Some Limits to Popular Science

Travelers in foreign countries seem sometimes to believe that they will be perfectly understood if they speak loudly and clearly enough in their own language. Such a fancy is harmless enough, but it rightly makes ridiculous those who display it. Yet there seems to be growing up a similar belief which is scarcely less ridiculous but not entirely harmless—a belief that all the mysteries of science can be made clear to the layman if only scientists will take the trouble to explain themselves in very simple terms. In the circumstances of today it is undeniably desirable that the general public should have an appreciation of science in the widest sense—its discipline and its methods, its results and applications, its promises and its dangers, its organization and its practitioners. This aim is laudable, but no useful purpose is served by propagating the belief that there are no limits to the success which may be achieved.

Clarity of exposition is certainly of the greatest possible assistance here, as in the communication of any other kind of knowledge, and it is undoubtedly true that scientists have much to learn not only in explaining themselves to the layman but in explaining themselves to each other. Nevertheless, there are limits to what the most lucid thinker and writer can do when seeking to enlighten untrained and often unreceptive minds. This is true of all complex human activities, and it is curious that while it is so generally recognized in many other spheres it is so often ignored in discussing the popular exposition of science. An analogy can perhaps fairly be drawn from the ancient and widely played game of chess. All the world may appreciate that it is skill and patience which lead to victory or rejoice in the success of their local or national champion. But no one would suggest that the spirit of the game, the danger of a particular situation, the precise point at which the play turns in favor of one player or the other, and all the fine points mastered only after years of play, can be appreciated by those who do not know even the basic moves assigned to the pieces. This fact is accepted by those seriously minded newspapers which regularly have columns on chess—such columns are always written in a style designed to convey as much information as possible to the enthusiast, but make no pretense of catering for the uninitiated. This does not, of course, mean that nothing interesting can be said about chess in more popular publications. There, however, the emphasis must rightly be placed upon those limited parts of the subject which a wider readership will find interesting and intelligible. The result itself, the idiosyncrasies of the players, unusually brief or protracted play, can all be touched upon. But none would suppose that this kind of comment tells us wherein lies the absorbing interest of the game for those who play it or anything of the complex tactics which determine success.

The analogies can be multiplied almost endlessly. Can the tone-deaf appreciate a fine orchestral performance, or any but a trained jurist appreciate the subtle points of a complex legal argument? Again, however, there are parts of such matters which anybody with an inquiring mind can grasp even in the short time it is possible for the ordinary person to devote to the pursuit of, to him, relatively minor interests. Similar arguments can surely be applied to the popular exposition of science. Parts of the subject must surely remain a closed book to the layman virtually by definition; when he can read these pages he is no longer a layman but entitled to call himself a scientist, whether he reaches this status by institutional or private study. This is a fact implicitly recognized by all the most successful writers of science for laymen: their genius has been not in explaining science as a whole, but in explaining those parts of it which can be made intelligible and interesting to the ordinary person with very limited time to spare.

Generally speaking, unfamiliar matters, whether scientific or otherwise, can be understood so far as the reader can relate them to his own general knowledge and experience. He can appreciate the general nature of many major scientific discoveries, and he can understand their likely effect on his daily life if they were to be widely applied. That he ought to have this kind of knowledge is generally agreed. A high rate of technical development seems, whether we like it or not, to be the only answer to the acute problem presented by a world population that is both increasing rapidly and clamoring for a higher standard of living. To achieve this development, the widest and speediest possible dissemination of technical knowledge is essential, since the necessary decisions on policy are still largely in the hands of nonscientists.

Even on the purely factual side of science, however, there are many important discoveries which it is virtually impossible to explain to the layman in anything but the most superficial way, for they are too remote from his experience and ordinary modes of thought. It is, for example, surely no accident that while the major applications of chemistry are quite widely known, for they form part of our daily lives, the whole realm of theoretical chemistry has been virtually untouched by the popular expositor. The elegance of an ingenious organic synthesis or the nature of the dynamics of a complex reaction cannot be conveyed to those with no prior knowledge. The public, for example, may accept the fact that the elucidation of the structure of vitamin B_{12} is a great achievement, but they cannot be expected to see wherein its greatness truly lies.

There are other barriers to popular understanding. Science would be an uninspiring business if it consisted of no more than the collection of new facts and their application for practical ends. These are but the beginning and the rounding off of a complex process. To be manageable, facts have to be marshaled within the limits of general laws, from which in turn new facts may be deduced. Practical applications almost invariably call for the solution of problems scarcely less difficult—and, indeed, often more difficult—than those involved in the original discovery. Many nonmaterial factors also are involved: imagination to see the significance of facts, pleasure from the pursuit of knowledge for its own sake, the satisfaction of the creative impulse. It is surely unduly optimistic to hope that mere clarity of writing will suffice to convey to the layman a proper understanding of the whole complex intermingling of the material and the abstract which constitutes modern science. How long is it seriously supposed he can give to reading about this vast subject? Surely it is at the very best no more than will enable him to scratch at the surface, for even the individual scientist can today apply himself to only a very small part of it.

