News of Science

Parity Not Conserved

The department of physics of Columbia University has announced that very recent experiments on the physics of elementary particles have shown that parity is not conserved in weak interactions. This finding destroys one of the basic laws built into all physical theories of the last 30 years. The experiments were as follows:

1) The beta-decay of oriented nuclei, C. S. Wu of Columbia University in collaboration with E. Ambler, R. Hayward, D. D. Hoppes, and R. P. Hudson of the National Bureau of Standards.

2) The angular asymmetry in electron decay of mu mesons, Richard L. Garwin, Leon M. Lederman, and Marcel Weinrich of Columbia University. (Note: Garwin is also a staff member of the I.B.M. Watson Scientific Laboratories.)

Both of the afore-mentioned experiments were suggested by two theoretical physicists, T. D. Lee of Columbia University and C. N. Yang of the Institute for Advanced Study, Princeton, N.J. The first of a series of three papers on the subject was entitled "Is parity conserved in weak interactions?" The experiments designed to answer this question give a decisive answer—parity is not conserved.

The concept of parity, although actually significant only in the realm of microscopic physics, has a well-defined everyday definition. One way of describing this is as follows:

Suppose that we are in communication with an intelligent civilization on another world and wish to determine whether their clocks run in the same sense as ours do—or again, whether they mean the same thing by left-handed and right-handed as we do. We have always believed that communication of this idea, in the spirit of this analogy, is impossible. There was no absolute, universal sense to "handedness." However, the stranger's laws of physics are perfectly good—even if his definition is opposite to ours for, say, a left-hand screw and a right-hand screw. The statement that the two worlds, one based on a left-handed system and one based on a right-handed system, have the same laws in physics is known as an "invariance principle"; that is, the laws of physics are said to be invariant or unchanged, if the right-hand and the left-hand convention are interchanged. The interchange is a reflection in the sense that a mirror image is a reflection in the plane of a mirror. Physicists refer to this reflection as a "parity operation." The principle of invariance to reflection or to parity operation has been built into physical theories since 1925 and serves as a severe restriction on the types of laws predicted by these theories. It is this principle which has been destroyed by the recent Columbia experiments.

The main reason for this is that it has been discovered that elementary particles—neutrinos and mesons—possess a "handedness" as an intrinsic property. One must now speak of a left- or right-handed neutrino, for example. More precisely, these particles must now be considered to possess, in addition to charge, mass, spin, and so forth—properties analogous to a screw—that is, a favored rotation (spin) and an advance along the axis of rotation, either in the right-handed or the left-handed manner.

Another way of describing the situation is to compare an elementary (spinning) particle with a spinning bullet. If the shape of the bullet were a perfect cylinder, there would be no screw defined or no handedness, since the two ends of the bullet are identical. The new concept of particles is now in analogy with a normal bullet (pointed nose) which differentiates one end of the spin from the other. Particles which "point" in one direction relative to the sense of rotation are called right-handed, and so forth. The fact that such particles exist on this world and on the other world now permits an absolute identification of right and left hand between the two worlds, in violent disagreement with previous concepts. No theory which has included the parity idea would have been successful. These experiments, brilliantly proposed by Lee and Yang, now at last open the way to a correct and unifying theory of elementary particles. Lee and Yang also point out that the over-all symmetry of the universe may still be preserved by assuming that, if our galaxy is essentially right-handed, some distant galaxy may be in turn left-handed. It may be that this assumed distant galaxy is identical to the hypothetical antimatter, now a subject of intense speculation. This would represent an enormous simplification in our theoretical attack on the structure of the universe.

University of Chicago nuclear physicists also have reported experiments that contribute to the contradiction of the principle of conservation of parity. Results of the tests, begun in September, parallel those announced by Columbia.

