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The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

## Instrumentation Creates New Opportunities

One of the principal avenues to scientific progress is the development of new means of probing nature. In an earlier day it was possible to make experiments with simple tools in many areas of inquiry. Gradually, however, most of the great questions that could be answered by simple procedures in virtually every area of science were examined. During the last decade the increased funds available through government support of research would not have been so useful had it not been for what has amounted to a revolution in instrumentation. This was financed to a considerable extent from funds in the hands of investigators who were searching for new approaches. Developments in instrumentation have affected the conduct of research in almost all areas of science.

In astronomy many of the recent advances are connected with new instruments and techniques—radio and radar astronomy—or with improvement in the measuring capacity of existing observatories through the development of more sophisticated devices—infrared detection, for instance. In space research all the new findings have involved the use of recently invented equipment, whether it be the launch vehicles, the satellites themselves, or the instrument packages. In nuclear physics most of the new discoveries are dependent on instrumentation—either the accelerators or the detectors, such as bubble chambers or spark chambers. Chemistry has become increasingly dependent on instrumentation for further progress. Recording infrared spectrometers are routinely used tools. In some laboratories whole programs are built around the use of gas-liquid chromatography. In others, mass spectrometry plays an important role. Studies of natural products are being greatly aided by new equipment for measuring optical rotary dispersion. Most organic chemical research laboratories employ nuclear magnetic resonance, which permits unique assignments of structure of complicated compounds. Perhaps nowhere has the impact of instrumentation been greater than in biochemistry and molecular biology. Many of the important advances of the past few years have stemmed from the use of column chromatography, the analytical ultracentrifuge, radioactive tracers, or the amino acid analyzer. The impact of new equipment has extended to the behavioral sciences. Today some psychology departments use more electronic equipment than most physics departments used a decade or two ago.

Instrumentation has an impact that shapes the course of research. The drudgery of many routine measurements has been eliminated by means of automatic equipment. Still more important, some of the new apparatus opens up new experimental capabilities. For instance, gas-liquid chromatography permits effortless identification and measurement of 20 or more substances present in a microgram or less of sample. In an earlier day, to get comparable information might have required kilograms of material and days of work. Similarly, in countless ways the computer saves human effort and permits detailed calculation and correlation which previously were impractical.

As with any useful development there is a danger of misuse. With powerful new gadgets available, some individuals are tempted to ask for each new item as it is developed and to treat it as a new toy. To others, the appeal is the possibility of amassing vast amounts of data. But the greatest importance of the new equipment lies in its usefulness in opening research frontiers which could not be explored in any other way. The potential of the new instrumentation will be developed only insofar as the instruments are used thoughtfully in efforts to answer meaningful questions.—P.H.A.