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Research policy and organization in dental research

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Research policy or science policy are new catchwords without precise definition. In a broad sense, they refer to the problems of how to determine financial support, growth rate, and priorities of research at various levels of organization.

At one time, research progressed quietly – out of public view; and not too long ago, it was possible for the dedicated individual to pursue his scientific interest as a hobby – at home or in his laboratory – oblivious of the outside world. Ideally, many of us who are involved in scientific activities might still wish that research could continue to take what direction it may, being guided only by the imagination and inventiveness of the individual researcher.

However, the focal point of my premise today is that – with few exceptions – those days are gone. The increased costs, the increased impact of science on life, the increased number of scientists, the competition and overlap, have necessitated a formulation of policy for science and an articulation of research goals – at the governmental level, in the research councils, universities, research institutes and laboratories. Science cannot today be conducted in isolation from society. The contacts between the two are already extensive and are expanding; and most importantly, society hos now come to expect some participation. The cry for relevance is heard from many sides – and science is under great pressure. Although this represents a dramatic change from the past, the circumstances and values which guide scientists have been subject to frequent changes throughout the history of civilization. The question, "What purpose should science serve?" is by no means a new one.

RESEARCH PHILOSOPHICAL SCHOOLS

According to ancient Greek ideology, the recognition and acceptance of the truth were deemed both necessary and valuable for the individual's well being; knowledge was considered to enrich life and provide happiness to the researcher himself. Such an intellectual comfort was in turn expected to be disseminated throughout the public by proper communication. This concept of the objective of scientific research was based on the significance of truth in the development of *intellectual welfare*.

It was FRANCIS BACON who in the 17th century introduced materialistic values in research. He held that new insight not only gives to man the power to understand himself, but it also allows man to control nature and her forces. Extended

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knowledge of the organization of nature was considered a necessary basis for the development of a technology which could promote human welfare. The value of scientific activities according to the Baconian thesis is thus defined in the context of promoting *material welfare,* and the individual scientist takes upon himself the role of the benefactor of mankind.

Both these research philosophies show that the scientist always has been in need of a justification for his activity, and that the search for truth has been made with reference to human values.

Problems arise, however, at the point where the connection between science and welfare no longer is explicit. All the way down through history from GALLILEO and TYCHO BRAHE to NIELS BOHR and OPPENHEIMER – or from the inquisition to the Cold War – the question has been asked, "Is the responsibility of the researcher limited to the exploration of nature and the unveiling of truth, or does he also share a responsibility for the practical application of the new knowledge provided?" This is the discussion of the inertia of research as introduced by MAX WEBER at the turn of the century, maintaining that the scientist is exempt from any moral and political consequences which his discovery or invention may have. It is also the concept of "science for the sake of science" and the "ivory tower research", which essentially holds that research by its very nature is valuable and neutral.

These three philosophical schools which I have tried to describe in crude terms, form the theoretical basis for the continuous justification and defense of scientific activity. In a general way, during this century, the Baconian concept has dominated in the natural sciences and in technology; research in the humanities has leaned on the Greek tradition, while WEBER's doctrine of inculpability has generally been applied to research in the social sciences. However, whatever the philosophical base, and irrespective of the problem under investigation, probably the most important factor in guarding research against the adverse effects of political and economic influence is a set of ground rules or requirements for the conduct of science: objectivity, honesty, system, methods of control and public disclosure. Without strict adherence to these methodological principles, there can be no scientific research.

Where then, does dental research find its philosophical platform? It is a historical fact that dentistry suffered a separation from medicine in early times. Dentistry took – or was forced to take – its own course and fought its way up from the quack's stand and the barber's shop through apprenticeship and vocational training to the university campus and the highly sophisticated clinics of today. It is a long, painful and less than prestigious history. But thanks to the vision and perseverance of the profession itself, dentistry advanced beyond the level of the trades and found its place among the health sciences. We continue, however, to speak about dentistry and dental research as one entity, and medicine and medical research as another. This dichotomy has been clearly fortunate in many respects, but unfortunate in others. Without raising this as an issue, it is desirable in the context of my discussion today to re-emphasize that dentistry, conceptually and by virtue of its content, is truly a branch of medicine, at the level of and in line with ophthalmology, dermatology, otolaryngology, etc. Dental research is thus a discipline in the biomedical sciences and relates to basic science in the same way as any other discipline in medicine.

