

*Medical Communications Need New Approaches**

Robert O. Becker, M.D.

The growth of science in scope and import has been one of the most prominent features of the past few decades.

According to Professor de Solla Price, historian of science at Yale University, science has followed an exponential growth curve for the past several centuries with a doubling both of known facts and numbers of scientists every 15 to 20 years.

More than 90 percent of all of the scientists who ever lived since the dawn of civilization are alive today and their activities are now affecting the life of every one of us in one fashion or another.

In general, we can be fairly confident in believing that this has been for the betterment of humanity—despite some of the results of over-enthusiastic technology such as air and water pollution, pesticides and population explosions. It would appear that further improvement in the lot of mankind depends upon the continued growth of science. Certainly solutions to the problems created by science must come from science, particularly from medical science and the application of all other disciplines to the problems of human biology.

However, it is apparent that today this vital growth is seriously threatened by a breakdown in one of its most essential elements—communications.

The life blood of science is the free and open exchange of information between scientists. Knowledge, regardless of its intrinsic import, that is not communicated to the community of scientists is valueless; and yet such communication is becoming increasingly more difficult.

While personal exchanges through meetings and symposia are currently much favored, the enduring record that makes up the corpus of scientific knowledge is still the printed pages of the scientific journals. To accommodate the increasing flow of information, resulting from the growth of science, the journals have proliferated in an uncontrolled fashion until they number nearly 100,000 at the present time. The scientists, including the physician and medical researcher, appear to be drowning in a mass of information, daily growing ever larger and increasingly more impossible to assimilate.

It would appear quite possible that the inherent limitations in our present system of communications may well be the limiting factor that will shortly inhibit the growth rate of science and may ultimately result in its decline.

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Increasing Interdependence

The increasing interdependency of individuals and nations is actually a reflection of the same process occurring in the field of science. The really great advances and new ideas are the result of interdisciplinary communication—for example, the present growth of molecular biology is the resultant of the application of many disciplines to the problems of biology.

At the same time, international communication in science is assuming increasing importance, not only from the viewpoint of its necessity for the most rapid increase in scientific knowledge, but, of equal importance, because the supranational character of science makes it the one area in which the international cooperation can take place.

Obviously the key element in both of these aspects of present day science is communication. This must be not only open and free but more importantly, it must be effective. The medical researcher, for example, must be able to keep informed of the new developments not only in his own field, but also in other fields of medical research, and perhaps most importantly, in other scientific disciplines as well.

This must be accomplished, not on the restrictive basis of national or related national literature, but on a global scale. It should be obvious to the reader (if he has progressed this far) that today this is an impossibility. The average medical or paramedical researcher is barely able to peruse that set of journals in his own language that deals with his own specialty, without jeopardizing his actual laboratory or clinical activities. Like the growth of a tumor that has exceeded its circulatory supply, the growth of science is about to develop areas of necrosis, which can only be detrimental to further growth and development.

Most Pertinent Question

In dealing with this situation, I believe that the most pertinent question is: does this volume of publications actually represent the true state of science or are these papers published for other than scientific motives? If the true state of science justifies this immense output, then new methods for effective communication must be devised. If, on the other hand, the publication:scientific fact ratio is markedly unbalanced in favor of the publication, then science must examine its set of ethical values.

It is my thesis that science, during the past two decades, has been functioning in an ever increasingly artificial state. The result of this has been an artificial growth in “scientific” communications which has brought us to the brink of a breakdown in this most important aspect of science itself.

Medical Communications Need New Approaches

It seems to me that all of the individuals and organizations that constitute the body of science today have responsibilities which they are evidently failing to meet in this regard.

Responsibility can be assigned, on the one hand, to the individual scientists themselves and, on the other, to the journals, their editorial boards and referees. The individual scientist obviously has a responsibility for effectively communicating his discoveries to his contemporaries. This is particularly important in the medical sciences where this information may on occasion be of immediate clinical import. In addition, in almost all sectors of scientific research, financial support is furnished by public funds and the public is entitled to expect not only that each project be pursued with devotion but also that the results be disseminated to ensure their incorporation into the body of knowledge where they may assist in the general growth of science.

Therefore, one of the most important functions of the scientist is to communicate and, in effect, to add to the body of scientific knowledge. In performing this function, however, the scientist must act in a responsible fashion, publishing when he has something of importance to say, and refraining from publishing for other motives. A cursory inspection of the contents of most current journals reveals a lamentable lack of responsibility in this regard.

The majority of papers are pedestrian, uninteresting, or repetitious, minor variations on old themes. They are poorly written, obscure and obtuse, and their titles are misleading, bearing little relationship to their contents.

Reports of significant work are frequently fragmented, apparently to produce as many papers as possible from one study, or they are skimpy, premature "preliminary notes" designed primarily to denote priority.

The most surprising aspect of this sorry state of affairs is that it is both recognized and condoned by such eminent authorities as Professor Price and Sir Theodore Fox, former editor of the *Lancet*. In recent writings they both conclude that a scientist's worth is determined primarily by the number of papers he publishes and that the function of the journals is not to inform or to serve as repositories of knowledge, but to serve as devices for the establishment of priority rights.

