What Will You Contribute to the New Medicine?"*1

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When I ask what you will contribute to the "New Medicine," the reply that must be expected is, "What is the New Medicine? Is it here now? Is it new?" Yes, it is new, and it is developing now, and it will continue to develop inexorably because it is demanded.

The New Medicine is the fusion of modern technology with medical science to such an extent that it is completely changing many aspects of medical practice, and the fusion will influence every aspect. I don't deny that medicine may have been a continually evolving field in the past, but there are two important differences in the evolution of the New Medicine. One is the rate of change, like combustion compared to explosion, and this requires no special comment because it is typical of much of modern life. The other, however, is the source of the energy creating the change. In the New Medicine, this energy source is primarily external, in contrast to the past situation in which medicine generally progressed by advances within its own established body of clinical and basic sciences. Medicine is now in a situation where social, political, and economic factors are demanding change, and fortunately the applied physical and mathematical sciences are providing the vehicle for change in the form of modern technology.

When I speak of forces demanding change I am not talking about changes in matters such as methods of physician reimbursement. I am talking about the fact that an increasingly sophisticated public is demanding increasingly sophisticated medical care, and the growth in population demands growth in medical care capability, and an unevenly distributed population—both geographically and economically—is demanding more evenly distributed access to medical care. Technology, especially in the form of biomedical engineering, is helping to solve these problems.

I have read several articles recently predicting that medical care in the future will be hospital-based, but one can also say that the New Medicine will be laboratory-based in both its preventive and therapeutic aspects. Multiphasic screening will be important to disease prevention and early diagnosis. Treatment will be based on precise data. The New Medicine will be more scientific, and the clinical laboratory is one of the cornerstones of the modern scientific medicine that the public demands. Of course, the public also wants a compassionate medicine, and this sometimes causes conflicts, but if the clinical laboratory can make the physician's scientific task easier, he may have more time to devote to his art. If these conclusions are reasonable, it is obvious that clinical chemistry, as a field, must be one of the key contributors to the New Medicine. The question I have asked, then, concerns the individual contribution that each of you will make, because, collectively, you will help make the New Medicine what you want it to be.

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I may define its nature, but I'm not going to predict its content. You are in the process of creating that.

Advances in medical science, however, are useful and important only if they relate to the real needs of the patient and the physician caring for him. Clinical chemistry can best guarantee its own growth by remaining sensitive to those needs. In fact, the question of what is really important to the patient and the attending physician should be uppermost in the minds of all of us who hope to facilitate better health.

At the National Institute of General Medical Sciences, we support several key programs that are directly concerned with patient problems, and I am sure most of you are aware that one of these, the program on automation in the clinical laboratory, is administered by the incoming president of the American Association of Clinical Chemists, Dr. Robert Melville. Another member, Dr. William Campbell, administers the Institute's Graduate Research Training Program in Clinical Chemistry.

The long range goal of these Institute programs is the general improvement of medical care through the provision of better objective data for the physician's guidance in diagnosis and therapy. Examples of areas being supported at present include: (a) the development of new analytical tools and methods for the tasks not now suited for automation owing to their complexity or lack of sensitivity, (b) the development of ultramicro automated systems for testing biological fluid from infants, (c) exploitation of basic research discoveries to provide new diagnostic tests for use in the clinical laboratory, (d) the development of proper laboratory standards and appropriate sets of profile tests suitable for detection of various diseases before irreversible changes have occurred, and (e) the development of appropriate computer hardware and software for laboratory data processing, for the control of analytical methods, and for the identification of abnormal test results.

In fiscal year 1968, nearly 3.4 million dollars was provided for research and development in areas such as these.

Future advances depend on today's research, but the future itself, and continuing development, depend on the people who will be available in the future and how they will prepare to staff the laboratories and do the research that will be essential to the New Medicine. In order to obtain a better picture of probable training needs for the future, Dr. Melville and Dr. Thomas Kinney, a principal consultant to the National Institute of General Medical Sciences, set up a conference on training for clinical laboratory scientists in December 1967. In order to determine training needs, it was necessary first to determine future service needs.

The following guidelines were used for the conference:

To find the best means to provide quality clinical laboratory service for all the citizens of the country.
To determine the proper organization of the various components of our health resources so that clinical laboratory service could be provided efficiently.
To make every effort to find ways by which the high cost of clinical laboratory service could be reduced.

In considering various needs it also was emphasized that care must be taken to preserve the character of medicine, and the freedoms that sustain it. It was recognized that accomplishing these goals would depend on the training, ability, and imagination of our laboratory scientists of the future.

Dr. Kinney and Dr. Melville were keenly aware of the requirement that the care of patients must be the focal point for such a conference. Thus, in addition to experts in the immediate fields of concern, they invited forward-looking specialists in a variety of clinical fields to discuss laboratory services that would be of great help in laboratory medicine right now, if available, as well as services that could become important in the future. It was noted that, in addition to new tests and central laboratory systems, which I shall mention, there is also increasing use of special facilities that have special needs. Examples are intensive care units, coronary units, and screening clinics.

