Basic Science; Quiet Progress

by Ruby Yoshioka

The absolute determination of the acceleration of gravity, a new way to measure mass and a completely different approach to separating chemicals are among the highlights of advances researchers in physics and chemistry have made in the past year.


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Chemical and physical research lacks the glamour and public excitement of space efforts, public health programs or nuclear excavations. But the basic research, such as that which leads to the observation of links between crystals in a polymer, the discovery of an excitonic molecule or finding the minimum amount of energy needed to produce a chemical reaction, is the foundation on which all technological progress depends.

Just as the studies of Dr. Robert Sanderson Mulliken, Nobel Prize winner in chemistry, and of Prof. Alfred Kastler, Nobelist in physics, opened wide the gates for better understanding of the behavior of chemical compounds and thus their application, and the development of the laser which is now an essential tool in many fields of research and technology, so other seemingly useless and impractical research could provide bases for future advancements, still unknown.

Chemists in recent years have been delving deeper and deeper into the molecular structure of compounds and the make-up of their atoms in search of the answer to what makes them tick, and the age-old question of what life is and where it begins.

Although the present trend emphasizes technology rather than basic science, for the complex and intricate technology of today in all phases of activity, basic research in chemistry and physics is indispensible.

This year:

The National Academy of Sciences-National Research Council urged a 25% increase during the next three to four years in the support of chemical research.

The theory that particles and antiparticles are mirror images of each other was challenged by one experiment on the eta meson and confirmed by another.

The discovery of a double-hypernucleus, the first known example of a lambda lambda helium nucleus with an atomic weight of six, foreshadows the development of a complete periodic table of chemical elements, with double and possibly triple hyper-nuclei.

A new absolute determination of the acceleration of gravity was made in falling-body experiments at the Gaithersburg, Md., laboratories of the National Bureau of Standards. A value of 9.801018 m/s^2 with a standard deviation of 0.3×10^{-5} m/s^2, was obtained.

The positron's gyromagnetic ratio, called the "g-factor," was measured to one part in 100,000, the first accurate measurement of this basic constant of the atom.

Tiny variations in the movement of electrons across the interface between nickel and germanium were observed, providing scientists with a clue to how catalysts work.

Mass can now be measured in space by a new method known as "linear spring mass pendulum," which does not depend upon the attraction of gravity.

The six-sided cell of carbon, which contains ten atoms, was seen for the first time through an electron microscope and photographed.

Discovery was made of a new extremely short-lived particle N*3245, the heaviest yet found, about three and one-half times heavier than the proton.

Direct measurement of the minimum amount of energy necessary to produce a simple chemical reaction was successfully made.

A radio-wave method was proposed as a means of discovering whether "quarks," the suggested building blocks of all materials in the universe, actually exist.

Direct measurements of the chemical properties of astatine, a highly radioactive element, were made for the first time.

A completely different method of separation of chemicals called parametric pumping was successfully tested. It operates by causing a continuous oscillating change in the temperature of adsorbent particles.

A material that bends and stretches like rubber and still has the characteristics of concrete was formed from a basically silicon substance.

An increase in the variety of tailor-made fibers was foreseen with the development of a two-component man-made textile fiber in which one constituent is embedded in the matrix of another.

Microwave radio waves of 12,000 million pulsations every second, the highest ever reported, were generated by means of a thin crystal of gallium arsenide.

For the first time a full-scale high energy physics experiment employed a super-conducting magnet in connection with a one-foot bubble chamber for tracking nuclear particles.

A strong, high-temperature plastic that is not degraded by long hot exposure to air was shown to be stronger than aircraft aluminum and to compare favorably with steel when reinforced with glass cloth.

So fast were the new advances in holography that three-dimensional television has been predicted within 20 years.

The intense bursts of light from a laser produced temperatures high enough to break gas atoms apart into electrically charged particles.

From analysis of barium 140 after atmospheric nuclear explosions since 1961, a New Zealand scientist reports that radioactive debris from American, Soviet, French or Chinese nuclear tests crosses the equator and falls out in the Southern Hemisphere.

The first direct observation of links between the crystals in a polymer has been made. The intercrystalline links measure up to 15,000 angstroms long and between 30 and 300 A thick.

A technique that makes it possible for the first time to duplicate and observe what happens inside molten metal as it solidifies has been devised.

An excitonic molecule, made up of two electrons and two positively charged "holes," was observed in silicon. Holes are unoccupied energy levels that electrons could fill.

Dr. Robert Sanderson Mulliken was awarded the Nobel Prize in Chemistry for his fundamental work on molecular structure.

Prof. Alfred Kastler received the Nobel Prize in Physics for his development of optical pumping.