

REPORT OF PROF. G. E. PATRICK.

IOWA AGRICULTURAL COLLEGE, }
Ames, December 29, 1893. }

SIR :—I have the honor of presenting to you the following report of the work done by the chemical division of the Survey during a portion of the past year.

The work was begun in a small way in May (1893), analysis of a few samples—as many as were sent in—being made during that and the two following months; but regular, consecutive work was not begun until toward the middle of August, when the analysis of the coals of the state was taken up.

COAL ANALYSES.

This constitutes the greater part of the chemical work thus far done. The samples were collected by others and were sent to me by the Assistant State Geologist, Dr. Keyes. The methods of analysis are given below and the results obtained have been reported to Dr. Keyes, and will doubtless be included in his report.

METHODS EMPLOYED IN THE ANALYSIS OF COALS.

The samples having been finely pulverized and tightly bottled, the several determinations are made as follows:

MOISTURE. Five grammes, spread thin on a watch glass, are dried for one hour at 103 to 108 degrees C. The loss is reckoned as moisture.

VOLATILE COMBUSTIBLE MATTER AND COKE. Four grammes of the coal are heated in a closely covered platinum crucible over a low Bunsen flame until the volatile matter is nearly expelled, then over a blast lamp for one and a

half minutes. The loss, less moisture, is the volatile combustible matter. The residue in the crucible is the coke.

TOTAL SULPHUR. Eschka's method, modified by substituting K_2CO_3 for Na_2CO_3 and by increasing the proportion of the flux. (Hundeshagen, Jour. Anal. Chem., v. VI, p. 385.)

SULPHUR IN SULPHATES. Calvert's method: two grammes of the very finely powdered coal are heated with a concentrated solution of sodium carbonate in the steam bath, with frequent stirring, for at least ten hours — longer if needful for complete extraction; after filtering, SO_3 in the filtrate is determined as usual.

SULPHUR IN SULPHIDES AND ORGANIC COMPOUNDS. This is found by deducting the sulphur in sulphates from the total sulphur.

ASH. Three grammes of the coal are heated gently over a low flame until smoking ceases, and then at a red heat until combustion is complete.

During the coming season the heat values of these coals also will be determined by means of a calorimeter; and, at the request of Dr. Keyes, portions of all the samples analyzed have been preserved for this purpose.

MISCELLANEOUS.

Under this head are included analysis of limestones, fire clay, sandstone, glass sand, and other materials named below. All of these samples were sent me from the office of the Survey, by the Assistant State Geologist. All samples received to date have been analyzed and reported upon.

SUMMARY OF ANALYSES.

The list of samples analyzed to date is as follows:

173 samples of coal.

2 samples of alleged ironstone.

6 samples of limestone.

1 sample of bituminous shale.

1 sample of fire clay.

1 sample of sandstone.

1 sample of glass sand.

1 sample of cement or stucco material.

SOIL INVESTIGATIONS.

Work in this line has progressed but little farther than the collecting of samples of soil from various parts of the state; no analyses have as yet been made, but this work is now being entered upon.

To the chemist was intrusted the collecting of the soil samples, as well as their analysis.

In investigating the soils of a state it is obviously a matter of first importance, as well as one of considerable difficulty, to secure for laboratory study samples that are truly representative of rather large areas of country, rather than merely of small fields or single quarter sections. To be able to select localities to furnish such representative samples, collectors must be well acquainted with the soil of extensive areas in various parts of the state. For traveling collectors to obtain this acquaintance would involve the expenditure of much time and money. These considerations led the writer to the thought of enlisting the aid of intelligent and painstaking farmers, already known to him as such, through association in certain experimental work in which the farmers have co-operated with the Experiment Station.

To about sixty of these farmers, located in nearly as many counties, the following circular letter was sent:

IOWA AGRICULTURAL COLLEGE,
LABORATORY OF AGRICULTURAL CHEMISTRY.

DEAR SIR: The Directing Board of the State Geological Survey have made arrangements whereby, under authority of the Board of Trustees of the College, a considerable number of soils of the state are to be submitted to chemical analysis, at this laboratory and under direction of the writer. Pursuant to this plan, Professor Calvin, Chief of the Survey, has requested me to secure for this purpose samples of such soils as it seems to me desirable to investigate.

The most economical way of getting these samples is through correspondence, and I naturally turn for assistance in this matter to the farmers, and others, who

have already shown their interest in the scientific study of agricultural problems by co-operating with me in the study of sugar beet culture in Iowa.

