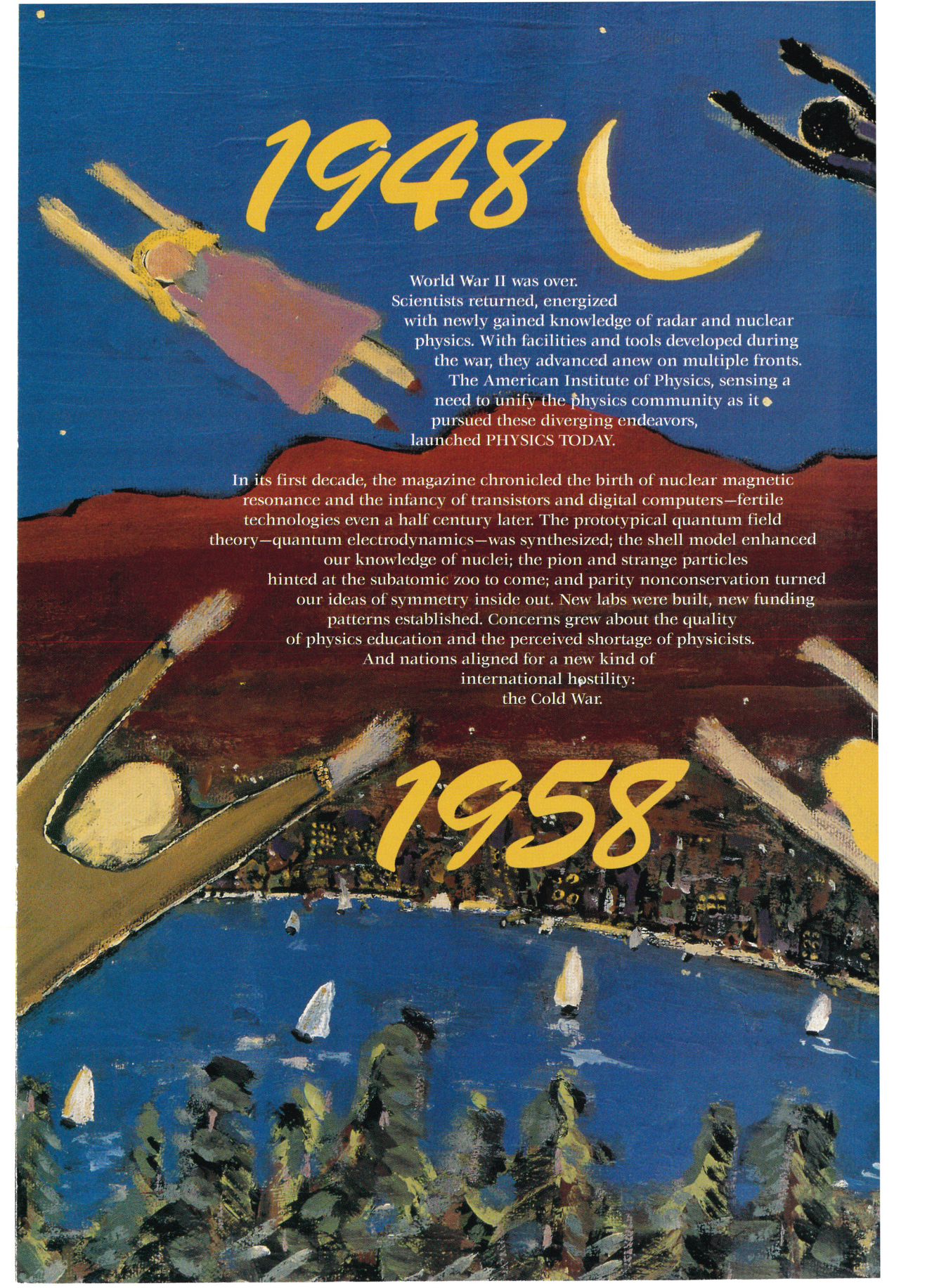




1948

World War II was over. Scientists returned, energized with newly gained knowledge of radar and nuclear physics. With facilities and tools developed during the war, they advanced anew on multiple fronts.

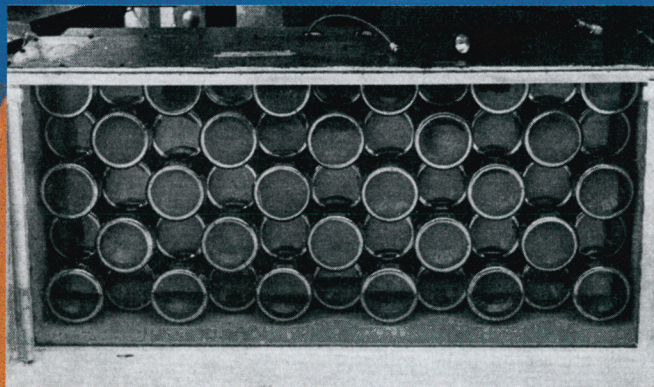
The American Institute of Physics, sensing a need to unify the physics community as it pursued these diverging endeavors, launched PHYSICS TODAY.

In its first decade, the magazine chronicled the birth of nuclear magnetic resonance and the infancy of transistors and digital computers—fertile technologies even a half century later. The prototypical quantum field theory—quantum electrodynamics—was synthesized; the shell model enhanced our knowledge of nuclei; the pion and strange particles hinted at the subatomic zoo to come; and parity nonconservation turned our ideas of symmetry inside out. New labs were built, new funding patterns established. Concerns grew about the quality of physics education and the perceived shortage of physicists.