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In talking of the popular exposition of science it thus seems easy to confuse the part with the whole, to suppose that the present vast outpouring of popular scientific material represents all aspects of scientific activity. The point is not merely of academic interest; it is of considerable practical importance also. For better or for worse, scientists have a great, and still rapidly increasing, influence on world affairs; one can see no limit to the material achievements of science. Not surprisingly, there are grave misgivings about this, for it is only too apparent that evil as well as good can spring from scientific progress. That the great majority of scientists are interested in applying their work only to beneficial ends may be well known in scientific circles, but it would be complacent to suppose that all the world is convinced of this. Nothing could be more damaging to good relations between scientists and the public than a suspicion that they are deliberately hiding knowledge of their activities by describing them in language so esoteric and obscure as to be incomprehensible to any but their fellow experts. It would be far more useful, and less productive of disillusionment, to teach that science is in reality a strict discipline demanding patient application. If he really wants to understand science, and not merely its more obvious results and applications, the layman must be prepared to study it seriously. How this is to be achieved, however, in an age in which there are so many interests to occupy hours of leisure, entails argument far too controversial and complex to be embarked upon here. It does seem, however, that the time has come for more general introduction of science into primary education.

In the years to come, the world will inevitably turn more and more to science to solve the grave practical problems which beset it. The response will certainly be wholehearted, but one would have to be very optimistic to believe that there will be no disappointments. These will be all the greater if it is believed that science is really a relatively simple matter, for it could make failure seem the result of indifference or preoccupation with more sinister research, rather than of the intrinsic difficulty of the problems themselves. A limit to the extent to which science can help the world is set by the number of people who are able and willing to give the time and trouble necessary to acquire scientific knowledge appropriate to their purposes. This applies, of course, not merely to science but to all learning: superficial knowledge will never be an effective substitute for real understanding. It is rather easy to forget that it is not on science but on scientists that we depend for the solution of some of our pressing problems.

Edmund T. Whittaker, Mathematician and Historian

It is not easy to convey to those who did not know Edmund Taylor Whittaker the particular quality of the man that most impressed itself on his friends. One knew, of course, of the exceptional breadth of his scientific knowledge and the profundity of the mathematical problems to whose solution he had made such distinctive contributions, but, in his presence, these receded into the background without sacrificing the hue that they imparted to everything he said. He wore his great learning lightly like a flower. The simile indeed is singularly apt. I have happy memories of a visit to his Edinburgh home during which he showed to me and explained the peculiarities of more varieties of delphiniums than I knew existed. And when he turned to matters of philosophy or physical theory, one was hardly conscious of any significant change in the conversation. He had a way of speaking of the most abstruse developments in science as though they were things of the everyday, commonsense world that quite naturally fell out as they did. You wondered why you had ever thought them difficult.

Scarcely less striking than the depth and scope of his knowledge was his readiness to share it. When one needed to know whether a particular mathematical problem had been solved and, if so, where the solution was to be found, it tended to become a habit to write to Whittaker, and the reply was invariably prompt, full, and illuminated by comments of his own. He was equally familiar with the oldest and newest work on the subject, and it was a matter for wonder how he could keep abreast of the world-wide developments that were taking place in the extensive fields of his interests. In this respect, he was probably unique. By his death, an unparalleled spring of knowledge has been sealed up.

Whittaker grew up in such an age as he would probably have chosen had the choice been offered him. He received his introduction to mathematical physics at the culmination of the Newtonian epoch, when, in the words of Kelvin, only two clouds obscured the beauty and clearness of dynamical theory. Those clouds grew into the principle of relativity and the quantum theory, which were to fill the sky and leave the Newtonian firmament a memory as irrecoverable as the crystalline sphere of Ptolemaic astronomy. Whittaker was not only a spectator of this process but a participator in it and, in his last years, was almost the only survivor who could claim this distinction. He felt that this laid on him an obligation to make available the facts from his own knowledge as well as from the already published records.

He had already, in 1910, written a masterly history of ether and electric theory up to the end of the 19th century, and, by the time of his retirement from the chair of mathematics at Edinburgh University, the need for a revision of this valuable work created the occasion, and his newly acquired leisure the opportunity, for a new work that would not only review the field of the old but would also show how the subject developed into relativity and quantum physics and would carry the story forward to the year 1950. The first volume of this undertaking, which appeared in 1951, was a revised and amplified edition of the older work. The second, which was to have been the final one, came out in 1953, but the amount of material was so great that it had to be restricted to the years 1900 to 1926, and the work of the remaining years was reserved for a third volume. This, alas, we fear was never completed, but it is greatly to be hoped that enough was accomplished to make publication possible in due time. It is a work of the greatest value, not only to the historian but to all who seek a clear understanding of one of the most remarkable adventures in the history of thought.

Of Whittaker's original contributions to pure and applied mathematics, it is impossible to speak both briefly and intelligibly, and perhaps this is fortunate since, fundamentally important as they are, it was the catholicity of his mental