

That such ideas as these are totally at variance with the truth, none who have ever studied the subject thoroughly can for a moment doubt.—It is a perfectly safe conclusion when any man asserts, for instance, the entire simplicity and ease of analysing a soil, that his analyses would not be of a very accurate description.

Chemistry is a science that must be studied earnestly and perseveringly, just like any other branch of knowledge which has a wide range. In order to know what is in a soil, and to determine what are the quantities of its constituents, an intimate acquaintance is necessary, not only with the substances themselves in their almost endless relations and changes; but with great numbers of other substances from which they must be distinguished, and with which they are likely to be confounded by an inexperienced person.

We can only determine quantities by means of certain chemical processes: most of these depend on the addition of other bodies, to a solution in which are dissolved those that we wish to separate. Suppose now these bodies which are thus added to be impure: obviously the whole result will be erroneous; the chemist then, must know how to distinguish with certainty between pure and impure substances, and to tell what the impurities are.

When he knows all of these things, there are still a great number of minor but very important points, that require attention. He must use absolutely pure water, must filter his liquids through paper that has very little ash, and must weigh everything upon a balance that is sensitive to at least the tenth of a grain.

I might go on and mention other requisites to a good analysis, but those already noted are sufficient to show, that great care, skill, and experience, are absolutely essential in this business; that uneducated persons must constantly be making mistakes of the most flagrant description.—The worst difficulty of all is that in many cases, not having even knowledge enough to know when they have gone astray, they actually rely upon their own work as trustworthy, and lead others to do so too.

Results produced by such proficient are unhappily too common, and are always productive of claim wherever they go. The farmer who knows even little or nothing of even chemical names, perhaps is not competent to judge of a good analysis; he cannot tell the difference between a pretender to scientific knowledge, and one who really knows something that is true and valuable. He takes these erroneous analysis as his guides, and probably falls at once into some serious mistake, by attempting to alter the supposed constitution of his soil. After he has been disappointed in this way a few times, he is very apt to condemn all scientific agriculture as ridiculous, and of no avail for any practical purposes.

What I wish to impress in this connection, is the necessity of caution in coming to such a decision. Let it first be considered, if the experiments to be carried out have been properly

and carefully made, so that there could be no mistake in that direction. Let it next be ascertained that no physical obstacles are in the way of success, and if it is found beyond doubt that there has been no error from either of these causes, then let the farmer conclude—not that chemistry and scientific investigation are useless; but that the results of analysis obtained were wrongly interpreted, or that the examinations were incorrectly made.

There is truth in science, but it is not every one who can draw it out; and the proper course in cases of an unsatisfactory nature, is to distrust the man and not the general principles.

It is easy to show that there are very serious difficulties, other than those which have been already mentioned, in the way of making perfect analyses. We will take soils as an instance.—Where mention has been made of the inorganic substances in soils, as in Table I, p. 60, it must have been noticed that the proportions of some of them were quite small, so much so as to seem of little importance. It was, however, explained that the presence of these minute quantities was absolutely necessary, so much so that our cultivated crops would not thrive without them.

Half a pound of phosphoric acid in 100 lbs. of earth, is a very unusually large proportion, even in our most fertile soils. Half a pound in 100, makes but a small figure when we come to give the composition of a single pound; it is only five thousandths of a pound. Now one pound is a far larger quantity of material than can be used with safety for an accurate analyses. The instruments employed, and the various methods of operation adopted, are such as, in nearly all cases, to forbid the use of a large bulk or weight of the substance to be examined. Consequently only a small fraction of a pound is worked upon, and from this all of the bodies present are to be separated, even down to small parts of a single grain.

It becomes at once obvious, that very great care and very good apparatus, and no small portion of skill, are requisite to an analytical chemist in the determination of these minute quantities. If any of the chemicals used in the analyses, are impure, the impurities of course have an influence upon the result: hence the chemist must know the properties of many other bodies beside those upon which he is at work, in order to be sure that he is not adding something which will prove injurious to the accuracy of his results.

There is still another, among many points that might be noticed in this connection. The processes necessary for the determination of potash, soda, and phosphoric acid, when all are present and in combination with other bodies, are in the least degree complicated and difficult. Many ways of determining them are described in books; some of these are altogether faulty, and all require much skill and knowledge on the part of the operator, that he may avoid serious errors. These bodies, it will be remembered, are among the most important that soils contain, because they