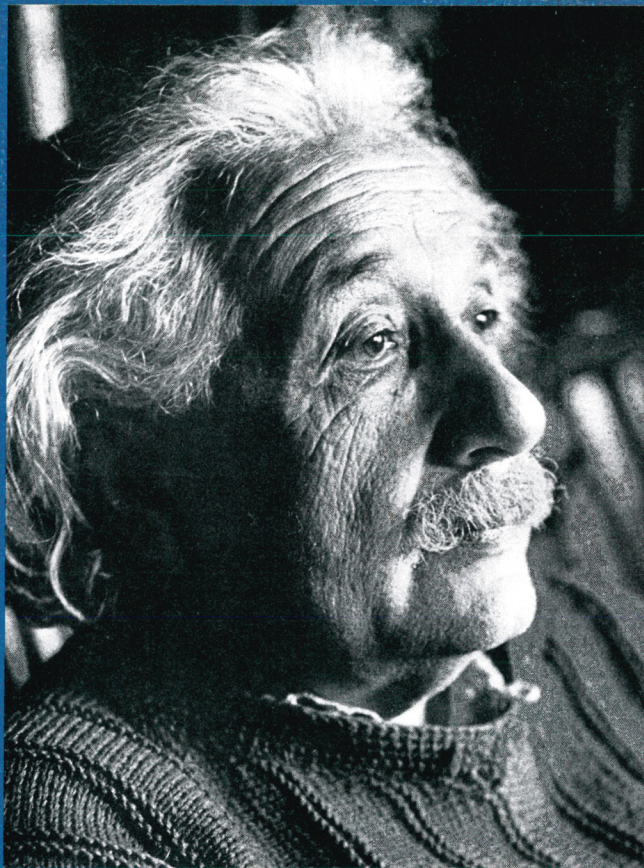
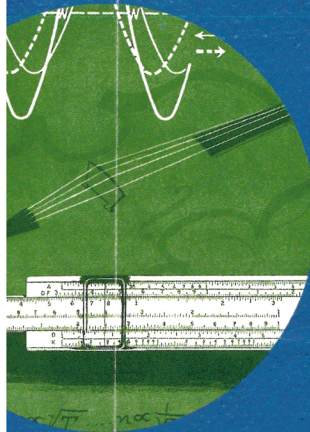
And nations aligned for a new kind of international hostility: the Cold War.

1958

First in Atomic Power

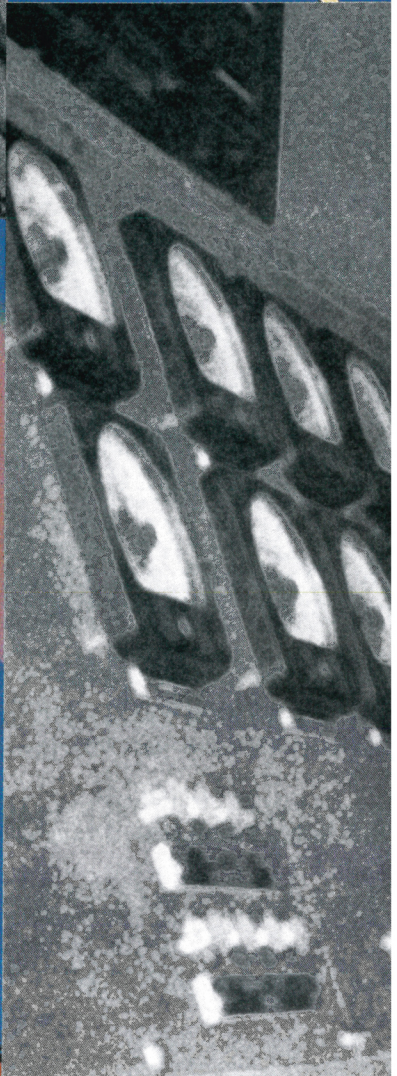
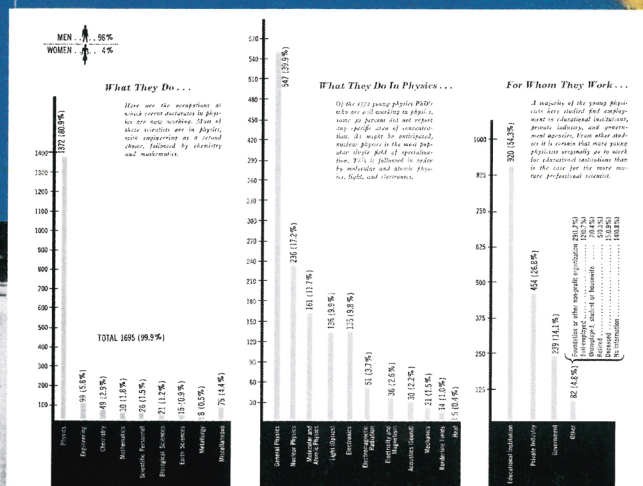


The June 1951 issue introduced
by W.F.G. Swann on
g and pure science.



Albert Einstein
(1879-1955)

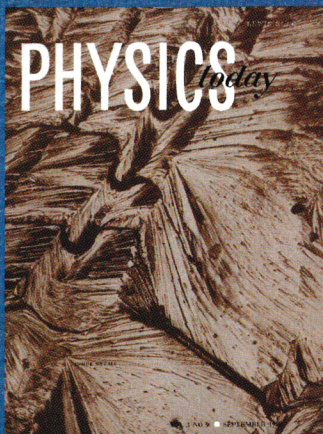
Demographics of the younger generation of physicists in 1950.



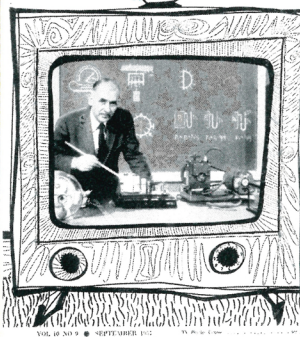
PHYSICS *today*

Berkeley professor
Harvey White
teaching high-school
physics on television
in 1957.

Fractures, from a
September 1950
article on the
insides of metals.



PHYSICS TODAY



Enrico Fermi (1901-1954)



1948–1958

▼ May 1948, page 14: Edward Purcell on nuclear magnetic resonance

Resonance absorption is observed when a substance containing magnetic nuclei—protons, for example—is subjected to a strong constant magnetic field and to a weak radiofrequency magnetic field. The intensity of the absorption and the width of the resonance line depend on the interactions between the magnetic nuclei and their surroundings in two ways: (1) The exchange of energy between the nuclear magnets and the internal degrees of freedom of the substance ("spin-lattice" interaction) brings the nuclear spins into thermal equilibrium. (2) The interaction between neighboring magnetic nuclei ("spin-spin" interaction) broadens the resonance line. This paper reports the first comprehensive experimental and theoretical study of both effects in organic liquids, aqueous solutions, some solids, and hydrogen gas. The effect of the spin-lattice interaction, which is described by the *thermal relaxation time*, is found to depend on the thermal motion of the molecules in the liquid and is closely connected with the viscosity of the liquid. Relaxation times as long as several seconds and as short as one-thousandth of a second have been observed.

