1973: Research Progress on a Broad Front

Despite political and economic turmoil, the year was productive of a number of new ideas, unexpected discoveries, and quietly spectacular developments in research both basic and applied. The debate over solutions to the energy crisis dominated the news but yielded little in the way of substantive progress in energy research. In other areas, however, the story was different. This week the Research News section is devoted to a sampling of highlights and trends in research during the past year.

Earth and Planetary Science

That the solar system is heliocentric and not geocentric was first proposed by the Polish astronomer Nicolaus Copernicus on the basis of telescope observations. Now, 500 years after his birth, exploration of the solar system has advanced to the point where seven major planetary probes —three U.S. spacecraft and four U.S.S.R. spacecraft—were en route in 1973 toward targets ranging from Jupiter to Mercury. This was also a year in which Skylab astronauts gathered a multitude of new data about the sun and in which analyses of data from earlier explorations began to produce a clearer picture of the moon and of Mars. On the earth, scientists made considerable progress in understanding the ozone layer that shields living things from ultraviolet radiation, the large eddies that constitute the ocean's subsurface "weather," premonitory phenomena that may give warning of earthquakes, and a variety of other atmospheric, oceanic, and solid earth phenomena.

(*Continued on page 1330*)

Biomedical Science

Immunology would have to rank high among the topics that dominated biomedical news in 1973. In particular, investigations into the genetic control of immune responses have received much attention.

The capacity to respond to certain antigens, including some viruses that cause cancer in mice, is determined by genes, called Ir or immune response genes that lie within the same chromosomal region as the genes for the histocompatibility (transplantation) antigens. Now, evidence from a number of laboratories has indicated that the products of the Ir genes may themselves be histocompatibility antigens and that they serve as recognition sites on certain cells of the immune system.

(*Continued on page 1331*)

Chemistry and Biochemistry

Unsuccessful new scientific theories generally die quietly, but that rule met with a major exception in 1973. The highly controversial polywater theory, which postulated the existence of a unique new high-molecular-weight form of water, was interred this year with nearly as much publicity as accompanied the first description of the theory some 7 years earlier. Its much heralded demise was but one of the highlights of a year that also marked the identification of the viruses that cause both forms of hepatitis, the taming of a rather unpleasant vaccine, the development of a major new form of an old drug, the unraveling of the structure of an antibody, and the development of a new type of pesticide.

(*Continued on page 1332*)

Physics and Astronomy

When the new discoveries for 1973 are analyzed, none of them have changed a scientist's view of the world—yet. The new experiments and observations are neither free of ambiguity nor easy to understand. Rather than reporting the discovery of a new particle with certain clear characteristics, physicists have found evidence for a subtle effect called "neutral currents." Rather than introducing the public to a new star in a growing cast of luminaries, astronomers reported finding two quasars apparently beyond the limit of last year's universe, radio signals that may carry new information about cosmology, and gamma rays that were never expected but come streaming toward the earth at least four times a year. Scientists may be forced to think about the dynamics of stars, cosmology, the properties of supercold matter, and the unification of the four fundamental forces of nature in new ways in order to understand the discoveries of 1973. Then again, they may not. Either way, much has been learned that is new.

The distances of objects far away from our galaxy, the Milky Way, are measured by the "red shift" of light that comes from them. The most distant galaxies ever discovered have red shifts of about 0.4, but quasars are found with larger red shifts. Only a year ago, the largest quasar red shift known was 2.88, and some astronomers were speculating that very few quasars with red shifts greater than 3 would be found. The red shift limit of 3 was likened to an indication of the limit of the universe or—because it takes more than 10×10^9 years for light from such distant objects to reach us—to a horizon in time. Last year the hypothetical limit was exceeded, as two quasars were found

(*Continued on page 1333*)

Materials Science

The year 1973 was an exciting one in the superconductivity research community—beginning with the announcement that superconducting fluctuations may have been observed at temperatures near 60°K in an organic compound, and ending with awarding of the 1973 Nobel Prize in physics to researchers in superconductivity. Amorphous metallic alloys began to receive some of the attention long reserved to amorphous semiconductors this year. High resolution electron microscopy techniques came closer to visualizing individual atoms in crystals than previously, and surface science continued to become more sophisticated. The ubiquitous energy crisis began to make its presence felt in materials technology, with renewed emphasis being placed on high-temperature materials for, among other things, more efficient engines, on finding less expensive materials to use in place of more expensive ones, and on improving the efficiency of extractive metallurgical techniques.

(*Continued on page 1334*)

Chemistry and Biochemistry: Polywater Is Buried, Hepatitis Viruses Surface

Polywater was first observed by Soviet scientists in 1961, but it was not until Boris V. Derjaguin of the Institute for Physical Chemistry in Moscow described it in the United States in 1966 that intense interest was generated. The anomalous properties of this Vaseline-like substance, which include a freezing point of −40°C and a boiling point higher than 400°C, led many scientists to speculate that it was a new form of polymeric water. Others argued that the unique properties resulted from impurities in the water, and the lively controversy was fueled by everyone's inability to produce more than microliters of the substance. The controversy was apparently resolved this year, however, when Derjaguin released extensive results showing that the anomalous properties were obtained only in the presence of a high concentration of dissolved minerals, and that these concentrations resulted from an enhanced dissolving power of condensing vapors.