They both believe that communication between scientists is best done by means of personal meetings or participation in symposia limited to "peer groups" in specific specialties rather than in the pages of the journals.

Invisible Colleges

I believe that this can only lead us back to the days of "invisible colleges," further compartmentalization of science and eventual stagnation. Professor Price even applies scientific, mathematical methods to an analysis of scientific stature and publications and can derive formulae proving his point. I believe this

reasoning to be both fallacious and dangerous. The concept that each paper, however insignificant, constitutes a quantum of knowledge is patent nonsense.

As Price himself states: "Who dares to balance one paper by Einstein against even a hundred papers by John Doe, Ph.D. on the elastic constant of the various timbers (one to a paper) of the forests of Lower Basutoland?" However, he goes on to prove that this constitutes only a small error which can be ignored.

Price's formulae and conclusions have been widely applied and since they are mathematical and scientific, they have been practically accorded the status of natural laws, but it should be noted that the data upon which his formulae are based, are drawn largely from the years prior to 1950.

When some future historian of science reviews the situation in the year 2000, he may well record the decades between 1950 and 1970 as a period of abnormal growth, not in accord with Price's formulations. In those years, the recognition of the fact that a nation's power resided in the state of its scientific technology resulted in the influx of unprecedented sums of money into the research establishment.

The resultant apparent growth of science has been enormous and probably, on Price's indices, more than the normal 15 year doubling. This wealth of science has brought its problems; primary among them is the influx of individuals who are basically non-scientists, engaged in research for the power, position and prestige that accompany it.

What Is The Key?

The key to the present situation is the answer to the question: why is it necessary for a scientist to publish as much as possible and to establish priority for his discoveries however insignificant? The obvious answer is that academic status and research funding are based almost completely on the "publish or perish" concept.

Almost all scientists are associated with academic institutions of one sort or another and since their status (both economic and social) is determined by this value structure, they "play the game." The number of people "playing the game" has more than doubled from 1950 and I believe that this has occurred predominantly in the John Doe population, rather than in the Einstein population. The error inherent in Price's formulae has increased to an alarming degree.

I would like to think that the deans and boards of trustees will some day acquire the intelligence to realize that the mission of their institutions is to instruct, and while occasionally the best teachers are the best researchers, this is not uniformly so. this utopia would appear to be far in the future and unattainable under the present system.

This unlimited, uncontrolled increase in "information," much of which is valueless, has made it extremely difficult to detect that information which is of

value, and has made interdisciplinary communication practically impossible. We all have a tendency to seek refuge in various “cure-all” schemes, the current one being computer retrieval of information.

This unfortunately has several serious defects limiting its utility, not based upon limitations of computer retrieval methods, but rather upon what the computer retrieves. The indexing of papers in the computer memory is based upon various key words or “descriptors” derived from the publication titles. Unfortunately, in a majority of papers the title is similar to the cover of a paperback book—promising much but delivering little. Secondly, this method presupposes that the enquirer knows exactly what he wants—and needs nothing more.

In short, the computer systems are no better than the men who design them or the papers that they index. Therefore, the efficiency of all computer based systems is totally dependent upon honesty and restraint in publication.

What Can We Do?

If we cannot alter the current value system of a direct proportion between number of papers and worth of a scientist what can we do? Obviously, if we all refused to play the game and published only when we had something of significance to report (and took pains to do so in a reasonably literate fashion), the number of published papers would decline markedly.

While this may also seem utopian, I believe there is sufficient urgency in the situation to require that we examine our motives for publication in at least a half-way objective fashion.

Unless the scientists themselves begin to assume their responsibilities in this area, science will soon be subject to the entropy principle and arrive at a state of uniform, unimportant mediocrity, with the bulk of publications classifiable as trivia.

At this point, science would, in all probability, assume the status of a public utility and be subject to automation procedures, with the computer, the ultimate compendium of trivia, integrating and directing the research.

All of the fault does not lie with the scientists and their academic peers. The journals, their editorial and review boards and their publishers have aided and abetted the establishment of this false sense of values. With few exceptions, the journals accept or reject a paper on the basis of evaluation by their review boards, the editor assuming little or no responsibility in this regard.

Since the review boards are composed of the eminent authorities in the field representing the “Establishment,” they are unavoidably conservative, resistant to change and intolerant of views from outside of their specialty.

Max Planck once said, “A new scientific truth does not triumph by convincing its opponents and making them see the light but rather because its

opponents eventually die.” We all recognize the truth in this statement. How much faster and more efficiently could science progress if it were not true?

Sir Peter Medewar has said that the value of a scientific paper is proportional to its explanatory value, “The degree to which it resolves what has hitherto been perplexing.” I believe that the corollary of that statement is equally true: the value of a paper is directly proportional to the extent to which it casts legitimate doubt on cherished dogma. But to get such a paper published, despite impeccable documentation and experimentation, is a practical impossibility.

