News of Science

Expanding Universe

The theory of the expansion of the universe rests observationally on Hubble's law, which shows that galaxies in space are receding from each other with velocities that are proportional to their distances apart. Evidence for this red-shift law rests on observations obtained only in the narrow visible portion of the wide electromagnetic radiation spectrum that impinges on the earth's atmosphere.

The observed red shifts of the optical lines have been interpreted as the result of a true recessional velocity, the shift arising through the well-known Doppler effect. Alternate explanations of the red shift have been advanced which would not require motions in the universe; as Finlay Freundlich has proposed, the spectral shift might be the result of a possible photon-photon reaction, whose red shift would depend on the path length and radiation field traversed by the quanta. From debates such as those raised by Freundlich, and because of the importance of the Doppler interpretation in cosmologies, astronomers, cosmologists, and physicists have considered the possibility of additional independent "tests" that would either support or cast doubt on the Doppler interpretation.

Such a test for the Doppler interpretation would be a red-shift measurement on an extragalactic object, using radiation of a wavelength that is significantly different from the optical wavelengths. If the observed red shift is the result of a real recession of extragalactic objects, the wavelength shift divided by the wavelength used should be constant anywhere in the electromagnetic spectrum.

The spectral line at a wavelength of 21 cm, which arises from hydrogen gas in the interstellar medium, offered such a test for the Doppler interpretation. Its detection by Ewen and Purcell at Harvard University in 1951 was one of the most important landmarks in radio astronomy. The emission line at the 21-cm wavelength comes from vast hydrogen clouds that are a part of the Milky Way.

This emission line is caused by a hyperfine transition in ground level of the hydrogen atom. Normally the line appears in emission, and studies of the intensity and Doppler shift by Dutch, Australian, British, and American radio astronomers have led to an enlightened picture of the dynamics of the Milky Way.

The hydrogen line may also appear as an absorption line if it is viewed against a sufficiently bright background such as a discrete radio source or radio star. The work at the Naval Research Laboratory has been primarily concerned with the absorption effect in the spectra of radio stars and has revealed previously unsuspected fine structure in the distribution of the hydrogen gas in the Milky Way. In addition, it has been possible to determine the distance to a number of the radio sources.

The identification by Baade and Minkowski of the Cygnus A radio source as a pair of colliding galaxies not unlike the Milky Way raised the possibility of detecting the hydrogen gas present in these galaxies in absorption against the hot region where the galaxies are in collisional contact. The two galaxies are at a distance of approximately 100 million light-years and were found by Baade and Minkowski to be receding at a velocity of 16,800 km/sec. If the recessional velocity, or red shift, were real and due to a Doppler shift of the optical emission lines, the same proportional shift would be present in the 21-cm hydrogen absorption line, and it should appear at a longer wavelength.

On this basis the spectrum of Cygnus A was studied by A. E. Lilley and E. F. McClain of the Naval Research Laboratory, and a weak hydrogen absorption line was detected at a wavelength corresponding to a recessional velocity of 16,700 km/sec.

In making the measurements a second nearby radio star Cassiopeia A, was used as a standard against which Cygnus A was compared. This had the effect of increasing the precision of the measurements by an order of magnitude.

With the hydrogen absorption measurements on the Cygnus source, Lilley and McClain have shown the constancy of the red shift over a base-line of 500,000 to 1 in the electromagnetic spectrum. This constancy is a natural consequence of the Doppler interpretation, giving this interpretation strong support. These results now impose the constancy requirement on any alternative explanation. This work was reported at the recent meeting of the AAAS in Atlanta, Ga.

Saltonstall-Kennedy Report

Nearly half of the $3 million provided for the U.S. Fish and Wildlife Service by the Saltonstall-Kennedy Act for the year ending 30 June 1955 was used for biological research on fish and fisheries, according to a report that has been issued by Acting Secretary of the Interior Clarence A. Davis. A total of $1,434,000 was expended on these studies. Approximately the same amount—$1,444,000—was spent for research in the exploration, development, and utilization of our fishery resources. About $92,000 was allotted to general administrative expenses and $30,000 to construction.

The Saltonstall-Kennedy Act was passed in 1954, amending existing statutes. It provides funds "to promote the free flow of domestically produced fishery products in commerce by conducting a fishery educational service and fishery technological, biological and related programs—and to develop increased markets for fishery products of domestic origin. . . ."

In carrying out this policy, the Interior Department has let about 60 contracts for research work in every section of the country for more than 40 percent of the year's funds. The contractors include 30 universities, colleges, and public institutions, and 13 commercial and independent scientific research organizations. These contracts represent in excess of $1,250,000.

More than 100 projects, representing a potential expenditure of more than $10 million have been suggested for study under the Saltonstall-Kennedy funds. An advisory committee named by the Secretary of the Interior advises in preparing rules and regulations and in recommending priority of projects.

NSF Survey of Industrial Research

Industrial research and development effort in the United States cost $3.7 billion in 1953 and required the employment of nearly 30 percent of all scientists and engineers in industry, according to a study conducted by the Bureau of Labor Statistics for the National Science Foundation. The report, *Science and Engineering in American Industry—Preliminary Report of a Survey of Research and Development Costs and Personnel in 1953–54,* is based on a questionnaire survey of a sample of approximately 11,600 companies carefully selected as representative of American industry. Alan T. Waterman, director of NSF, says of the report:

"The gratifying response from nearly 90 percent of the companies surveyed shows clearly the increasing emphasis industry is placing on research and de-

velopment. On the basis of this survey, and other studies now under way, we must revise upward to more than $5 billion the total cost of research and development performed by private industry, educational institutions, Government agencies, and all other types of organizations. Private industry performs roughly two-thirds of all research and development in the natural sciences and engineering. Over one-third of this amount is done for the Federal Government chiefly on contracts with the Department of Defense and the Atomic Energy Commission. However, the survey indicates that only 4 percent—nearly $150 million—of the total cost of research and development conducted by private industry in 1953 went into basic research."