▼ June 1948, page 27: Nevill Mott on discovery of the pion

Especially fruitful have been the studies of cosmic radiation. For cosmic radiation the best-known centre is Professor Blackett's at Manchester and, more recently, Professor Powell's at Bristol. In a field like this, one can still hope to do something—if not with string and sealing wax, at least with quite limited resources. This is shown particularly well by the recent success of Professor Powell and Dr. Occhialini in the discovery of the heavy meson. For a number of years Professor Powell had been developing the photographic plate as an accurate method, comparable with the Wilson chamber, for the determination of the range of charged particles. Given this long and painstaking background, the experiment was simple enough; just to leave some plates on the top of a mountain for three weeks, and then to look through a microscope to see what reaction the cosmic rays had produced. Out of this came the heavy meson, which has gone such a long way to simplify current nuclear theories. An experiment, we feel, in the true Rutherford tradition.

► August 1948, page 22: Discovery of the transistor

New Amplifier

A semi-conductor has been used for electronic amplification in the Bell Telephone Laboratories. For years the only flexible amplifier available, the vacuum tube, has been an important tool, not only in radio, telephony, and industrial control but in physical research as well. Now a fundamental study of certain problems of solid state physics has provided a new amplifier which seems suited for a variety of practical applications. Developed by John Bardeen and Walter H. Brattain under a general research program initiated and directed by William Shockley, the Transistor, as it is called, is a semi-conductor triode which can be used as an amplifier, an oscillator, and in other ways in which vacuum tubes perform.

This device, about the size of an automobile fuse, has no vacuum, no glass envelope, no grid, no plate. No warm-up time is needed to make it operate; it uses less power than a vacuum tube, can pass 25 milliwatts, operates in a range up to 10 megacycles (in the present state of the art), and is expected to have excellent life and wear resistance.

▼ June 1948, page 8: Richard Feynman reports on the Pocono conference

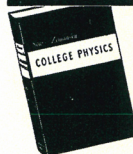
Quantum Electrodynamics

Then Schwinger went on to try to put these ideas on a satisfactory theoretical basis. He succeeded in identifying the terms in the theory which were giving the trouble and producing the infinite result. He then demonstrated that these terms, if they were finite, would have no other effect but to alter the mass of the electron. However we observe only the total mass of an electron and do not know what the mass would be if it had not been altered. Thus the terms, if they were finite (and they presumably would be in a correct theory were it available), would have no effect and henceforth can be safely and consistently omitted in a calculation. A major portion of the conference time was spent in hearing and discussing these results of Schwinger. They represent a real advance in our understanding of physics.

There was also presented by Feynman a theory in which the equations of electrodynamics are artificially altered so that all quantities including the inertia of the electron turn out finite. The results of this theory are in essential agreement with those of Schwinger, but they are not as complete.

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◀ June 1948, page 36: When Sears and Zemansky was new

▼ January 1957, page 17: John Bardeen, William Shockley and Walter H. Brattain when they won Nobel Prize



▼ **December 1948, page 29:**
Introducing xerography

A new dry method of photography and printing by electrostatics was demonstrated by R. M. Schaffert and Joseph C. Wilson at the annual meeting of the Optical Society of America in Detroit. The process, called xerography, substitutes powders for ordinary developers and ink, and involves no chemical reaction. It was invented by Chester F. Carlson and developed by Battelle Memorial Institute, and the Haloid Company has arranged to use and license it.

In the photographic operation, a sheet of aluminum, or some other electrical conductor, is coated with a photoconductive insulating material and passed under a corona spray which creates an electrostatic surface charge and makes the plate sensitive to light. When this plate is exposed in a camera—or in a contact printing frame—it can be made to reproduce an image because the charge leaks from the photoconductive layer into the aluminum backing wherever light strikes it. Developer powder (a mixture of a coarse carrier material and a very fine resinous material, electrically charged through friction) is then passed over the plate and its oppositely charged particles stick to the image pattern. The plate, which is a negative, can then be printed by putting a piece of paper (or some other material) over it and charging the paper with the corona spray so that it attracts the powder image away from the plate. The resulting print is fixed by heating, which fuses the powder to the paper.

▼ **November 1952, page 27: Site is chosen for CERN**

The proposed European Nuclear Physics Laboratory is to be located on a plateau near Lake Geneva in Switzerland, it was decided on October 6th by the ten-nation European Council for Nuclear Research (CERN) during a conference held in Amsterdam. CERN, established with the help of the United Nations Educational, Scientific, and Cultural Organization, represents Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, and Yugoslavia. The decision is reported to have been influenced by arguments that Swiss neutrality would offer some protection for the laboratory in the event of war. Also, as has been noted before, Switzerland possesses ample resources of hydroelectric power and offers a reasonably central location for the member nations of the Council.

▼ **May 1953, page 16: From Pierre Noyes's article on particle physics**

EXTENSIVE EXPERIMENTATION has been done at a number of laboratories on the charged and neutral V -particles first found by Rochester and Butler in 1948. It is well established that the type called V^0_1 decays into a proton and a π -meson, but in order to prove that no neutral particle is also emitted, it is necessary to show that the plane defined by the charged daughters also contains the line of flight of the neutral parent. Cloud chamber studies at MIT, using several lead plates inside the chamber, reveal the high energy event in which the V^0_1 originates in several cases and show conclusively that only the two charged particles are emitted in the decay; the decay energy, Q , is 37 Mev and the lifetime is about 3×10^{-10} seconds. A second neutral V -particle with the decay scheme $V^0_2 \rightarrow \pi^+ + \pi^-$ has also been observed, but the Q is only very roughly estimated as 200 Mev, while the lifetime is probably not very different from that for V^0_1 . Experiments at Caltech were also cited as giving evidence for $V^0_3 \rightarrow p + \pi^-$ with a Q of about 75 Mev, $V^0_4 \rightarrow p + (?)^0$, and $V^0_5 \rightarrow K^- + \pi^+$ where the negative particle is definitely heavier than a π^- meson and could be as heavy as a negative proton.

▼ **May 1949, page 33: From John von Neumann's review of Norbert Wiener's Cybernetics**

The author is one of the protagonists of the proposition that science, as well as technology, will in the near and in the farther future increasingly turn from problems of intensity, substance, and energy, to problems of structure, organization, information, and control. Any statement of this kind and generality is risky, inviting—and not quite innocently inviting—misinterpretation, and of dubious value outside of its technical context. It may, nevertheless, be important and valuable, if its true context exists and if it has a background of fruitful ideas. The reviewer believes that this context, this background of ideas, indeed exists in the case under consideration.

