



SCIENTIFIC RESEARCH IN THE FUTURE — A RADICAL VIEWPOINT

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During the last decade, we in South Africa, have experienced and have become part of a "scientific revolution". Most of the developed countries in the world are spending steadily increasing proportions of their national income on research. State finance is now an important factor, also in South Africa, in the growth and development of science. It is thus imperative that the benefits of scientific research to a country should receive attention.

Benefits of Scientific Research

Byatt and Cohen (1) lists in detail manpower and research benefits, the main types being:

- (i) Manpower benefits. The output from the Universities of graduates and post-graduates taught by those pursuing research.
- (ii) The benefits of applied and mission oriented research, i.e. benefits accruing where the area of application of research is known.
- (iii) The benefits resulting from the application in the economy of fundamental ideas discovered in basic curiosity oriented scientific research, either in this country or abroad.
- (iv) The cultural values of scientific research.

The first three types of benefits can be regarded as "investment" benefits and the last as "consumption" benefits. Research can be seen as a particular type of investment activity of a country. Basic scientific research (1) adds to the stock of useful knowledge which may be drawn on unpredictably in various ways and at various times in the future.

Investment in scientific research in the modern context must justify itself. "Firstly, scientific knowledge must be useful and secondly, marginal increase in expenditure in providing for scientific research should produce

as high a return over investment cost as marginal changes in other forms of investment activity." This statement of Byatt and Cohen leads one to the fact that such an "investment" should concentrate on the costs and benefits of marginal changes in research activity, i.e. what would the differential return be on the differential increase in investment?

Planning Scientific Research

Over the last decade or more, scientific expenditure in most developed countries in the world experienced a rapid growth. For that reason marginal benefits versus marginal expenditure became such an important factor. To obtain maximum marginal benefits with minimum marginal expenditure, it is imperative to aim for maximum efficiency in research. To be able to achieve such maximum efficiency it is required that proper planning of research should exist. Libik (2) maintains that "research planning is very different from industrial planning, as greater account has to be taken of the probabilities of reaching targets, and also of the special and rapidly developing rhythm of research as a whole".

The planning activity can be broken down into:

- (i) Setting of primary or alternative targets,
- (ii) Selection of a strategy according to the chosen target,
- (iii) Determination of detailed tactics.

According to Libik, who made a thorough study of scientific planning in most countries in the world, the consensus of opinion is now that it is impossible to make 10 or 20 year national development plans without estimating and analysing the likely progress of science.

It is imperative that the detailed achievement of science should be applied in every field

of economic planning. This implies that economic planners themselves should have a sound knowledge of different fields of science and their achievements. This is expecting very much, with all due respect to our present economic planners who probably do not have any thorough knowledge of modern operations research techniques. Without making some kind of estimate of the future development of basic sciences, it is impossible to plan production increases or forecast technical changes.

Future developments: curiosity research or directed research

At present, we are facing a world consisting of crisis problems. Urgent recognition of such problems as nuclear escalation, famine, participatory crises, racial crises, and what John Platt (3) refers to as the crises of administrative legitimacy, will probably dominate the need for basic research. From our present attributive viewpoint, many of the technological changes of the last 25 years are approaching certain "natural limits". Platt points out that "we may never have faster communications or more T.V. (i.e. in the U.S.A.) or larger and more destructive weapons or a higher level of danger than we have now."

It is suggested that nothing less than the application of the full intelligence of our society is likely to be adequate. The organisation of task forces of full-time inter-disciplinary teams for Social Research and Development are propagated by Platt, who has worked out crisis intensity charts for the U.S.A. and for the world. A copy of the latter chart of Platt is given in Table 1.

Platt suggests that the first step in crisis studies should be the organisation of intense educational discussion and education groups in every laboratory. Further possible developments would be the establishment of large research laboratories concerned with crisis problems.

A compromise viewpoint: research on crisis problems in the present economic environment

It is my personal belief that in our present economic environment in South Africa, we have the required dedicated manpower to become sensitive to crisis problems that face our country. It would however require that scientific management becomes sensitive to research demand (4) and "manage" their subordinate manpower accordingly to be able to produce the results which would solve crisis problems or assist the solving of such problems, not forgetting that short term economic factors cannot be neglected. The ideal would however be that each scientist doing research or applied research should become dedicated to playing a part in solving crisis problems in the spirit of the viewpoint of W.L. Rautenbach (5). We as scientists probably "had our day" of research for research itself; we now have to use our ingenuity in solving the crisis problems of South Africa as a country which also forms part of the world, but keeping inside the realistic budget that can and will be allocated by the central and local governments as well as business authorities.

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Table 1. Classification of problems and crises by estimated time and intensity (World) (3)

Grade	Estimated crisis intensity (number affected X degree of effect)		Estimated time to crisis*		
			1 to 5 years	5 to 20 years	20 to 50 years
1.	10^{10}	Total annihilation	Nuclear or RCBW escalation	Nuclear or RCBW escalation	*(Solved or dead)
2.	10^9	Great destruction or change (physical, biological, or political)	(To soon)	Famines Ecological balance Development failures Local wars Rich-poor gap	Economic structure and political theory Population and ecological balance Patterns of living Universal education Communications-integration Management of world Integrative philosophy
3.	10^8	Widespread almost unbearable tension	Administrative management Need for participation Group and racial conflict Poverty-rising expectations Environmental degradation	Poverty Pollution Racial wars Political rigidity Strong dictatorships	?
4.	10^7	Large-scale distress	Transportation Diseases Loss of old cultures	Housing Education Independence of big powers Communications gap	?
5.	10^6	Tension producing responsive change	Regional organization Water supplies	?	?
6.		Other problems-important, but adequately researched	Technical development design Intelligent monetary design		
7.		Exaggerated dangers and hopes		Eugenics Melting of ice caps	
8.		Noncrisis problems being "overstudied"	Man in space Most basic science		

*If no major effort is made at anticipatory solution.

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