Electrical equipment and aircraft industries, the survey showed, far exceed all others in the size of their research and development programs. Together, these industries accounted for $1.5 billion of the 1953 research and development cost.

The chemical industry far surpassed all others in dollars spent for basic research. Nearly as high, however, was the proportion of basic research allocated, out of total research and development expenditures, by the stone, clay, and glass industry group because of the emphasis placed on basic research by many glass companies.

Of the 554,000 scientists and engineers employed by the surveyed industries in January 1954, the largest groups included 409,000 engineers, 60,000 chemists, 11,000 metallurgists, 10,000 life scientists, 10,000 earth scientists, 8000 physicists, and 6000 mathematicians. Included, as well, were about 34,000 scientists and engineers classified by their companies as administrators. Of this total, about 157,000 scientists and engineers—nearly 30 percent—were engaged in research and development, including approximately 105,000 engineers, 27,000 chemists, and much smaller numbers in other fields of science.

The survey found that more than 15,000 companies contributed to the nation's research and development effort. Of these, about 13,000, or 85 percent, employed less than 500 persons. Cost figures show, however, that this large group of small companies performed only about one-tenth of all industrial research and development, whereas the 375 largest companies (with 5000 or more employees) performed about 70 percent. These data are exclusive of enterprises employing less than 8 persons and of individuals working alone, as well as of scientific and engineering consulting firms and a few other types of organizations. Copies of the preliminary report may be obtained from the Superintendent of Documents, Washington 25, D.C., for 30 cents each.

UNESCO Technical Aid Budget

■ UNESCO's technical assistance program will be expanded in 1956. In December, the U.N. General Assembly voted to increase UNESCO's share of the U.N. technical assistance budget from $3,937,653 to $4,940,933. A large part of the increase is in the form of national contributions that have in the past proved difficult to utilize because of currency restrictions.

UNESCO plans to have 300 technical assistance experts in the field in 51 nations in 1956. At present, 162 experts are working in 43 countries.

The U.N. finances its technical assistance program by voluntary contributions from member states. The General Assembly this year determined the percentage of the budget that each of the specialized agencies would receive, and UNESCO was allotted 16.6 percent of the total.

Soviet Visitors

Four Soviet medical scientists have arrived in the United States for a 4-week tour to study methods of treatment of poliomyelitis and the preparation of the Salk vaccine. All four of the visitors are from the Academy of Medical Sciences of the U.S.S.R. Members of the group are Mikhail P. Chumakov, director of the Poliomyelitis Research Institute, Marina K. Voroshilova, senior research worker of the Poliomyelitis Institute; Anatolii A. Smorodintsev, director of the department of virology of the Institute of Experimental Medicine; and Lev I. Lukin, scientist of the academy. Arrangements for the tour were made by the U.S. Public Health Service at the request of the Department of State.

The scientists will go to seven cities, including Pittsburgh, where they are scheduled to visit the Municipal Hospital and meet with Jonas Salk. In addition to Washington, D.C., other stops on the schedule include Children's Hospital in Boston, Mass.; Yale University Medical School; the University of Minnesota Medical School; Children's Hospital Research Foundation in Cincinnati, Ohio; Johns Hopkins University; and the National Institutes of Health. The group will be accompanied by Alexis I. Shelokov, virologist for the National Institutes of Health.

New Affiliate of AAAS

The National Society of Professional Engineers was founded in 1934 with a membership of approximately 2500. The four founding state societies—New York, New Jersey, Connecticut, and Pennsylvania—have since then been joined by 35 other state groups, and the national society today includes more than 36,000 members in the United States and its territories.

The membership is limited to engineers who have met the requirements for professional registration as set forth by the laws of a state, territory, or possession of the United States. Organized on a three-level structure—local chapter, state, and national—NSPE gives the individual engineer an opportunity to participate in professional activity and to develop his professional attitudes in terms of service to the community, the state, and the nation.

The society endeavors to raise the standards of the profession in the eyes of the general public, of industrial management, and of engineers themselves. In pursuit of its objectives, the society carries out a broad program of public relations designed to portray the professional engineer's many and important contributions to the American way of life. An important phase of this program is the sponsorship of National Engineers' Week each year, during the week of George Washington's birthday. The events of this week, observed throughout the country, have been highlighted by a congratulatory letter from the President of the United States. During the week, emphasis is focused on engineering activity through the press, radio, television, appearance of engineers before civic organizations, sponsorship of career conferences, and guided industrial tours for students and parents, and similar activities.

The society, in cooperation with the Professional Engineers Conference Board for Industry, carries on a continuing research activity in various phases of engineering-management relationships. A series of Executive Research Surveys has furnished industrial executives with a comprehensive body of material designed to stimulate better use of existing engineering talent. Through its Committee on Engineers in Industry, the society has published a comprehensive volume on engineering - management relationships, focusing attention on existing laws as they affect these relationships and on a number of problems that may be resolved through engineering-management cooperation.

Operating through its national-level committees and implementing activities through similar state and local committees, the society is active in such fields as ethical practices; national defense; vocational guidance; work with young engineers; and the promoting of interest in mathematics and physical sciences in high schools. The society has been active in promoting and improving state registration laws for professional engineers