▼ **July 1950, page 36: Confirming the existence of 'strange' particles**

Most of the exciting events in physics are those that occur during the rare moments when previously unverified observations are duplicated in independent experiments. One recent example is a patient piece of detective work carried out at the California Institute of Technology by a team of physicists headed by Nobel Prize winner Carl D. Anderson and reported at the Washington meeting of the American Physical Society in April. Using a specially rigged Wilson cloud chamber, the group took in the neighborhood of eleven thousand photographs of cosmic ray events to obtain thirty-four pictures giving evidence of two new elementary particles that first had tentatively been reported in England three years ago. The particles, one carrying a charge and the other neutral, were first observed by G. D. Rochester and C. C. Butler of the University of Manchester in 1947. The British scientists had obtained two photographs suggesting the presence of the particles, but despite repeated efforts, neither they nor others were able to find further such evidence.

Last year, Anderson, together with R. B. Leighton, E. W. Cowan, A. J. Seriff, and C. Hsiao, began getting cloud chamber photographs of a neutral particle that occasionally revealed itself by decaying into two charged particles, at least one of which appears to be a meson of a type already known. Since the original particle carried no charge, it could not be seen in the cloud chamber, which registers only the passage of ionizing particles. The evidence, then, consists of photographs showing an inverted V with its apex marking the point of disintegration of the original particle. Thirty such pictures eventually were obtained. Calculations of the mass and energy of the two secondary particles suggest that the new particle has a mass at least twice and possibly seven times that of any known cosmic ray particle.

▼ **December 1955, page 34: Antiproton discovered at the Bevatron**

The anti-proton, a negatively-charged particle having the same mass as the proton, has been discovered experimentally by a group of physicists at the University of California Radiation Laboratory in Berkeley, thus supporting the generally-accepted atomic theory that for more than a quarter of a century has assumed the necessary existence of a negative proton. First observations of the particle were made on September 21st by physicists Owen Chamberlain, Emilio Segrè, Clyde Wiegand, and Thomas Ypsilantis, with the help of Herbert Steiner and the cooperation of Edward J. Lofgren, physicist in charge of the bevatron.

1948–1958

▼ May 1949, page 30: Ralph Alpher and Robert Herman on the expanding universe

The most reasonable interpretation of the red shift observed in the spectra of nebulae is that the universe is expanding uniformly. Non-static cosmological models based on the general theory of relativity have been studied by many investigators. Recent theoretical studies of the formation and relative abundances of the chemical elements have made possible a quantitative description of the expanding model.

The neutron capture theory of element formation developed by Gamow and the authors is in general agreement with data on the universal relative abundances of the elements. This theory yields values for the temperature and density of matter at a particular epoch in the early state of the expanding universe. Using these values in conjunction with a well known cosmological model composed of non-interconverting matter and radiation, one may determine quantitatively the time dependence of the density of matter, of the temperature, and of proper distance. The results obtained are consistent with physical conditions in the universe observed in the present epoch.

After the elements were formed, the universe continued to expand and cool. Matter and radiation were homogeneously distributed throughout space, and the rate of expansion was controlled by the relatively high radiation density. After about ten million years, the expansion changed in character from one controlled by radiation to a free expansion with the rate determined primarily by the density of matter.

▼ July 1950, pages 35, 36: More big accelerators

With 300 Mev synchrotrons and synchrocyclotrons budding at scattered points over the Northeast and as energetic a betatron reported in Illinois, there can be little doubt that the springtime of Big Physics has arrived. Other large accelerators have been sighted as far north as Ontario and as far south as Oak Ridge, and from the far west come rumors of still greater wonders to come.

Columbia University's new synchrocyclotron was formally dedicated on May 2 by the University's president, General of the Army Dwight D. Eisenhower.

A week or so earlier, the General Electric Company announced the successful operation in its first phase of the GE Research Laboratory's new 300 Mev "nonferromagnetic" synchrotron.

Brookhaven National Laboratory has two accelerators in progress. The first is a 20 Mev cyclotron purchased from the Collins Radio Company that at present is remarkable chiefly because it is so handsomely designed, but which is also expected upon completion to be extremely useful as a research instrument. The second Brookhaven machine is the giant proton-synchrotron (the "cosmotron"), which, it is predicted, will reach energies as high as 2.5 or 3 billion volts.

From Stanford University has come word that tests of the fifteen foot prototype model of a projected billion volt electron linear accelerator have given encouraging results.

▼ November 1948, pages 17, 21: from 'Take Away Your Billion Dollars' by Arthur Roberts, 'the physicist's balladeer'



The merry and somewhat irreverent comment on big operations in physics, which appears on the following pages, was first played at a small farewell party for Arthur Roberts just before he left Cambridge.

"Take Away Your Billion Dollars" was written in 1946 "at a time when it seemed as though every physicist was inventing, building, or projecting a new and larger machine, and while plans for the Brookhaven Laboratory were being formulated," Roberts writes (from Brookhaven, where he was working this summer).

"The AEC was not yet in existence, and all financing for new machines was being thought of as from the Armed Forces. This appeared to many people a dangerous situation. . . . I was impressed by the number of people who thought that it was aimed at them. Incidentally, in 1946, ten billion volts still seemed like an astronomical figure."



1948-1958

▼ June 1950, page 28: National Science Foundation compromise approved

The Senate-House committee of conference on the question of the Science Foundation bill came to final agreement in late April, and in early May President Truman signed the bill aboard his special train during his "whistle-stop" tour about the country. The crippling amendments relating to security provisions submitted by the House of Representatives were eliminated in the final wording, which in brief has the effect of proposing that existing national security safeguards are adequate and that no radical innovations are needed in the case of the Foundation.

Foundation personnel requiring access to classified information in the atomic energy field will be bound by the Atomic Energy Act of 1946, which requires AEC clearance. Foundation research activities pertaining to other aspects of the national defense will be given security safeguards to be established by the Foundation itself, except where such research is carried on with funds transferred from the Department of Defense—in which case the relevant security requirements will be set by the Secretary of Defense. Provision has been made in the bill for both an affidavit and an oath of loyalty for fellowship holders.