At least three key developments in hepatitis research have occurred this year. First, Maurice R. Hilleman and his associates at the Merck Institute for Therapeutic Research, West Point, Pennsylvania, succeeded in transmitting hepatitis A—a mild form of liver disease often called infectious hepatitis—to South American marmosets. Their success provided evidence that hepatitis A is caused by a virus and produced the first animal model of the disease.

Then, in December, Stephen M. Feinstone, Albert Z. Kapikian, and Robert H. Purcell of the National Institute of Allergy and Infectious Diseases (NIAID), Bethesda, Maryland, used a relatively new technique called immune electron microscopy to visualize RNA virus-like particles in stool filtrates from hepatitis patients. Immunological evidence indicates that the particle is probably the causative agent in hepatitis A and is most likely the same agent used to infect the marmosets. The two achievements represent a major step toward understanding the nature of hepatitis A and toward development of a vaccine against it. The key stumbling block now facing the investigators is finding a tissue culture system in which the putative virus will replicate to produce sufficient quantities for further experiments.

Meanwhile, Purcell and John L. Gerin of the NIAID-Atomic Energy Commission Molecular Anatomy Laboratory in Rockville, Maryland, together with a team of physicians from the Stanford University School of Medicine, have demonstrated that the larger virus-like particles previously isolated from the blood of patients with the more severe form of hepatitis, serum hepatitis or hepatitis B, contain a DNA polymerase that is essential for viral activity, and probably also contain DNA. Their work provides strong evidence that hepatitis B is also caused by a virus, and suggests that a test for DNA polymerase activity in screening blood donors might be more useful than current tests for a hepatitis-associated antigen. Taken together, the three projects suggest that one difference between the two forms of the disease might be that hepatitis A is caused by an RNA virus and hepatitis B by a DNA virus.

The improvement of an existing vaccine has been the goal of T. J. Wiktor, S. A. Plotkin, and D. W. Grella of the Wistar Institute in Philadelphia, Pennsylvania. They have developed a much more potent, less hazardous form of the normally unpleasant vaccine against rabies, a severe, generally fatal viral infection of the central nervous system. Individuals who have been exposed to rabies or whose jobs or hobbies open them to exposure (veterinarians and spelunkers, for example) normally require a series of 14 to 21 daily injections of rabies vaccine to produce immunity, and the injections are frequently accompanied by unpleasant localized reactions to contaminants from the duck embryos in which the virus is grown. The new Wistar vaccine is grown in a strain of cultured human cells and not only produces far fewer side effects, but also provides full immunity with only one or two injections. The vaccine is not yet commercially available.

Many ailments can be relieved by aspirin, the most widely used drug in the world. But many people—especially arthritics and other heavy users—experience severe stomach distress or bleeding caused by irritation from tiny aspirin crystals that are released as the tablet dissolves. Attempts to administer it in a liquid form have generally been unsuccessful because the aspirin molecule degrades readily in any liquid that can be ingested by humans. Earlier this year, however, Louis Luzzi, C. W. Whitworth, and H. W. Jun of the University of Georgia, Athens, reported that this decomposition could be blocked by esterifying the salicylic acid moiety of aspirin in a glycol-based solution. The resulting thin syrup, they claim, is as effective an analgesic as aspirin, has a pleasant taste, does not irritate the stomach, and can probably be made cheaply.

This year's—or any year's—most impressive example of protein structure determination was the elucidation of the amino acid sequence of human immunoglobulin M (IgM) by Frank W. Putnam and his associates at Indiana University, Bloomington. The 576-amino acid IgM, with a mass of 950,000 daltons, is the largest protein yet to have been sequenced; it is also only the second antibody to have its structure determined. IgM is the first antibody formed in a newborn animal or human. The cells that produce IgM later divide into daughter cells that produce immunoglobulin G, whose structure had previously been deciphered by Nobel laureates Rodney Porter and Gerald Edelman. Knowing the structural differences between IgG and IgM, Putnam says, will thus help to illuminate the mechanisms that control their production.

An unusual new type of pesticide was announced this year by Timothy P. Yoho and Linda Butler of West Virginia University, Morgantown. They have found that some normally harmless dyes, including many that are used to color foods and drugs, are toxic to flies and some other insects if such animals are exposed to sunlight after ingesting the dyes. The dyes have no effect on insects kept in the dark. Yoho suggests that the dyes are activated by light that filters through the relatively transparent body of the flies, and that the activated dyes are central nervous system poisons. The group is now testing the dyes for control of flies around barns and stables.

On the lighter side of the year, Edward Majchrowicz of the National Institute on Alcohol Abuse and Alcoholism, Washington, D.C., has offered some experimental support for the old wives' remedy of using "the hair of the dog that bit you" for curing hangovers—that is, having another drink when the hangover begins. Majchrowicz and his associates found that ingestion of ethanol blocks the liver's metabolism of physiologically produced methanol, allowing unusually large quantities to accumulate in the blood and urine. When the concentration of ethanol in the blood stream approaches zero, metabolism of the excess methanol produces the withdrawal symptoms characteristic of a hangover. These symptoms can thus be alleviated by the consumption of more ethanol.—THOMAS H. MAUGH II