tion by a group from Saclay, where it is being built. In the early 1970's, the beam intensity of the proton synchrotron is expected to be increased by a booster injector.

Meanwhile, what physics is being done with the new neutrino beam? In an earlier CERN experiment, the data mostly concerned elastic neutrino-neutron interactions in the bubble chamber in the nuclei of the constituents of a freon (CF_3Br), producing observable protons and muons. Now data on inelastic neutrino-proton interactions is being sought. Neutrino-proton interactions produce pions as well as muons, but in heavy nuclei, such as those of freon, the pions tend to be absorbed: hence the switch to propane (C_3H_8) as the liquid in the bubble chamber. Propane contains a greater number of protons per unit volume than liquid hydrogen does, and therefore several neutrino-proton events are observable each day; the presence of carbon nuclei gives five times as many events, but most of the secondary particles from these interactions can be sorted out by the use of a 27-kilogauss magnetic field within the chamber. Beyond the bubble chamber, an array of spark chambers will be used to observe neutrino-produced muons deflected by the magnetic field in the bubble chamber, and thus to verify (to an accuracy of one event in a thousand) the muon-conservation law that the neutrino always yields a negative muon while the antineutrino yields a positive muon.

More generally, the new experiments will represent a big advance over the rather crude neutrino experiments of the past. "The aim," as L. van Hove, chief theoretician at CERN, puts it, "is to study absolutely precise, clean reactions." Deeper questions are now being asked: for example, do neutrons "look" the same to neutrinos as they do to other particles, such as electrons?

Another important study at CERN promises the most precise determination of one of the very few properties of the muon that distinguishes it from the electron: the gyromagnetic ratio relating its spin and magnetic moment, which differs from that of the electron by half a percent. With the use of a muon storage ring 5 meters in diameter, the gyromagnetic ratio of negative muons has been determined to be better than one part in a thousand, and the value agrees with the predictions from quantum electrodynamics. Reversal of the polarity of the storage ring, and improved instrumentation, should now give an even more precise value for the gyromagnetic ratio of the positive muon.

Despite the growing interest in neutrinos and other leptons (weakly interacting particles), the work at CERN continues to be dominated by investigation of the strong nuclear force—in particular by the classification of hadrons (strongly interacting particles) according to unitary symmetry. Several experiments are in progress to aid understanding of particle collisions in terms of the new classifications through systematic comparisons of interactions between protons and a wide range of incident particles. Table 1 shows current work with the proton synchrotron at CERN and serves, incidentally, to illustrate the international character of the undertaking.

At the end of June a key piece of equipment for a new and unique CERN facility arrived at Geneva from the University of Aarhus, Denmark. It is the isotope separator for the Isolde project, which is linked to CERN's 600-Mev synchrocyclotron and will open up new opportunities to nuclear physicists. The creation, separation, and study of very short-lived nuclides has generally depended on what nuclear chemists call the RAFAP technique (Run as Fast as Possible) for transporting irradiated material to the laboratory. The trend now is toward on-line analysis, and, in the CERN project, it has reached a high pitch, with successive chemical and electromagnetic separators producing isotopically pure ion beams that are fed to an array of detectors by ion optics or moving-tape collectors. Nuclides with half-lives from 10 seconds down to 0.1 second will become susceptible to study.

Fewer than half of the "credible" nuclides, those believed to be stable against nucleon emission, have so far been identified. Further exploration of the very short-lived neutron-rich and neutron-depleted nuclei on either side of the ribbon of known stable and radioactive nuclides will be of interest to theorists as knowledge of binding energies and deformed nuclei becomes available. The high-energy processes of fission and spallation that give rise to the short-lived nuclei must also occur in stars and are therefore relevant to theories of the astrophysical formation of the elements.

The first experiments with the new facility will be concerned with the production of short-lived isotopes of xenon, krypton, mercury, and alkali metals. The development and use of special techniques appropriate to various target elements will occupy experimenters for years to come. The target element for production of mercury isotopes, for example, will be lead which will have to be kept near its melting point to allow the mercury atoms to diffuse rapidly out of the target. Beside CERN's own nuclear chemists, participants in the project come from Aarhus, Copenhagen, Gothenburg, Heidelberg, Orsay, Oslo, and Stockholm. A group from Orsay, using the proton synchrotron but without the chemical separator, has already carried out a similar experiment at CERN. The group has discovered new, short-lived rubidium and cesium isotopes.

The atmosphere of CERN today is one of hard work and high confidence. The imminent completion of the 70-Gev accelerator at Serpukhov does not seem to dismay anyone, and van Hove guesses that CERN still has about as good a chance as any laboratory of discovering the long-sought quarks, the hypothetical particles of which the other particles are composed.

—NIGEL CALDER

APPOINTMENTS

Robert E. Stowell, scientific director of the Armed Forces Institute of Pathology, to chairman of the department of pathology and assistant dean of the School of Medicine, University of California, Davis. . . . **Norman J. Boyan**, associate professor of education, Stanford University, to director of the Division of Educational Laboratories, Bureau of Research, U.S. Office of Education. . . . **Shannon McCune**, educational consultant to a United Nations mission in Indonesia, to director of the American Geographical Society. . . . **Roy O. Greep**, dean of the Harvard School of Dental Medicine, to John Rock Professor of Population Studies, Public Health Department, Harvard, and to director of the Laboratory of Human Reproduction and Reproductive Biology, Harvard Medical School. . . . **Charles H. Boettner**, chief of surgery, Public Health Service Hospital, Chicago, to associate director of the Bureau of Health Manpower, U.S. Public Health Service.