vision repay with overflowing measure all the labor they have cost, for it is then that the miracle is wrought and the eyes of Peter Bell are opened.

Permit me one more word. Science lays her spell upon us because she lives and moves. It ought to be clear that the advancement of knowledge is not less vital to the educational interests of the university than are its conservation and dissemination. Are we quite sure of ourselves in this regard? We have heard of late an intimation that the universities have not been so much leaders of progress as "depositories of stationary thought." Well, depositories of stationary thought the universities indubitably have been, like the monasteries that they succeeded as centers of learning; and they have thus served as the guardians of a treasure that is beyond all price. But this is only half the truth; for it has long been one of our most cherished ideals that universities should also be the natural homes of original discovery and productive scholarship. The real universities—and I believe that our own is one of them—have demonstrated by their example that the atmosphere which these things create make teaching live and move. But even as we are insisting upon this we find ourselves wondering how our ideal is likely to fare hereafter in the continual expansion of modern universities and the multiplicity of new demands upon their teaching resources. Our pedagogical and executive machinery is admirably organized. It has developed a high degree of efficiency. Will it be efficient enough in the future to maintain an atmosphere in which scientific research and creative scholarship may freely breathe? It is easier to ask hard questions than to answer them. This one, nevertheless, we shall not escape; for the day is coming when the leadership of the universities in intellectual progress will depend on the reply that we and those after us shall make; and not our words, but our deeds will speak for us.

Edmund B. Wilson
Columbia University

PLAIN WRITING[1]

Two years ago I spoke to the American Mining Congress on the subject "Plain Talk"—both preaching the use of direct statement and trying to practise what I preached. Of late my thoughts have turned more and more to the need of the use of popular language in stating technical results; hence this afternoon I venture to discuss plain writing from the standpoint of a government scientist. For twenty-odd years my association with scientists has been fairly intimate, and though I may not qualify in plain writing myself, I can claim large acquaintance with both the written and the printed page whose meaning is far from plain.

At its best, science is simple; for science is not much more than arranging facts so as to set forth the truth. Scientific thought is exact and direct, and scientific writing must therefore be accurate and to the point. The scientist should think directly and with the precision of one of the instruments of his trade, and above all his language must present that thought exactly.

In scientific writing this need of exact statement has led to the use of special terms, words that keep their razor-edge because used only for hair-splitting distinctions. In a certain degree this adoption of words not commonly used is unavoidable and therefore defensible. Yet the practise is carried to an extreme and far too often the result is a highly specialized language so distantly related to our mother tongue that as a preliminary qualification the writer has to pass a civil-service examination and the reader usually finds himself "shut out" and facing a "no admittance" sign unless he happens to possess the degree of Doctor of

[1] Meeting of American Mining Congress, San Francisco, September 13, 1915.

Philosophy in that particular branch of science.

Mind you, it would be folly to throw away these tools so well fitted for special purposes; yet it is no more the part of wisdom to put them to every-day uses. The task for the scientist is to decide when to use his technical terms and when to talk United States. Of course, any writer's first duty is to be intelligible. Choice of language thus resolves itself largely into an understanding of the audience. If a scientific investigator desires to announce his discovery to his fellow workers, he does well to use those exact terms that carry the same shade of meaning the world over and indeed may have the same form in several languages; if, on the other hand, his results have immediate value for the mine operator or the prospector, the geologist does not and can not accomplish his purpose unless he writes in plain language, using words possibly less exact but surely more understandable.

It may be that I have stated the case too simply, so that this matter of plain writing may seem altogether easy, yet making out the prescription is always much easier than effecting the cure. Indeed, I suspect the difficulty is largely an internal trouble with the author, so deep-seated that my simple remedy of fitting the language to the reader does not reach it.

Sir Clifford Allbutt in his "Notes on the Composition of Scientific Papers" lays down the plain rule: "Take pains, therefore, with yourself first, then with your reader." His idea that clear thinking must be the first step to plain writing of course deserves our endorsement, based upon experience. How common is the sad discovery that a piece of obscure writing is simply the product of roundabout reasoning or twisted thinking. Printer's ink, in whatever amount used, unfortunately possesses no magic properties as a reagent for clarifying muddy thoughts. Yet no doubt it sometimes happens that some of us try to cover up with long words our uncertainty in thinking. So in preaching reform in scientific publications, those of us who are doing the work must realize that plain thinking comes first. There's the rub!