► May 1953, page 20: Astin fired over battery additive (He was later vindicated and reinstated)

A packaged mixture of epsom salt and Glauber's salt, with a pinch of barium sulfate and other unidentified substances in minute quantity, has rocked the scientific community, created a new political uproar in Washington, and led to the forced resignation of the Director of the National Bureau of Standards, a man whose considerable scientific contributions to the nation during his 23-year career in government service are a matter of public record. The product in question, a commercial preparation advertised as capable of prolonging the useful life expectancy of lead storage batteries, had originally been the subject of a controversy only between the manufacturer and the Bureau of Standards, which had declared the mixture to be useless for the purposes claimed. By March of this year, however, it had become the center of a storm involving not only the original parties to the dispute, but also the Secretary of the Department of Commerce and numerous members of Congress. There was every indication that the number of active participants would continue to increase.

Allen V. Astin, 49-year-old physicist who joined the Bureau as a research associate in 1930 and later served as chief of the NBS Electronics Division before being appointed Director by former President Truman in October 1951, submitted his letter of resignation to the White House last March 30th, pointing out that he had been informed by Craig R. Sheaffer, Assistant Secretary of Commerce for Domestic Affairs, that Secretary of Commerce Sinclair Weeks planned to study and possibly reorient some of the operations of the Bureau, and in that connection would like to have a man of his own choosing in charge of NBS. President Eisenhower accepted the resignation two days later, stating that it would become effective April 18th.

On March 31st Mr. Weeks informed the Select Committee on Small Business of the U. S. Senate that one of the reasons for deciding to change the Bureau's administration was that NBS had not been sufficiently objective in its manner of dealing with the case of the battery preparation, an "additive" marketed under the name AD-X2 by Pioneers, Inc., of Oakland, California. He stated that the company's business had "suffered severely at the hands of certain bureaucrats" and implied that NBS has been favoring the interests of the big battery manufacturers.

▼ February 1953, page 22: APS statement on visas

The following statement was approved by the Council of the American Physical Society at its meeting in St. Louis, Missouri, on November 28, 1952.

"In the past few years, the progress of American physics has been impeded by United States visa and passport restrictions. A few American scientists have been denied passports and many distinguished foreign scientists have failed to receive United States visas even for short visits to attend scientific meetings. Other foreign scientists fail to come because their visas arrive too late after delays of many months or because they had been irritated by inappropriate questionnaires and inquisitorial personal interrogations. The international notoriety of these difficulties is now such that some international scientific meetings that originally were to be held in the United States are transferred to other countries.

"This loss to the United States is not compensated by any gain in the security of classified information, since the meetings from which the visitors are excluded are open scientific meetings on unrestricted subjects. The main reliance for the security of our technical secrets must necessarily be on the very strict guarding of the information by those who have access to it and not on such illusory and ineffective procedures as the exclusion of foreign visitors from open scientific meetings. Furthermore, the interrogations of foreign scientists are chiefly effective in excluding and humiliating scientists who believe in political and intellectual freedom rather than in detecting spies who would be less scrupulous about their answers.

"The Council of the American Physical Society is not questioning the propriety of excluding any person who wishes admission to this country with any idea of advancing communism here. However, the Council strongly urges a more realistic approach by the authorities to the problem of travel restrictions so that free scientific interchange will not be impeded."

▼ July 1954, page 7: Dirac denied visa

NOBEL LAUREATE P. A. M. Dirac, Lucasian professor of mathematics at Cambridge University, is reported to have been denied permission to enter the United States. Dirac, who has been in this country several times in recent years, was invited to come to Princeton this year as a visiting physicist at the Institute for Advanced Study, which is directed by J. R. Oppenheimer. On May 26th Dirac said that his visa application had been "turned down flat" under the terms of Section 212 A of the Immigration and Naturalization Act, a lengthy list of reasons for denying entry that covers categories of undesirables ranging from vagrants to stowaways.

His exclusion was protested vigorously in a letter to the editor of *The New York Times* of June 3rd which was signed by three Princeton physicists, W. Bleakney, J. A. Wheeler, and M. G. White. Their letter said, in part, "We do not pretend to be experts in the law which governs the issuance of visas. However, if this is what the McCarran Act means in practice, it seems to us a form of organized cultural suicide. We are very strongly aware of the advantages to this country of Professor Dirac's proposed visit. We are aware of no disadvantage. We also know that his case is only a particularly obvious example of a general policy which operates to this country's detriment."

On June 10th it was reported that the State Department had ordered a review of the decision. Said the *Times*: "One of the factors contributing to the ruling against Professor Dirac, it is understood, was the 'atmosphere' in this country. This appeared to indicate that an application that might have been approved a few years ago might be rejected today."

1948–1958

▼ January 1954, pages 22, 23: McCarthy claims Fort Monmouth harbors spy ring

Fort Monmouth has suddenly been labelled before the world as a center of Communist espionage.

The staff of professional scientists and engineers is largely civilian, and Fort Monmouth has had its share of difficulty in hiring adequately trained research specialists. The existing shortage of scientists and engineers has been partly to blame, but there is also the unenticing fact that the bulk of the Signal Corps' research at its own laboratories is classified. A scientist who accepts a position to do research on military gadgetry at a weapons research establishment such as Fort Monmouth must reconcile himself, in most cases, to a kind of professional retirement in which his freedom to publish his results or present papers at meetings of technical societies will be materially more restricted than if he had taken a job in academic or industrial research.

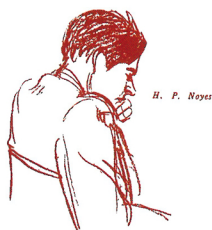
Such personnel troubles, while serious enough for those struggling to maintain the nation's technological security, are now overshadowed by threats of an acute famine of scientific manpower at Fort Monmouth. The present crisis has involved the suspension of some 30 members of the civilian staff, a set of hearings before a Congressional investigating committee, and a popularized but seemingly unsubstantiated impression that an active espionage ring is now operating inside Fort Monmouth.

On October 6th, the Army disclosed that several civilian staff members had been suspended for security reasons. Two days later Senator Joseph McCarthy went to New Jersey to take personal charge of inquiries then being conducted at Fort Monmouth by his Senate Permanent Subcommittee on Investigations. On October 12th, McCarthy said that his staff had unearthed a situation at the Laboratories that "has all the earmarks of extremely dangerous espionage. If it develops it may envelop the entire Signal Corps."

The Senate investigation, held behind closed doors, continued for about one month. Senator McCarthy held frequent press conferences and in many cases gave detailed accounts of the testimony. No witnesses were identified by name, and the Senator was careful to note that "the fact that witnesses are called by us should not reflect on them. Some are good, loyal Americans who are giving us important information." While many witnesses were reported to have used the 5th Amendment in refusing to answer questions, it was made clear that they were not currently employed at Fort Monmouth. As the investigation progressed, numerous references were made to witnesses said to have been friends, acquaintances, or contacts of Julius Rosenberg, who, according to Senator McCarthy, had organized an espionage ring in the Signal Corps. The Senator's remarks were widely reported in the press, accompanied by sensational headlines implying the continuing existence of a "radar spy ring" at Fort Monmouth. After questioning nearly 100 persons, he dropped the closed hearings early in November.

