parts of the area he is mapping to be sure that he is consistent with himself in the determination of the color, texture, structure and topography variations. The more persons engaged in the mapping of a particular area the more complicated the problem of consistency becomes. The man in charge cannot exercise too much care in going over the work of the other members of the field party to see that the mapping is consistent. A very undesirable practice is where several additional men join in a field party for the last few weeks of a season to help finish the work. This always causes an inconsistency in the mapping, because men who have not been working in the same area cannot possibly adjust themselves to a certain system of mapping within such a brief period. There is considerable difficulty in keeping the work consistent in adjacent counties. After the one county is completed usually some years elapse before another is started. Owing to changes in the nomenclature,

improved methods of mapping and a new field party a very marked inconsistency is sure to develop. If the field men in charge of the work in the various states would do more or less mapping in all the areas of their respective states, and would go out beyond the county lines for 2 or 3 miles and make a careful study of soil conditions they would often be able to discover what might be a very important soil type in some of the unmapped counties, but would have such a limited development in the county being mapped that, without this additional knowledge, it would be combined with some other type.

A mistake often made by field men is a failure to recognize properly a new soil condition. Rather than give it a number and map it separately it is tucked in with whatever type it seems to resemble most closely. Possibly a number of these soil differences, all worthy of recognition, are included with other types in mapping and not even as much as a note is taken to describe them. In consequence the soil map and report are incomplete and will in course of time need revision. A field man should map and describe carefully all soil types, phases and questionable phase differences occurring in his area. It is not his place to combine, but rather he should take up the matter of field combinations with the inspectors.

A question, that can be very profitably discussed at this meeting by field men, is how to carry on detailed and reconnaissance surveys most expeditiously under various road and topographic conditions? In this paper your attention is called to only one exceptional condition--where a morainic belt, 10 miles long and 4 miles wide had such an intermingling of soil types that on an average, eight distinct soil areas were shown on a 40 acre tract. Owing to the smallness of type occurrences it was found impossible to insert the type numbers in the area as indicated on the map, nor could these be indicated on the margins of the map on account of the great number of small areas. This difficulty was successfully overcome by the adoption of symbols to take the place of numbers. These symbols could be legibly inserted in a one acre space as indicated on a map, having a scale of one inch to the mile. The map never had to be oriented in order to read them. A particular symbol was used for a certain type for only one day at a time. This was done because the number of symbols was very limited and a certain type might be well represented in one locality and not at all in another. The blank was used for the type, which would likely be encountered in small areas most during the day, the period for the one of next most frequent occurrence, and then the multiplication sign, dash and radical for other small areas.

Means of transportation is an important problem. Today, a soil man is almost compelled to operate a car, and many times it might seem to him that the greatest problem of the field man is to keep the thing running. In one instance less than 20 minutes have been lost in the field for the last seven and one-half months on account of car trouble. The party, before beginning the season's work, engaged a first-class mechanic, who was trustworthy, to see that the Ford was in good condition. To avoid tire trouble five demountable rims, an equal number of first quality tires and an equal number of the best of inner tubes were used. Where one has to drive over unimproved roads they sometimes get stuck, and have to lose several hours in getting the necessary assistance to pull out. Under such circumstances a light fence stretcher, log chain, rope, sledge and three and one-half feet of two inch pipe for an anchor will enable one to pull the machine, even though it is resting on the axles in the mud, at the rate of one foot a minute. In well forested areas a tree can usually be

found to take the place of the pipe anchor.

When a man has finished his field work and is ready to write his report, he may find his notes lacking in fullness and incisiveness. The character of his report will be largely dependent upon the kind of notes he has taken. Those notes written while making the observation are by far the best. Notes are usually too general. The field man should ever strive in describing a soil section or any other phenomenon for accuracy. However, he should not content himself with being a mere recorder. Much in a soil section is obscure. One should not only see what spontaneously arrests his attention, but he should draw out from what he observes inferences and interpretations to promote further observations. When these suggestions have arisen, the field man should seek out the phenomena that discriminate between them, and under such stimulus, phenomena that would otherwise escape his attention at once comes into view because his eye has been focused for them.

To summarize:- it is deemed important that a field man should understand thoroughly what it means to come in close contact with the soil while mapping, to make accurate observations of soil sections, to learn from farmers about their soil problems, to be consistent in mapping, to properly map and take notes on new soil conditions, to proceed most expeditiously in making maps under various road and topographic conditions, to handle a car in field work and to take good notes.

DISCUSSION OF THE FIELD MAN'S GREATEST PROBLEM.

By W. E. Tharp, Scientist in U. S. Bureau of Soils.

The field man's problems vary, necessarily, with the character of the area being surveyed, the conditions under which the work is being done, and in no small degree upon the individuality of the field man himself, but one question almost invariably arises: "How much detail shall I try to show".

We shall attempt no specific advice, or give any general recommendations for nothing along these lines would be essentially new to the field men assembled here. We will however venture a few suggestions which possibly may be helpful in some instances.

The Bureau's scheme of classification admits of a high degree of differentiation but, as we all know, it is impracticable to indicate all the soil variations easily recognizable in the field. The best of mapping consists essentially in grouping into types and phases the closely related ones. Some features must be given clear recognition, others more or less subordinated. Time, cost and human limitations must be taken into consideration. At this point the field man might ask, In what way can I make this survey best serve the agricultural interest in this particular area? What problems are arising with which some soil distinctions are, or seem to be, related? Are there not some features within the scope of my work which seem especially desirable to indicate?

In most of the older counties of the Northern States the use of lime, the increasing interest in commercial fertilizers, the adaptation of soils to particular strains or varieties of crops, and the necessity of conserving soil fertility on the thin or eroded lands, are out standing problems. If all the technical soil distinctions could be expressed all these agronomic problems, so far as soil surveys apply to them, would be provided for, but as previously mentioned this is not entirely practicable. But if it is possible to twist our field methods a little bit and thus make the map show more clearly some of the soil variations connected with these problems it seems desirable to do so, even if some technical distinctions have to be slighted.

The recognition of topographic phases seem desirable whenever they may express appreciable differences in land values. The careful delimitations of muck deposits, of permanent marshes, and of bodies of water, seem well worth while. As an official reference for non-resident land owners, investors, and financial institutions, the soil maps should show the boundaries of these features with as much accuracy as possible.

In the survey of undeveloped sections of the country a sort of moral responsibility rests upon the field man in his classification of the land. A detailed map carefully executed places him in the clear. This is not always practicable, but a separation of agricultural and non-agricultural lands as measured by present economic conditions should always be made. Here again the judgment of the field man as to land values should take precedence over his knowledge of soils. One of the first interests his report will probably serve is the highly important one of assisting people not previously acquainted with the region in the selection of land for a farm home.

In conclusion it seems desirable to lean toward the so-called practical side of soil mapping whenever a choice must be made between this and the extreme of technical separation.