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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 foster scientific freedom and responsibility, 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.

COVER The image of a single crystal of the amino acid DL-leucine reveals the individual methyl groups at the end of each amino acid molecule as white spots. It was taken with an atomic force microscope. See page 209. [Photograph by Scot Gould, Department of Physics, University of California, Santa Barbara, CA 93106]

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Advances in Instrumentation

Scientific progress and instrumentation have become inextricably intertwined. The discovery of new phenomena can lead to new ways of characterizing or quantifying the systems scientists study, and advances in instrumentation can open up new ways for conducting scientific research.

Instrumentation affects research in a variety of ways. New measurements reveal previously unknown phenomena; quantities can be measured more precisely, accurately, and rapidly. Each of these aspects leads to increased productivity and in many cases to the ability to solve new problems. In addition to these traditional measures of value, however, are hidden or less quantifiable ones. An especially critical aspect of improved instrumentation is the ability to catch errors and wrong assumptions quickly. An incorrect assumption may lead to extended efforts that ultimately prove futile. Modern instrumentation often allows the recognition that one is on the wrong path and thus saves the experimenter from a long and unproductive journey. Also, more alternatives can be explored with less extensive effort. The consequent increase in productivity in some fields has been remarkable.

Instruments come in a variety of styles, shapes, and prices. Commercial instruments have costs that range from thousands to hundreds of thousands of dollars. For many scientists, commercially available instruments such as Fourier transform infrared, nuclear magnetic resonance, electron paramagnetic resonance, x-ray, and mass spectrometers, and the mutual coupling of these instruments with various separation technologies, have revolutionized the nature and complexities of the problems on which they work. One-of-a-kind instruments—accelerators, synchrotron light sources, neutron sources, free electron lasers—lie at the other end of the scale. These generally are used to make measurements that simply cannot be made in any other way.

Between these two extremes we have a most interesting area—instruments that are still in the process of laboratory development. Their impact derives in part from applications to immediate tasks in the laboratory of their developers. But there is also the possibility that these instruments will become widespread in their availability and usefulness, and join the ranks of commercially available instruments used routinely in many laboratories and in the field. The instruments described in this issue fall largely into this category. We present a selection, from many that might have been chosen, of state-of-the-art techniques that have the promise of being seen in many laboratories during the next few years.

Hansma, Elings, Marti, and Bracker describe scanning tunneling microscopy (STM) and atomic force microscopy (AFM). These techniques were recognized immediately for their ability to provide direct views of the atomic domain. Surface details at the atomic level of graphite, organic conductors, and adsorbed atoms are displayed. Thin conductive metal coatings allow viewing of biological materials. The AFM provides a nondestructive view of organic materials that are nonconducting. Possible future applications, including dynamic studies, are described.

Clarke and Koch describe progress in SQUID magnetometers, which are among the most widely used superconducting devices. This is probably the first application in which high-temperature superconductors are playing a role. In this article the advantages and disadvantages in the applications of this new technology are discussed.

Gordon, Huang, Pentoney, and Zare describe capillary electrophoresis. The resolving power in separation and the great sensitivity of this new, relatively simple methodology make it almost certain that it will become a mainstay of the analytical community.

Finally, Landergren, Kaiser, Caskey, and Hood describe the area of DNA diagnostics. Molecular science and the ability to perform automated analyses are making it possible to undertake the solution of a very large number of important, disease-related problems.

Zare, quoting Joshua Lederberg, points out the often unacknowledged role which instrumentation plays in research. This issue of *Science* acknowledges that role and shows that the way in which we are able to carry out our science has a profound impact on the science that we are able to do. Advances in instrumentation continue to open new horizons.

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