In relatively simple experiments, Valentine L. Telegdi, associate professor of physics, and Jerome I. Friedman, research associate, both in the university's Enrico Fermi Institute for Nuclear Research, used the decay of the pi meson to show that matter is not equally "right- and left-handed" but has a definite preference for one. This was determined by the decay tracks of the meson in photographic emulsions. Comparisions of the Chicago results with those of the Columbia experiments, which used electronic, rather than emulsion, techniques, were made by telephone.

Regional Consultants on Science and Mathematics Teaching

In order to meet more effectively the goals of the AAAS Science Teaching Improvement Program during the coming year, a plan for regional consultants in science and mathematics to serve colleges and universities has been established. The consultants will be available for visits to colleges and universities in their areas upon invitation by the institutions. In accepting responsibility for this work, the 20 consultants will actually be additions (without compensation) to the staff of STIP, which will pay travel expenses and a small allowance for secretarial help. The schedule of visits will be the responsibility of each consultant. This regional consultant service has been made possible by a grant to the AAAS from the General Electric Educational and Charitable Fund.

STIP is an action program to increase the number of well-qualified science and mathematics teachers at the secondary-school level. In order to carry out STIP, the cooperation of scientists in all parts of the country must be obtained. Success will depend to a considerable degree upon decisions and activities on a local basis. During the first year of operation, representatives of STIP presented the program to scientists on 50 college and university campuses, in state and regional meetings called by STIP, and at meetings of 12 state academies of science as well as of other professional scientific societies. In these travels many

good suggestions were obtained; counsel was given on the development of local projects, and cooperation was sought in the attainment of STIP objectives.

The frequent suggestion that visits to a campus from a representative of a national scientific society can be of value in the stimulation of local activity has resulted in the project for regional consultants. In calls on colleges and universities the consultants might: (i) meet with staff members in education and science jointly to consider problems of science and mathematics teacher education; it would be desirable in these conferences if at least one representative of the state department of education could also be present, and possibly also secondary-school teachers; (ii) suggest ways in which colleges and universities might maintain closer working relationships with science and mathematics teachers in secondary schools; (iii) review possibilities for achieving greater awareness of the need for strong programs in science and mathematics, on the part of the general public, school boards, and school administrators; (iv) take part in the discussion of programs to interest more young people in the study of science and mathematics and the preparation for careers in science, engineering, and teaching; (v) seek information about promising programs which can be shared with other consultants and with the STIP office; (vi) discuss ways in which the AAAS, through STIP and other activities, may be of assistance in the improvement of science teaching.

The regional consultants for various areas are the following: *New England,* selection to be made by American Academy of Arts and Sciences; *New York,* Lowell D. Uhler (biology), Cornell University; *Pennsylvania, New Jersey,* Marsh White (physics), Pennsylvania State University; *Virginia, West Virginia,* E. J. McShane (mathematics), University of Virginia; *Maryland, Delaware, District of Columbia,* I. E. Wallen (zoology), assistant director, STIP (on leave from Oklahoma A&M College); *North Carolina, South Carolina,* Walter M. Nielsen (physics), Duke University; *Georgia, Alabama, Florida,* Russell H. Johnsen (chemistry), Florida State University; *Ohio, Michigan, Indiana,* A. B. Garrett (chemistry), Ohio State University; *Wisconsin, Minnesota,* Kenneth O. May (mathematics), Carleton College; *Illinois, Missouri, Iowa,* Jerry J. Kollros (zoology), State University of Iowa; *Kentucky, Tennessee,* F. Lynwood Wren (mathematics), George Peabody College for Teachers; *Mississippi, Arkansas, Louisiana,* Houston Karnes (mathematics) Louisiana State University; *Nebraska, Kansas,* G. Baley Price (mathematics), University of Kansas; *Montana, North Dakota, South Dakota,* Adrien L. Hess (mathematics), Montana State College; *Oklahoma, Texas,* Joe P. Harris, Jr. (biology), Southern Methodist University; *Colorado, Wyoming,* Burton W. Jones (mathematics), University of Colorado; *New Mexico, Arizona,* M. G. Seeley (chemistry), University of Arizona; *Utah, Nevada,* Melvin C. Cannon (chemistry), Utah State Agricultural College; *Washington, Oregon, Idaho,* E. G. Ebbighausen (physics), University of Oregon; *California,* Norman A. Watson (physics), University of California (Los Angeles).