My purpose in this letter is to ask you if you will assist in the present work, by collecting samples of the representative soils in your vicinity and sending the same to me by express — charges to be paid at this end. If you reply (by enclosed postal) that you will, I will immediately send you printed directions telling exactly how to proceed in taking the samples. Do not collect any until you receive these directions. The labor of collecting the samples will be but trifling, as I shall only wish to study the *best* and the *poorest* soils that occur, over any considerable area, in your vicinity. Those who collect samples will receive credit therefor in the Report, when published; and what is more, will feel the satisfaction of having helped in a good cause.

A reply by return mail will be greatly appreciated. Yours truly,

G. E. PATRICK.

As expected, responses came promptly from nearly all expressing a willingness to give the desired aid. To each thus responding, the following circular was immediately sent:

DIRECTIONS FOR TAKING SOIL SAMPLES.

The soil selected for sampling should be as far as possible in its natural condition, not modified by recent applications of manure. The purpose is to obtain a sample representing the *best* and another representing the *poorest* soil that occurs *over a considerable area* in your vicinity — i. e., in your own or adjoining townships.

Having selected a field or area, of several acres' extent if possible and apparently uniform in character, *that can be taken as representing either type* (the best or the poorest soils, using those terms as just explained) proceed as follows to take samples from five (5) different spots, quite widely separated within the field or area — the five samples to be subsequently mixed together to produce a true average sample.

Remove decaying grass, leaves, etc., from the surface. Then take the sample in form of a block or cylinder, with vertical sides, down to a depth of nine (9) inches by measure — provided the true soil or "surface soil" extends to that depth, as it does nearly everywhere in Iowa. If in any case it should not extend to that depth — as shown by a marked change in color and character — then take the sample only to the depth of said change, measuring and noting down the depth. But in no case take the sample to less than six inches' depth, however shallow the soil may be, for above that depth it cannot escape the plow. * * * As the most practicable way of taking a sample, I advise using a common spade, taking care to dig down *vertically* and to take for the sample *all* that comes from the hole.

The object of taking five samples is to eliminate local variations and thus secure a true average of the field or area.

Mix the five samples together very thoroughly, on a large cloth or stout paper, crushing the larger clods with the fingers. When the mass is thoroughly mixed fill from it one of the paper bags which I send you by this mail, tie the bag at top as though it were of cloth, and attach a tag bearing your own name (the collector's) and also the word Best or Poorest, as the case may be. * * * The aid which you will thus render in promoting the chemical study of Iowa soils will be greatly appreciated by the undersigned and will be duly credited in the report of the work when published. Yours truly,

G. E. PATRICK,
Agricultural College, Ames, Iowa.

About two weeks after this circular was sent out the ground became frozen, rendering the collection of samples somewhat difficult; this probably accounts for the fact that only twenty-eight of the farmers have sent in samples—the others will probably do so in the spring. These twenty-eight sent fifty-eight samples of soil, from twenty-six different counties of the state. Following are the names, addresses, and number of samples sent by each:

J. F. Grawe, Waverly, Bremer county, two samples.

Geo. Gadbois, Salix, Woodbury county, two samples.

Jas. Sullivan, Stuart, Guthrie county, two samples.

Fred Direlbess, Logan, Harrison county, two samples.

A. M. Bingham, Jessup, Buchanan county, two samples.

W. H. Steimel, Eagle Center, Blackhawk county, two samples.

J. Wernli, Le Mars, Plymouth county, two samples.

Jos. Beath, Corning, Adams county, two samples.

S. S. Beers, Judd, Webster county, two samples.

David Wild, Springville, Linn county, two samples.

E. F. Iseminger, Marathon, Buena Vista county, two samples.

J. M. Lehman, Cumberland, Cass county, two samples.

W. C. Goodrich, Lehigh, Webster county, two samples.

Jas. Pemble, Wapello, Louisa county, two samples.

C. C. Plater, Red Oak, Montgomery county, two samples.

W. O. Tice, Monroe, Jasper county, three samples.

John Barnard, Muscatine, Muscatine county, two samples.

S. H. Tally, Belleville, Jefferson county, two samples.

H. Gadmer, Quinby, Cherokee county, two samples.

H. A. Saunders, Grand Junction, Greene county, two samples.

John Klein, Keota, Keokuk county, two samples.

C. D. Miller, Denison, Crawford county, two samples.

D. D. Ronan, Waukon, Allamakee county, three samples.

J. O. Overholt, Havelock, Pochahontas county, two samples.

L. Skeels, Wallingford, Emmet county, three samples.

T. H. Drake, Fruitland, Muscatine county, two samples.

S. G. Tyrrel, Riceville, Mitchell county, one sample.

Judd Storm, Nevada, Story county, two samples.

Work upon these samples is now begun, and the results will be reported in due time. Respectfully,

G. E. PATRICK.

TO PROFESSOR SAMUEL CALVIN,

State Geologist.

A
GEOLOGICAL
MAP OF
IOWA
BY
C.R. KEYES
1894.