Second Game

As a result, the younger investigator will play a second game, as well as the one called “publish or perish.” This one can well be called “don’t rock the boat,” and it involves staying within the presently defined safe boundaries, not doing anything really new and referring to the papers of your peers as often as possible. Eventually he acquires status and joins the Establishment, losing, along the way, his illusions and ideals. The sense of excitement, wonder and awe is gone from his research and is replaced by competitiveness, status seeking and the quest for power. Not only will his research lack creativity but he will also do his best to discourage it among his younger colleagues.

Another defect in the journal system currently in force is the almost total lack of true interdisciplinary journals. It is my firm belief that future progress in science, particularly the life sciences, can come only by increasing application of other disciplines to biological problems. This necessitates a place where the current frontiers of all sciences are displayed for all scientists to see and integrate with their own. Almost without exception, the newly founded journals are more restrictive in scope than their predecessors.

Doctor Fox, feeling that the scientific journals are primarily for the establishment of priority claims has proposed the founding of scientific newspapers to serve as the conveyors of interdisciplinary information. He seems to feel that the scientist is incapable of writing in a lucid, interesting fashion, and that this task is much better done by editorial staffs.

This seems to me to be an unnecessary complication of the situation. Scientific and medical newspapers are of value, but they are not bibliographic repositories of information. Their value is ephemeral and should be limited to reporting the “news,” a different sort of information than scientific reports.

There is, however, a place for publications of this sort; the popularity of *Scientific American*, *International Science and Technology*, and *Medical World News* bears this out. Nevertheless, these publications are neither written for the scientist nor to serve the function proposed by Fox.

The *Scientific American* is a reasonably accurate popularization of science for the educated layman; *International Science and Technology* is aimed at the

management and executive levels of science; *Medical World News* seems to come closest to Fox's suggestion but is aimed primarily at the practicing physician. In all cases these newspapers could be vastly improved in value for the researcher by including adequate bibliographies, adopting a volume format so that they actually constitute a repository of some sorts and by aiming at a more sophisticated reader.

This might actually be better accomplished by founding a new series of interdisciplinary newspapers, adequately staffed and edited, with lucidly written and illustrated papers, issued in volume sets and sufficiently accurate to serve as bibliographic references.

I believe that a real need exists for several kinds of this type of publication: a true interdisciplinary scientific journal (to supplement *Nature*, which is the only one presently in being), a biomedical interdisciplinary journal, a clinical medical interdisciplinary journal and perhaps even one presenting current research developments to the practicing physician in an understandable fashion.

Of course, with the increasing interdependence of science and government, a need has arisen for newspapers of primarily informative nature in this area such as *Scientific Research*. In addition, various groups of scientists working for government or industry require publications of the newspaper type that are not repositories of scientific fact but rather accountings of the newsworthy events in their area and forums for expression of pertinent opinions.

There is no reason why the publishers of scientific journals who, after all, have a considerable stake in the well being of the body scientific, cannot establish additional scientific and technical journals of a truly interdisciplinary nature. This would appear to be a much more rational approach than the constant founding of evermore restrictive type journals.

Independent Attitude

Along with this initiative on the part of the publishing and literary fraternity, one would hope for a more independent attitude on the part of the established journals with less reliance upon review boards and a return to the original purpose of the scientific journal, that of informing.

All sciences thrive best in an atmosphere of intellectual ferment and dissent. The publication of controversial papers is not akin to pornography, corrupting the minds of the young scientist, but is much more likely to result in discussion, experimentation, and reevaluation of established "facts"—procedures vital to the growth of science.

In short, it would appear that all of us, from the physician engaged in simple clinical research, to the sub-atomic physicist delving deeper into the stuff of the universe, are currently engaged in a gigantic game called "how to succeed in science by publishing papers."

Becker, 1966

The game is monstrously expensive, terribly complex and exceedingly dangerous to the future of mankind. Today, when the world as we know it, with all of its imperfections and inadequacies, is largely the product of science, all scientists might do well to adopt and follow a code of ethics similar to that of the physician.

Responsibilities Clear

The responsibilities of all of us are clear; all that is necessary is that we all make an attempt to assume them, at least in part. This is particularly true in the medical and para-medical sciences and in those sciences that are currently engaged in altering man's environment.

It has been said that education is too important to be left to the educators alone; perhaps the same can be said of science.

More practical, however, might be the statement that all sciences must be the province of all scientists. We cannot safely assume that the molecular biologists cum geneticists, for example, are simple, trustworthy fellows who wouldn't think of engaging in any activity dangerous to mankind, and as a result remain ignorant of what they are doing. Some of their current experimentation on alterations of viral genetics may well result in the production of entirely new diseases to which the human race has little or no resistance.

One wonders how many of the readers of this publication were aware of this and how many would subsequently voice their opinion. Sir MacFarlane Burnet did just this at one of the specialized symposia favored by Doctor Fox. It would surely have escaped notice by the rest of us had it not been picked up and reported by *Medical World News*—potentially an action of singular import.

Medical science, with its long traditions of service to humanity may be in the best position to lead the way out of the current chaos in communication which may be the forerunner of the death of true science.