BASIC AND APPLIED RESEARCH

While I find it useful to distinguish between basic and applied research for the purpose of indicating the general nature of the activity, I do not subscribe to the idea that this in any way provides a basis for the rating of research on a quality scale. Generally, I find such a discussion nonsensical and fruitless, and consider that probably the most important distinction is between good and bad research.

The overall aim of all research in the life sciences is to provide ways and means of preventing and curing man's diseases and to promote health. Within this frame of reference, dental and other medical research, while rendering much satisfaction to the individual researcher, is not an intellectual enterprise in its own right. It can never be an end in itself, but serves defined practical purposes. I believe that those who are engaged in clinical research will have no problems in accepting this definition of purpose. I do know, however, that there are still many colleagues in the basic sciences who flatly reject this commitment, with general reference to the dogma that contributions from basic research are best secured through a free-wheeling, non-controlled, non-directed activity. Indeed, the history of science is replete with fundamental discoveries resulting from chance observations during "playing around" in the basic science laboratory, and most certainly I do believe that no major innovations can take place if research is confined to the application of existing knowledge. In this vein, it should be considered a tragic mistake if support for the Niels Bohr Institute or the Rockefeller Institute and similar centers of excellence were not given high priority. However, while appreciating the need for a non-committed, curiosity- driven research at the fundamental level, there is, in my opinion, another segment of basic science which relates more directly to defined problem areas and therefore would be subject to slightly different research policy considerations. For lack of a better term, let us call them "supportive or applied basic sciences", with the understanding that their function would be to assist and interact with clinical research in solving definable problems. What I have in mind is the situation of a genuine working relationship between the basic and applied scientist and a continuous cross-fertilization of minds, which is likely to enlarge the scope of the working hypotheses and the results beyond the level of those of the individual members of the group.

One problem with clinical scientists is that they are generally unaware or unable to assess the level of basic information already available. Another is the misunderstanding that complete basic knowledge is required in order to go forward on a clinical problem. However, at present as in earlier times, major discoveries are being made without full understanding of all scientific principles involved. The bronze and iron ages developed without quantitative knowledge of the structure or properties of metals, and today we are clearly able to prevent and cure diseases into which we do not have full insight.

What is implied here is not that we revert back to ancient primitivism, nor is it suggested that we be satisfied with less than profoundness in our approach. I am just warning you against the axiomatic belief that those working in the so-called applied sciences have to sit and wait for basic information from chemistry, physics and molecular biology to come along. I am reminded that almost all PASTEUR's work from fermentation of beet sugar through the disease of the silkworm to the cure of rabies, was on quite practical pro-

blems. Yet it led to the formulation of new biological principles and to the destruction of false ones.

But research today is too complicated for one person to cover the entire spectrum of scientific methodology, and a comprehensive in-depth attack on a problem is generally beyond the capacity of the individual researcher, as is his immediate access to needed equipment and facilities. Also, the exploration of complex problems at whatever level it is undertaken, does not always coincide with the neat departmental structure of universities and professional schools. These organizations were developed primarily for teaching purposes. It seems to me that successful modern science requires at least a minimal aggregation of scientists who complement and reinforce each other through teamwork, and an organization of individual research laboratories into multidisciplinary units where the continuous interaction between researchers and the full use of facilities are not hampered by formalities connected with the crossing of boundaries between departments.

PRIORITIES IN DENTAL RESEARCH

The social cost of dental diseases is fantastic. For the United States alone, it is estimated that if the entire population were to be provided with adequate dental care, as defined by current treatment procedures, it would cost some $8–$10 billion. An extrapolation of this figure to apply to the total population of the world yields astronomical figures, and it becomes obvious that most countries are unable to meet the necessary economic and manpower requirements. Moreover, and with specific reference to Swedish data, if a country should choose to direct its financial and educational resources to such a goal, indications are that the mere application of therapeutic measures may not have much impact on tooth mortality rates during the latter part of adult human life.

The only acceptable alternative to these problems seems to be to determine the causation of the diseases – and prevent them. Under the current circumstances, this, in my opinion, represents the most rational basis upon which decisions for the support of dental research can be made.

However, the total amount of money that comes to dental research is no longer enough to simultaneously support all aspects of the prevention of caries, periodontal disease, oral cancer, teratological defects, viral diseases, malocclusion, etc., and priorities must be set at the various levels of decision-making, no matter how hard it may seem to make these choices. Thereafter, it is necessary to provide potent organizational forms that permit the realistic isolation and pursuit of reasonably comprehensive scientific objectives. I believe this to be the principal background for establishing five new dental research institutes in the United States; not in order to substitute for ongoing departmental, laboratory and individual research activities, but to create a system of support of research motivated by specific socially desirable goals.