JOHN R. MAYOR
AAAS Science Teaching Improvement Program

Zürich and the Hungarian Crisis

The students of the Swiss Federal Institute of Technology, Zürich, canceled their traditional banquet and ball this year in order to carry out a collection to pay the expenses of Hungarian refugee students so that they might continue their studies in Switzerland. At almost the same time, the students and staff of the University of Zürich passed the following resolution:

"1) We the Professors, Lecturers and Students of the University of Zurich, assembled in the Great Hall, express our indignation and loathing at the inhuman action of the Communist rulers of Russia against the Hungarian efforts towards freedom.

"2) We unconditionally condemn the renewed subjugation of the Hungarian people, which is a flagrant violation of the right to self-determination, the maintenance of which was solemnly guaranteed by Soviet Russia.

"3) We express our admiration and are deeply moved by the heroic struggle of the Hungarian people and bow our heads mournfully, thinking of the dead who have given their lives, fighting for liberty. We mourn with their widows and orphans and vow our aid wherever an opening can be found for any help.

"4) We appeal to all Universities of the Western World to unite in the struggle against the moral, physical and spiritual subjugation of the peoples of Europe and to search for ways and means of liberating them from their shackles.

"5) We stand up for human dignity and the human rights which in the case of entire peoples have been shamefully trampled on by Soviet Russia, and we pledge our support in defence of the freedom of learning.

"6) We are not content with a mere protest and unite in a solemn vow neither to maintain nor accept any kind of scientific or cultural relations with Soviet Russia, as long as the Communist rulers of Russia continue to dishonour Hungary or any other European nation by brutal repression of spiritual liberty and to rob it of its hereditary culture.

"7) We call on all concerned to exclude Soviet Russia entirely from any economic, athletic and ideological relations."

Retinal Pigment in Deep-Sea Fish

It has been known that the visual pigments of fish are not all alike. Wald has made the generalization that the retinal pigments of fresh-water forms are purple (porphyropsins) and those of coastal marine forms rose-colored (rhodopsins). To these, E. J. Denton and F. J. Warren [*Nature* **178**, 1059, (10 Nov. 1956)] have now added another group of visual pigments that are characteristic of deep-sea fish. These pigments, which are golden, have been designated as chrysopsins or visual golds.

Experiments were carried out on board R. V. *Sarsia* with the fresh retinae of four species of deep-sea fish from the Bay of Biscay (*Stomias boa, Flagellostomias* sp., *Argyropelecus olfersii, Mycotum punctatum*). The unbleached retinae were golden on simple visual inspection. The changes in spectral absorption on bleaching were those of retinal photosensitive pigments differing from visual purple in that their maxima were displaced about 20 mμ toward the blue end of the spectrum. A retinal pigment with a very similar absorption curve has recently been found in the conger eel, which is a deep-sea form when young and again, finally, when mature.

The golden retinal pigments found by Denton and Warren to occur in high density in all of their deep-sea fish are admirably suited for efficient utilization of that particular fraction of daylight which reaches deep oceanic waters. Additional experiments aboard R. R. S. *Discovery* showed that 15 species of deep-sea fish contained golden retinal photosensitive pigments and that only one oceanic fish, a surface form (*Saurus scombresox*), had visual purple.

—W. L. S., Jr.

High-School Mathematics Club

A national high-school mathematics club, Mu Alpha Theta, has been formed. This is the first time that such an organization has been established at the national level, and it is expected that existing and future high-school mathematics clubs, if properly qualified, will wish to join the new organization.

The officers of the governing council are as follows: pres., Henry L. Alder, Department of Mathematics, University of California, Davis; v. pres., Edward