On November 13th, Army Secretary Robert T. Stevens, who had attended the Committee hearings, said that the investigation had not produced "any current case" involving espionage, nor were any of the suspended persons involved in charges of espionage. Several of those suspended, he said, had already been reinstated.

▼ June 1954, page 14: From 'Developments in High Energy Physics' by H. P. Noyes (Sketches by Rona Finkelstein)



► July 1954, page 4: The Oppenheimer case

ONE year ago this month the President's personal advisor on atomic energy matters, Admiral Lewis L. Strauss, succeeded Gordon Dean as chairman of the Atomic Energy Commission. Four days after assuming office, Strauss had taken steps to initiate a new security and loyalty investigation of the theoretical physicist who had served a decade earlier as the chief architect of the atomic weapons program to which the AEC owes its existence.

The AEC's case against Oppenheimer, developed at length during the latter half of 1953, consisted of a list of charges presented to him on December 23rd in the form of a letter from Major General K. D. Nichols, general manager of the Commission. Oppenheimer's "Q" clearance was suspended at that time and he was notified that he could, if he chose, request a hearing before a personnel security board of the AEC. He replied in writing on March 4th with a detailed answer to the allegations contained in the Nichols letter and asked that he be granted a formal hearing. The AEC accordingly established a board for that purpose under the chairmanship of Gordon Gray, president of the University of North Carolina and former Secretary of the Army. The two other members were Thomas A. Morgan, former president of the Sperry Corporation, and Ward V. Evans, professor of chemistry at Loyola University in Chicago.

Gray and Morgan found that the nation owes a particularly great debt of gratitude to Oppenheimer for loyal and magnificent service, praised his high degree of discretion reflecting an unusual ability to keep to himself vital secrets, came to the clear conclusion that he is a loyal citizen, but found themselves unable to recommend that it would be in the national interest to reinstate his clearance.



Evans, in his minority report, agreed that Oppenheimer is a loyal citizen, said that in the matter of "associations" Oppenheimer now has fewer politically suspect friends than he had when he received full AEC clearance in 1947, insisted that there is nothing wrong with Oppenheimer's character, and came to the firm conclusion that his clearance should be restored. Failure to do so, he said, would be "a black mark on the escutcheon of our country".

"The Board," said Gray and Gordon, "takes cognizance of the serious alarm expressed to it by witnesses and frequently adverted to in the public press that denial of clearance to Dr. Oppenheimer would do serious harm in the scientific community. This is a matter of vital concern to the Government and the people.

"We should express our considered view that, because the loyalty or security risk status of a scientist or any other intellectual may be brought into question, scientists and intellectuals are ill-advised to assert that a reasonable and sane inquiry constitutes an attack upon scientists and intellectuals generally.

1948–1958

▼ December 1948, page 34

Notice!

All employers of young scientists are urgently advised to prepare themselves *immediately* to handle draft cases. Men who clearly should be classified II-A are being inducted through failure of their employers to learn the regulations and take the necessary steps in time.

Be sure to submit *before classification* a request for deferred classification in writing for all cases covered by the regulations. This action is necessary to establish the right to appeal. Appeals must be made in writing within ten days of classification. Write letters. Don't wait for forms.

ON December 16 the President declared a state of national emergency.

Men of science, traditionally peaceful, internationally minded, and nonpolitical, have become a major war asset. It is important that they be used to the greatest advantage. Therefore, I am asking you as representatives of science to consider carefully how you and your fellows can be most useful to our country in the years to come. I believe that we are facing dangers so great as to make the comfort and convenience of any group trivial in comparison to the contribution such a group can make to our survival.

I propose the establishment of a Scientific Service Corps directed by a Scientific Manpower Board and based on a national roster of scientists. These organizations would be concerned only with scientists who have completed their education, not with students. Nevertheless, two categories are concerned: men of military age, normally subject to call for military service, and older scientists. Both categories would be under the general supervision of the Scientific Manpower Board and both would be listed in the roster. At present, only the scientists of military age would be required to join the Scientific Service Corps, and only the members of this Corps would be subject to orders from the Scientific Manpower Board. For older scientists the Board would act in an advisory capacity only.

Turning to the question of stockpiling, that is, the training of new scientists, we have quite a different problem. Various schemes have been proposed for the deferment of students. Most such schemes do not make it clear that we are aiming at a positive goal, not a negative one. We are not interested in helping individuals escape the duty of military service just because they are bright boys or happen to have played with chemistry sets as children. We are interested in developing a group of men with trained minds and disciplined imaginations who can strengthen the country over the next twenty years. That some of them will be doing very nearly what they would choose to do in peace time is irrelevant except insofar as it may make them more effective.

These may not be the best solutions to this problem, but they are possible ones. Any system to be established must obviously be flexible and subject to change with experience and with changing international conditions. Either the organization I have suggested, or a better one, should be set up now before we repeat the errors of the last war.

▼ May 1949, page 27: From report by Frederick Seitz on March APS meeting

In the first place there were a number of papers on the properties of silicon and germanium which further advance our rapidly developing knowledge of these materials. This work ranged from investigations of the electrical properties at very low temperatures to work on the photoelectric effect near room temperature. Papers appeared from all of the prominent laboratories interested in these semiconductors. Dr. Goucher of the Bell Laboratories presented a thirty minute paper in which detailed measurements of quantum yield in the photoelectric effect was described. This work seemed to be particularly noteworthy because it provides an insight into the behavior of electron levels near the edge of the filled and empty bands.

◀ February 1951, pages 18, 19, 23, 24: From Harry Smyth's article 'The Stockpiling and Rationing of Scientific Manpower'

▼ December 1951, page 29: Scientific 'manpower' shortage

The Shortage is becoming Critical

Evidence continues to mount that the number of scientifically and technically trained people in the United States falls far short of being adequate to satisfy even the present research needs of the government, industry, and education. While proposals for emergency expansion of the programs of the Atomic Energy Commission and other agencies imply that there will be a vastly increased drain on the nation's resources of trained manpower, there is every indication that the production of scientists and engineers is declining. During the 20th Anniversary Meeting of the American Institute of Physics in Chicago last October, it should be noted, the AIP Placement Register provided facilities for representatives of industry, government agencies, and universities to discuss employment opportunities with those physicists (about 130) who expressed any personal interest in the matter. It is significant that the available jobs listed at that time by the Placement Register outnumbered the physicists who listed themselves as being available for employment by a ratio of almost four to one.