THE DENTAL RESEARCH INSTITUTE AT THE UNIVERSITY OF MICHIGAN

By sharing with you the research strategy and the present operational features of the Dental Research Institute of Michigan, the intention is to demonstrate one of several ways of materializing the concepts and scientific objectives, which we have just discussed, into a research organization.

The Dental Research Institute came into existence in 1968. During the first 5-

year period, the initial phases of its development were accomplished: The research building as part of the Dental School complex was completed and occupied. Equipment worth $1,000,000.00 including four electron microscopes, ultracentrifuges and a multitude of other costly and necessary instruments were installed; and a research staff was hired.

By 1973, the Institute numbered some 40 researchers with basic training in biology and scientific degrees, and approximately the same number of supporting staff, organized into the following 11 laboratories:

Bacteriology
Biochemistry
Bioengineering
Biometrics
Cell Biology
Experimental Pathology
Genetics
Histology
Molecular Biology
Pharmacology
Virology

The budget as supported by the National Institutes of Health is in excess of $1,300,000.00. Adding individual grants and various types of University support, the total annual expenditure amounts to approximately $2,000,000.00.

In my opinion, the only justification for the existence of a research institute is that it should constitute a scientific instrument more effective as a whole than would be the sum of its separate parts. The gathering of a number of scientific groups under one roof with common basic interests will not alone achieve this end. Accordingly, it was my recommendation to the Scientific Advisory Committee and the Policy Committee that the unique potential of the institute concept would be best realized by formulating a research strategy which identified important oral health problems which could be attacked through interdisciplinary group efforts.

Based upon the existing facilities, manpower and level of support, three target areas have now been delineated toward which the entire thrust of the Institute will be directed. The three research areas are:

(1) Periodontal disease and caries
(2) Viral diseases of the oral cavity
(3) Growth and function of masticatory apparatus.

The idea is that within each target area it will be possible to deal with selected problems, ranging from the descriptive and experimental-clinical to the analytical-molecular levels. The following working titles illustrate the current activities and interests of the three groups:

PERIODONTAL DISEASE AND CARIES

- Natural history of periodontal disease
- Composition and immunogenicity of dental plaque
- Cell mediated immune response in patients with various severities of periodontal disease
- Pathogenicity of plaque bacteria as releated to extra-chromosomal genetic determinants
- Mechanisms of drug resistance in oral bacteria
- Structural and chemical factors governing epithelial-connective tissue interaction in healthy and diseased periodontium
- Chemistry of connective tissue components
- Genetic factors affecting tooth transplantation

VIRAL DISEASES OF THE ORAL CAVITY

- The natural history of oral herpes simplex virus infections

- Molecular biology of the host-HSV interaction
- Mechanisms of action of antiviral drugs

GROWTH AND FUNCTION OF MASTICATORY APPARATUS

- Growth and development of normal and abnormal facial syndromes
- Assessment of diagnostic methods and procedures
- Functional disturbances of the masticatory system
- Quantification of masticatory neuromuscular feedback systems
- Computerization of electromyographic analysis for clinical diagnosis and prognosis
- Predictive and diagnostic criteria for functional capabilities of the masticatory system

It is important to note that these projects were chosen voluntarily by the group or the individual scientist, and that beyond the approval of the projects, the research activities will be subject only to quality control.

The necessary rearrangements of the organizational structure and adjustments of laboratory activities for the purpose of maximizing the multidisciplinary involvement in the defined areas have been initiated and will be completed within this calendar year. It is important for me to emphasize, however, that these organizational changes do not represent an administrative technique, but do indeed reflect a research concept, the essence of which proposes that the nature of an organization like a dental research institute offers a rare opportunity for subjecting salient dental problems to truly interdisciplinary basic research, meeting short-term demands by working continuously toward long-term objectives. In my view, the sole purpose of administrative organization is to provide the most favorable conditions possible for scientific work; any extension of bureaucracy beyond this purpose is detrimental. There is, of course, no way of knowing for sure, but I believe that through meaningful collaboration and prudent guidance, it will be possible to generate a sufficient degree of intellectual stimulation and satisfaction from these group efforts to compensate for the partial surrender of the traditional autonomy of the individual scientist.

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