The clinicians, who represented users of laboratory tests, specifically noted a general need for better laboratory organization and management to include (a) efforts to increase capacity for testing and rapid reporting, and (b) coordination of services to avoid duplication of equipment and personnel. Also, there should be (c) demonstrable reproducibility of results through improvement of performance and wider application of quality control, and (d) systematic efforts should be made to display and explain quality-control findings to physicians, thereby increasing their confidence in laboratory reliability. (e) Regular communications to clinicians are needed concerning the predictive value of various test combinations; the normal value of tests for age and population groups; the need for additional tests if indicated by unsolicited information obtained through battery testing; and the nature and possible uses of new techniques being offered in the laboratory. It was also noted that (f) well-defined research units should be created in the clinical laboratory to bring new developments of basic science to the diagnosis and treatment of disease.

One especially critical area in clinical chemistry, and one with absolutely wide-open potential for
development, is pharmacology and toxicology. Better ways are needed to measure drug concentrations and drug metabolites in body fluids for the safe management of patients. Even though it may have seemed self-evident, it is only in the past few years that much attention generally has been paid to the fact that drug dosage schedules may have little relation to the resulting individual drug levels, and that many drug idiosyncrasies are due to atypical rates of absorption or metabolism. This becomes particularly important in the presence of the multiplicity of drugs that often are administered to patients. Also, the markedly increased use of drugs for self-medication adds to the need for rapid techniques for the specific identification of drugs, singly and in confusing combinations. Quantitative and qualitative pharmaceutical tests must be automated and made available on a routine basis. They will be a significant part of the chemical description that every clinician will someday use in addition to his physical description of his patient.

Since this aspect of clinical chemistry blends with and includes toxicology, I might note that the special problems of detecting and analyzing what may be called trace amounts of substances become very important and can be the basis of broad research programs encompassing activities from the most basic to the most applied. Modern drugs and many toxic compounds—especially those in important areas such as psychiatry or environmental pollution—should be measurable in terms of nanograms (millimicrograms) rather than milligrams.

It is my opinion that pharmacology and toxicology are the most important, most underdeveloped areas in clinical chemistry.

A number of other special needs were singled out at the Conference on Training for Clinical Laboratory Scientists. Readily available assays have not been developed for a number of enzymes that may be clinically useful to measure. General accessibility to a number of more sensitive hormone assays would be beneficial in several fields—internal medicine, obstetrics-gynecology, and pediatrics, for example. Further progress in microanalytical techniques is an obvious need in pediatrics, but many other types of patients cannot spare much blood either. It would be hard to estimate how many barrels of blood would be spared each morning in America by general adaptation of micro-techniques. Better, simpler screening tests would be valuable in every area. Actually, it is difficult to conceive of any test that could not be improved.

With this sketchy background of some of the things that need to be done, the question becomes, "Who will do them, and how?" The answer to "who" is simple: everyone associated with clinical chemistry can contribute very directly. No one, for example, is in a better position than the medical technologist to make observations on more efficient ways of doing things or on the perennial problem of the man-machine interface which has raised a veritable "Medusa head" with the advent of automation. Chemists in the smallest general hospitals have equipment and reagents at their disposal which would make the most famous research workers of a few decades ago weep with envy. Furthermore, abundant material is available for study, and few clinicians would be unwilling to discuss their needs or to help in some way that would provide them with better service. All it takes to do some kind of research is an inquiring mind. In other areas, all kinds of special talents and backgrounds may be needed, including such obvious ones as engineering and physics. In the larger academic- or investigative-type laboratories, wide varieties of talents may be focused on very complex problems, and the facilities are likely to be especially comprehensive. The facilities factor alone puts the clinical chemist in a relatively strong position in times of tight research budgets.

The Pathology Training Committee of the National Institute of General Medical Sciences, in a report to Dr. Frederick Stone, the Institute director, stated, "At present, the savings in per-test cost and in personnel that have resulted from automation of common tests are counterbalanced by the investment in the new and more complicated procedures. However, it is foreseeable that as the work load becomes more manageable, some of the resources of the laboratory can soon be freed to attack problems more fundamental to human biology. This should make laboratory data more clinically useful."

You, obviously, are interested in the problems of clinical chemistry or you wouldn't be here participating in such a well-balanced program. The program itself indicates a basic enthusiasm for research and innovation. It also is apparent that much progress is being made on all fronts—industrial, academic, medical service, and government—and that much of the progress is due to cooperation between these categories. This is as it should be. It is hoped that new systems of automation such as those that have been developed by Technicon and those being introduced by Beckman and DuPont will continue to enhance the effectiveness and efficiency of the clinical laboratory, and that this will provide the opportunity I have mentioned for additional research. Furthermore, it is especially gratifying to note that your symposia will stress innovation in the laboratory on the one hand, and, on the other, the human biological problems of health and disease toward which the clinical laboratory must remain oriented.

The New Medici is upon us.

Are you contributing your share?