

PEER REVIEW AND THE PROGRESS OF SCIENTIFIC RESEARCH

Dr. Jonas Salk developed the polio vaccine; the whole world has profited as a result. Dr. Salk's research exemplifies what I shall call Type II research. Type II research will undoubtedly continue to be the major concern of human society for it is usually Type II research that serves society's immediate needs. However, there is another type of research, which I shall call Type I, exemplified by the research of Louis Pasteur some 100 years ago. Pasteur completely contradicted the medical establishment of that day, showing that diseases like poliomyelitis were caused not by an imbalance of four "humors" (blood, phlegm, choler, and melancholy) as was then universally believed, but by microorganisms. It is clear that without the Type I research of Pasteur, the world would never have known polio vaccine or the other vaccines in whose development NIH played a major role.

The relation between Type I and Type II research thus resembles the relation between the spring and the river it feeds. As long as the spring of Type I research steadily flows, the river will continue to provide benefits to mankind.

Seen in historical perspective, Type I and Type II research are indeed complementary and mutually dependent; seen at close range, however, too often they exhibit not harmony but severe conflict. This is so because Type II research of the present generation primarily benefits Type II researchers of the next generation. To the present generation of Type II researchers, contemporary Type I research therefore appears a threat. It undermines current beliefs, and hence the prestige and credibility of scientists who make their living by teaching or research based on those beliefs. Since by definition Type I research is a rarity, it is not difficult to see how, in this conflict, the Type II research scientists, because of their great numerical superiority and visibility, have little difficulty suppressing Type I research. Indeed, it seems virtually miraculous that in Western civilization Type I research somehow has managed to survive thus far.

In the past, many factors contributed to this survival of Type I research. One was that as a rule this kind of research was not very costly—witness the observation of the motions of heavenly bodies, the voyage of the *Beagle*, the planting of peas. A second contributing factor was the scarcity of scientists. Both of these favorable conditions for the preservation of Type I research have changed. Today research is a highly expensive enterprise. And mass education has brought forth such a glut of scientists that success in the intensive struggle for research dollars and publication

space has become the determining factor for the survival of Type I scientists—and of Type II scientists as well.

It was in response to the dramatic increase in the volume of scientific research and the consequent competition for financial support and for publication that the opinion of experts or peers was sought in evaluating various ideas for research and scientific articles submitted to journals. Hence the creation of the peer review system. I believe that in a great majority of cases the peer review system has served well, and continues to serve well, in eliminating poor ideas and poor papers. Unfortunately, the system also threatens to curtail scientific innovation—and hence to obstruct major scientific progress.

This suppressive effect is all but inevitable, since the judgment of merit by peers can only be derived from the framework of accepted concepts. Thus peer review will function well in mature scientific areas such as physics and mathematics which, however, because of their very maturity, offer relatively little for the future. But the peer-review system functions poorly in young scientific areas such as biology and medicine which, because of their youth, offer most for the future. Since scientists in a more mature area tend to be more influential and more frequently listened to, their ready acceptance of the peer-review system might well have set the foundation for its currently widespread acceptance.

Once, however, we recognize the basically antagonistic positions of the "peers" and Type I research, the urgent need for a reform of the peer-review system becomes self-evident. One does not need to be a jurist to comprehend that in a fair and just system, one cannot use the opinions of a party to a dispute to judge the validity of the opinion of his antagonist. Yet this is what peer review amounts to when dealing with Type I research.

Equally urgent is the need for establishing an appeal mechanism, so that a wrongly "accused" applicant can defend himself.

The harm the current version of the peer-review system may do is by no means limited to causing a few scientists to be ostracized because of their pursuit of Type I ideas—ideas, that is, running counter to established concepts. The greater damage is to a whole generation of young scientists, who discover that the surest way to succeed in science is not to seek truth but to report only such findings and express only such opinions that are sweet to the ears and eyes of anointed "peers." When enough scientists choose that course, the credibility of all scientists will dwindle. In the long run, a retreat from science and from a free rational way of life may well follow. Hopefully, however, that will not be how the story ends.

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