It is therefore not a coincidence that some of the deepest thinkers in geological science have also possessed a literary style conspicuous for clarity of expression. On the other hand, some authors whose English needs the most editing are equally careless in the quotation of facts determined by others and indeed in the statement of their own observations. I mention this simply to show that I am strong in my belief that plain writing is not something beneath the plane of endeavor of the scientific investigator—indeed, it is something so hard to attain that the most of us need to aim high, to raise our standards of scientific thinking. The use of common words is worthy of any writer if his purpose is to transmit thought.

The discussion of plain writing at this time is not academic, because my real purpose is to take this opportunity to announce to you the policy of the United States Geological Survey on this subject. Our explorations, surveys and investigations are in the public interest only as results are made public. This policy is as old as the Geological Survey itself, but several things have given a special impetus to the development of this policy. Beginning in August a year ago, a large volume of inquiries from producer and consumer of minerals came pouring into our office, and as never before the Geological Survey became a kind of "central" to the mineral industry. This opportunity for a larger service to the public not only resulted in gratifying relations with a large number of correspondents, but the rendering of such service has proved instructive to the public servants charged with the duty. Many of us on the Survey staff have acquired a keener realization of the need not only of giving the public the facts, but also of making those facts intelligible and useful to the citizen who may lack professional training in geology or engineering.

Another line of this larger service has been the issue of four guidebooks to this great western country, in which the purpose has been to inform the traveler concerning the resources of this part of our country as well as to unfold to him in attractive form its fascinating geology. The effort to meet the public need of

authoritative information of this type seemingly has met with success, and other guide-books in this series will follow in other years. More than that, however, the reflex influence of this innovation is already felt, and the evident appreciation by the general public of this type of popular description is encouraging the Survey writers. The educational responsibility of this federal service is being more fully realized, and we intend to give much more attention both to the simplification of the language of the professional publications and to the issue of reports that shall be popularly descriptive and instructive without loss of exactness. Even if plain language is used our reports should be no less efficient vehicles for professional discussion or for the announcement of geologic discoveries.

For thirty-six years the United States Geological Survey has reached an ever widening circle of readers, and even in the early years of the Survey's life King and Emmons and Gilbert gave to the West the results of their work in strong and forceful English. Yet with the growth of the organization and the development of the science the tendency toward highly specialized writing has been too marked and the present plea for plain writing has become necessary. The government scientist has at least two obligations: first, that of making his investigations more and more exact in method and direct in result; second, that of making his product, the written report, such as to meet the needs of not only his professional associates but also the general public. It is our ambition that the reports of the United States Geological Survey shall be written in the language of the people.

George Otis Smith
U. S. Geological Survey

SOIL FERTILITY

As long as a soil continues to produce moderate crops, the question of its fertility arouses no concern, but when the yield falls below normal the reason for this decrease is immediately sought. Until a short time ago it was believed that this difficulty admitted of an easy solution, but when the farmer saw his crops decreasing and sought the cause, the type of answer which he received depended on whether he consulted a soil physicist, a soil chemist, or a soil bacteriologist. In any case it was generally conceded that the supply of "plant food" had been exhausted and the only question remaining was how to replenish it.

The soil physicist saw in this undesirable condition, from his standpoint, a violation of the maintenance of one of the following requirements for the soil under examination. First, the proper temperature had not been established in the soil to admit of the rapid growth of crops; second, the proper ventilation of the soil had been interfered with, either by a change in the porosity of the soil due to physical or chemical changes, or to the deposition and retention of the by-products of the crops; or third, the plant did not receive sufficient moisture and this was due to the non-operation of one of the following agencies, osmosis, surface-tension or transpiration. The importance of this third point is very apparent when we remember that all plant food taken from the soil must be in solution.

The following quotation from Johnson's "Agricultural Chemistry" illustrates the standpoint of the chemist of a few years ago in regard to soil problems.

> The art of culture is almost entirely a chemical art, since nearly all its processes are to be explained only on chemical principles. If you add lime or gypsum to your land, you introduce new chemical agents. If you irrigate your meadows, you must demand a reason from the chemist for the abundant growth of grass which follows.

The extension of such ideas as are contained in the above quotations led to the belief that there is a certain definite relation between the productiveness of the soil and its content of nitrogen, potash, phosphoric acid or other chemical constituent, and many persons believe at the present time that from a chemical analysis of a soil the analyst can tell just the kind and amount of fertilizer to be added in order to increase its productiveness.

With the introduction of more exact methods in bacteriology and the perfecting of bacteriological technique, all of which has taken place