▼ August 1954, page 7: More on the Oppenheimer case

THE Atomic Energy Commission announced on June 29th that it had reached a decision in "the matter of Dr. J. Robert Oppenheimer". By a vote of four to one the AEC decided that Oppenheimer should be denied access to restricted data. Commissioners Lewis L. Strauss, Thomas E. Murray, Eugene M. Zuckert, and Joseph Campbell voted to deny clearance, and Commissioner Henry D. Smyth voted to reinstate clearance. Strauss, Zuckert, and Campbell signed the majority opinion, Murray concurred with the majority in a separate opinion, and Smyth submitted a dissenting opinion. Both Zuckert and Campbell issued statements in amplification of their views.

Smyth, who warned in his dissent that "failure to employ a man of great talents may impair the strength and power of this country", stated that the conclusion that Oppenheimer is a security risk "cannot be supported by a fair evaluation of the evidence".

1948–1958

▼ May 1949, page 30: Enrico Fermi on origin of cosmic rays

According to the theory proposed, cosmic rays are distributed more or less uniformly in the interstellar space of the galaxy. A cosmic proton is supposed to wander through this space for a period of time that, on the average, is of the order of one hundred million years, and which may, exceptionally, be twenty or thirty times longer for those few protons that statistically escape destroying collisions.

During this time the proton steadily acquires energy by collisions with wandering magnetic fields which are supposed to permeate the interstellar space. The rate at which the proton gains energy is shown to be roughly proportional to its total energy (including rest energy) so that the energy of the proton increases exponentially with time. The older a proton is, the larger is its energy which can reach a value of the order of 10^{16} electron volts for those few protons that have not had destroying collisions since the beginning of the universe.

One of the features of the theory is that it yields naturally an inverse power law for the spectral distribution of the cosmic rays. The chief difficulty is that it fails to explain, in a straightforward way, the heavy nuclei observed in cosmic radiation.

▼ July 1952, page 20: New computers at Princeton and Los Alamos

Descriptions of two closely related electronic digital computers, one at the Institute for Advanced Study at Princeton, New Jersey, the other at the Los Alamos Scientific Laboratory in New Mexico, were made public for the first time in June. Both are designed to perform very high speed calculations in pure and applied mathematics and in mathematical physics.

The Institute's machine, which has been a work in progress for the past six years, is actually the prototype for the Los Alamos computer and for various other machine developments, including two more for the AEC and one which was recently completed by the University of Illinois for the U. S. Army Ordnance Corps Ballistic Research Laboratories at the Aberdeen Proving Ground. Prior to the Institute's public announcement the Princeton machine had successfully completed a number of quite extensive problems. One of these was a large calculation of about twenty million multiplications to test a conjecture of the famous 19th century mathematician, E. E. Kummer, which had never been established. The machine did this work in six hours. Two considerably shorter astrophysical problems (each requiring the solution of three simultaneous differential equations) and a number of cubic diophantine equations were calculated. In addition, work was done on several twelve-hour meteorological predictions covering the continental United States, each amounting to about 800,000 multiplications and requiring about one hour of continuous computing time.

▼ November 1957, page 42: Sputnik launched

The Soviet Union, amid a competitive flurry of H-bomb testing and ICBM rattling, announced early in October that it had launched a first (and remarkably heavy) artificial orbital satellite as one of its contributions to the IGY program—and thus secured an immense propaganda victory and an implied technological advantage over the West. The ("Vanguard") satellite project that is part of the US program for IGY was set up in the Naval Research Laboratory as a low-priority experimental effort divorced from the several massive programs to develop intermediate and long-range missiles for military purposes. The Russian satellite program, on the contrary, was a high-priority effort tied directly to military missiles development.

▼ January 1956, page 32: from 'American Physicists in the Current Quarter Century' by Marsh W. White

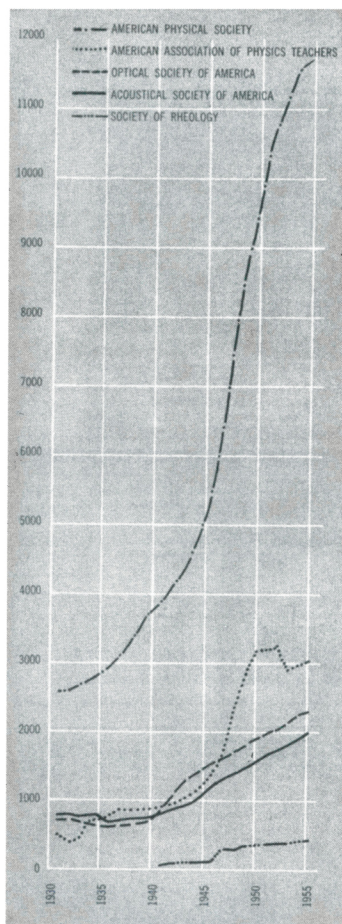


Fig. 1. Membership in the professional physics societies during the current quarter century.

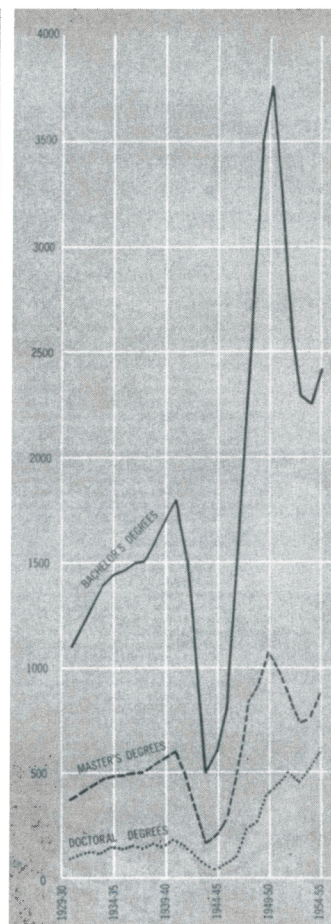
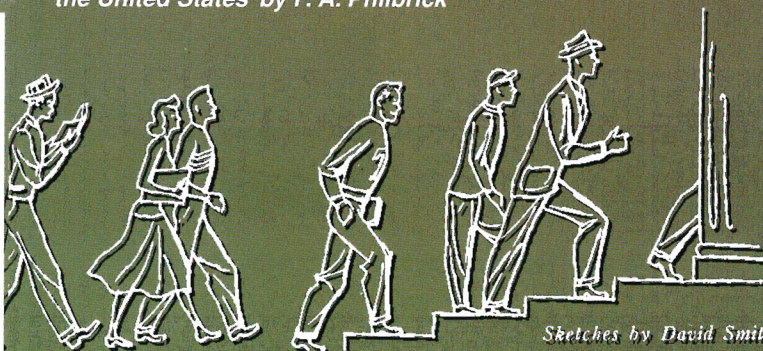


Fig. 2. Degrees awarded to physics majors during the current quarter century.

