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Research and Political Power

It is now widely accepted that research is the spearhead of the economic growth of a country, giving rise to new products, new industries, and new jobs. Over the last two decades, the pattern of industry of the more highly developed nations has altered massively in accordance with world scientific discovery, and increasingly countries and firms are concerning themselves with how much of their income they should invest in research.

This does not mean that economic strength is determined by the research expenditure of a nation or a corporation. Many other factors operate—availability of raw materials, investment capital, skilled manpower, and, perhaps above all, leadership. It is probably true, however, that the greatest economic gain comes to those countries which exploit research most quickly and most completely, rather than to those which contribute most to the world store of new knowledge.

This is especially so since it is still accepted throughout the world that the results of fundamental research should be published freely and internationally. The pool of common world knowledge is therefore there for all to exploit who will and can. It is frequently said that, until World War II, at any rate, the United States had the genius to exploit new discoveries more quickly than other nations, while the countries of Western Europe produced new science to a greater extent than other regions but failed to make full use of it. There is certainly much truth in this, but as science and industry become more complicated, exploitation and research contribution are tending to come ever closer together.

The fact is that very little of contemporary discovery in fundamental research can be put to productive use until much applied research has been undertaken. Fundamental research, applied research, technological development, and production are becoming more and more parts of the same spectrum of activity in the new science-based world into which mankind is emerging. This means that research power in the larger sense will, in the future, be more determinative of economic power.

While the economic significance of research has long been accepted, albeit in some places grudgingly, it is only recently that its political influence has become obvious. The atomic and hydrogen bombs dominate the foreign policies of the powers that possess them and influence greatly the foreign policies of countries which lack them. But even neglecting these scientific monsters, whether they are regarded as threats to the peace or as deterrents to war, modern warfare and defense have become so sophisticated in the technological sense with the numerous uses of radar, jet planes, guided weapons, proximity fuses, and so forth, that only countries possessing highly developed research resources and the elaborate industries supporting the defense program can feel secure and strong.

Political power is founded on economic and defense strength, both of which are increasingly dependent on research. It follows, therefore, that research power and political strength are now mutually dependent through a complex chain of cause and effect. This is recognized even by the politicians. In introducing a recent debate on foreign affairs in the House of Commons, Harold Macmillan, the British prime minister, said, "The

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scientist is always ahead of the politician." Scientific discovery has now an immediate and profound effect on foreign policy.

Research has always required the support of a patron. In the early days of the experimental method, the individual scholar often sought the support of the prince or man of wealth just as did Mozart and Hayden. Later, as the possible "uses" of research became recognized and needs became greater—also, one might add, as princes and millionaires became scarcer—patronage was taken over by industry and the state. It was not, however, until World War I that this became marked.

Germany was the first of the great powers to encourage and exploit science. The rise of German political power and scientific achievement followed the political unification of that country, a phenomenon which might easily be repeated if Europe as a whole now achieves a degree of political or at least economic unity. It is unlikely that Germany could have waged World War I, or at any rate have fought for a prolonged period, but for the practical method of nitrogen fixation, devised by Haber, and the chemical industry which applied it. Equally, on the other side, this war having proved itself, although by later standards only relatively, to be a scientific war, the British quickly discovered their lack of scientific resources and proceeded to build them up quickly. The rise of the very active British chemical industry received a great impetus from this, and on the Government side, the Department of Scientific and Industrial Research was created, as well as the first of the industrial research associations.

Until the outbreak of World War II, the concentration of research power was at least on the fundamental level in Western Europe, especially in the laboratories of Germany, Great Britain, Scandinavia, the Netherlands, and Switzerland. It is probable that this area was producing as much as 70 percent of the world's significant scientific output, although American science, particularly industrial research, was building up quickly during this time. The political strength of Western Europe during the same period was very great.

During and after World War II, great changes took place in the distribution of political power. The U.S.S.R. grew greatly in importance, Germany was defeated, while the political force of the rest of Western Europe, exhausted by war or occupation, declined considerably. At the same time, the United States developed to become the strongest world power. Research power too followed this trend. The total volume of scientific activity has increased everywhere, to a large extent because of direct or indirect government finance, and it has been exaggerated by continued defense preparations and atomic energy programs. Relatively, both with respect to pure and applied research, the scientific activity of the United States has soared in volume. Ewell has calculated that, of the cumulative total of money spent on research and development from the Declaration of Independence until the end of 1954, 45 percent was spent in the last 5 years of the period.

For the first time also, the U.S.S.R. has become a major force in science, and her acceleration, although starting at a much lower level, probably exceeds that of the United States. In Western Europe, there has been a great and healthy growth of scientific activity. The British atomic energy and aeronautical programs, for example, have been outstandingly successful. Germany has also made a remarkable scientific recovery since the war. It is clear too that in Europe there has been a substantial increase of facilities for the quick development and exploitation of scientific discovery. Nevertheless, the proportion of world research product coming from Western European laboratories has fallen greatly with the expansion of resources in the United States and the U.S.S.R, and this is in parallel with the declining political strength of the area.

It is difficult to give a quantitative estimate of these trends. It would be useful if some enterprising operational research scientist would analyze by region the number of scientific papers in the main abstract journals for, say, 1938, 1950, and 1956. It would probably emerge that Western Europe's share of research output had fallen from a prewar figure around 70 percent of the world total to below 40 percent of the much bigger amount today. With the impressively large Soviet effort in the training of scientists and technologists, we may expect the relative research effort of the U.S.S.R. to mushroom within the next 10 years, and by the end of that period, China and the other populous countries of the East will be occupied with research in a big way. Already the training of scientists and the creation of research laboratories is proceeding rapidly. Many interesting Chinese papers are now appearing in the Soviet abstract journals.

There is no evidence that scientific ability or even genius is the monopoly of any country or race. Indeed, it may well be that potential ability is spread throughout the human population more or less with a statistical uniformity, although, of course, opportunities to actualize it vary greatly on account of nutrition, environment, economic level, and educational possibilities. If these human potentialities were developed fully and research were spread uniformly throughout the world, the proportion done by the United States would be about 6 percent and that by Western Europe about 9 percent of the total. It is certainly not to be expected that this will happen, at least for many years to come, but nevertheless the drive to improve economic standards throughout the world and particularly the spectacular building up of educational and research resources behind the Iron Curtain is bound to produce shifts in that direction.

It takes 5 to 10 or more years for the results of fundamental research to develop economically in the form of new materials, instruments, or production methods, so that the next decade should see in full measure the fruits of the great upsurge of American science since the war, followed closely by that of the U.S.S.R. and later by China. The figures hazarded here may be inaccurate, but the relationship between research, political, and economic power is now so close that these undeniable trends command consideration by those who are concerned with scientific and educational policy.

As the total amount of research undertaken in different parts of the world increases, individual countries will become progressively less self-sufficient and will have to draw heavily on work undertaken abroad. With the open publication of research, this is at present outwardly the case. In reality, however, there is a great deal of unconscious and understandable nationalism amongst scientists. Journals published in one's own country are much more widely accessible than those from abroad, and this is enough to insure that domestic research results are read more quickly and more widely than those from abroad. Beyond this, language difficulties have a similar effect. It is doubtful whether more than a very small percentage of the results of Soviet research are yet used by the scientists of the United States or Western Europe. On the other hand, the U.S.S.R. and the satellite countries with their strong and centralized information services have a deliberate policy of full exploitation of world research. In the West, we are as yet hardly aware of the magnitude of this problem and have certainly not tackled it seriously.

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