▼ November 1949, page 15: from 'Science Education in the United States' by F. A. Philbrick



Sketches by David Smitton

1948–1958

The theorists predicted that these particles, the mesons, should interact very strongly with nucleons once they were formed and should, therefore, be easily absorbed, be easily scattered, and should easily cause nuclear reactions. They did nothing of the kind. In fact, they did nothing of any kind. They just moved along, were slowed down as any charged particle is, finally came to a stop and disintegrated in some way then unknown. All the same, theoretical physicists persisted in their belief in the connection between Anderson's cosmic-ray particle and Yukawa's prediction. But the differences between the experimental results and the theoretical prediction were so great that it was proposed to make the best of another disagreement among physicists, one about the name of the particle, and to call the experimental particle, the mesotron, and the theoretical particle, the meson. Attempts to identify the two particles continued until finally, in 1947, a group of Italian physicists, Conversi, Piccioni, and Pancini, found that the cosmic-ray meson had even less interaction with the nucleus than had been suspected before. Even when they gave the meson a chance of sitting around the nucleus for a long, long time, namely a microsecond, even then it wouldn't make use of its opportunity and would not get captured by the nucleus. This finally proved that the two particles could not be identified. But then it took only a few months before the solution to the puzzle was found in Bristol, England, by Occhialini, Powell, and Lattes, who discovered that there existed still another particle which they called the π -meson, the primary meson, which decayed after a short time into the meson which had been previously discovered and which they called the μ -meson, the "meson" meson.

The π -meson, at last, fulfilled Yukawa's dream. It had a strong interaction with the nucleus. Once created, it was easily scattered; it was easily absorbed by the nucleus; and since 1947 we have come to believe that the π -meson really is the particle which transmits nuclear forces.

▼ February 1954, page 23: Hofstadter et al. measure nuclear charge distributions

Present concepts of nuclear structure may undergo some revision in the light of recent experiments performed at Stanford University and reported in the November 15th *Physical Review*. According to R. Hofstadter, H. R. Fechter, and J. A. McIntyre, authors of the paper, "the charge distribution in heavy nuclei tentatively suggested by this work differs rather seriously" from the model usually accepted.

At first glance it would seem that the mutual repulsion of identical charges should lead to a concentration of charge on the outer surface of a nucleus, where it is less densely distributed; or the charge could be spread evenly throughout the volume of the nucleus. In either case there is a distinct "edge" to the charge distribution. Ordinary light waves are diffracted at sharp edges, and, analogously, diffraction effects might be expected if a fast electron having a de Broglie wavelength of the order of the nuclear dimension passes near a nucleus. A series of maxima and minima in the angular distribution of elastically scattered fast electrons is predicted by theory, and these were looked for at Stanford. Electrons of energies of 125 and 150 Mev from a linear accelerator were used in the experiment, with thin foils of gold, lead, tantalum, and beryllium providing the scattering nuclei. The results: "there is no pronounced evidence of diffraction minima or maxima. . . ."

To appreciate the impact produced by Fermi's theory of β -decay on the world of physicists, one may refer to the remark by Konopinski: "It is amazing what varieties of observed phenomena (and what thicknesses of *The Physical Review*) have their roots in his one paper on the subject."

Bethe then remarked that Fermi, with his paper on β -decay, brought to a close his purely theoretical studies and became an experimentalist, a role he pursued with undiminished intensity. Emilio Segrè sketched with warmth and color the evolution of the famous Italian school, which in short order became the scientific Mecca for nuclear physicists. Here we get a picture of the man and his methods seen by a close friend and collaborator. Warm, understanding, and untiring, Fermi organized a small group of co-workers that included Segrè, Rasetti, Amaldi, d'Agostino, and later Pontecorvo. One could not but be impressed by the directness of their methods, the general spirit of camaraderie, the minimum of red tape and the circumvention of what there was of the latter.

First came the experiments with neutrons from radon-beryllium in which an extensive series of elements was bombarded and the induced radioactivity observed. Thus the signal disclosing Fermi's entrance upon the field of experimental physics proved as telling as that which had announced his arrival in theoretical physics just fourteen years earlier. After describing the then perplexing results of uranium bombardment, Segrè went on with the story of first experiments with neutrons slowed down in paraffin. Here again a new and broad horizon was unfolding, foreshadowing the historic developments that soon were to follow.

◀ November 1955, page 11: from Nicholas Metropolis's report on memorial symposium for Enrico Fermi (1901–54)



◀ February 1954, page 6: Hans Bethe's article on nuclear forces discusses the muon-pion confusion

This, then in outline form, is the present status of the neutrino—except for the startling developments of the past few months.

THE concept of the neutrino was born of a grave difficulty and saved the energy and momentum conservation laws in their application to nuclear phenomena. A few months ago Lee and Yang (1957) invoked the neutrino to explain another puzzle, this time the failure of a conservation law, that of parity conservation as it has been applied until now. This historic renunciation followed experiments suggested by Lee and Yang (1956) dealing with weak interactions, the class first introduced by Fermi to explain beta decay.

A problem basic to neutrino physics is the question of the identity of the neutrino from nuclear beta decay with those produced in the decay of various mesons. To date we have only indirect arguments on this point, but in the experimental results of Garwin, Lederman, and Weinrich which demonstrate that meson decay neutrinos also probably fail the parity test we may have an additional reason for assuming this identity. Until now, the main argument has stemmed from the apparent equality of the coupling constant in the beta decay of the mu meson with that of nuclear beta decay and from the rule of parsimony as applied to the invention of new particles.

◀ August 1957, page 16: From article by Frederick Reines and Clyde Cowan on neutrino physics