made against others, such as schistosomiasis. (Liu read part of a poem by Chairman Mao praising a successful battle waged by one community against the snail-borne disease.)

Liu received her master's and doctorate degrees at the University of Illinois, returning to China in 1954, where she now works in the Institute of Environmental Chemistry of the Chinese Academy of Sciences. She describes the government's role in environmental protection as one of coordination and support. Research, for example, is largely aimed at conducting effluent-quality surveys, studying natural cycles of ground water, analyzing drinking water and human blood for trace element contamination, and development of catalytic reactors to neutralize industrial wastes. Liu pointed to some specific results of these endeavors, including successful correlation of certain diseases to trace element contamination, and partial control of the "yellow dragon"—nitrogen oxide smoke. Some sophisticated techniques have apparently also been developed; Liu mentioned the use of laser scanning to measure particulate concentrations.

Though "many problems remain," she says, success of initial environmental programs can already be seen in the health of the people and the sight of the land. Even the Yellow River is now less yellow because reforestation has helped control erosion upstream. Addressing her American colleagues as "dear friends," Liu said the delegation hopes to gather useful suggestions from scientists here on how to meet environmental challenges. □

Charging quarks through beta decay

The beta decay of nuclei has been extensively studied since the late 19th century. There are libraries of data on it, and its parameters are very well known. Perhaps this precision can be used to determine things about the particles that make up the nucleus, things that direct particle-physics experiments necessarily have to be somewhat vague or even inconclusive about. "In a spirit of adventurous naivety" D.H. Wilkinson of Oxford University sets out to use beta-decay results to check the theoretical prediction of the electric charges of the quarks. His results, presented in the Sept. 18 NATURE, favor the original quark theory.

The effort is adventurously naive or naively adventurous because to arrive at this quasi-experimental determination one must believe not only the basic hypothesis to be tested but a chain of subsidiary hypotheses as well. As R.J. Blin-Stoyle of the University of Sussex remarks in a commentary in the same issue of NATURE, "This is a remarkable connection to make [between quarks and beta decay] and inevitably intermediary assumptions and hypotheses have to be made in achieving it."

The basic hypothesis to be assumed is that protons and neutrons are made up of quarks. Beta decay involves the change of a neutron to a proton by the emission of an electron and an antineutrino, so it is the quark structure of protons and neutrons that is dealt with. Theory proposes that particles (except leptons) are made of two or three out of three subparticles called quarks. The three are designated: n, p, and lambda (because they have certain properties analogous to neutrons, protons and lambda hyperons). The makeup of neutrons and protons is supposed to involve n and p quarks. The older quark hypothesis says the charge of a p quark is two-thirds that of an electron and is positive. That of an n quark is one-third the electron charge and negative. (A newer suggestion would allow the charges to be equal to the electronic charge.)

Wilkinson points out that there is some independent evidence for quarks in the construction of neutrons and protons from particle-physics experiments. They seem to indicate constituents that act over a radius of 0.02 fermi. Since the size of the neutron or proton is about 0.8 fermi, the quarks are indeed point particles. It also appears that they make up 95 percent of the nucleon, leaving only a small allowance for antiquarks.

Beta decay is mediated by the so-called weak interaction, but since electromagnetically charged particles are involved, corrections for electromagnetic forces are also involved. It is the strengths of these (their coupling constants) that are crucial in the calculation. To arrive at the basis of calculation requires swallowing some hypotheses about the weak interaction, especially that the weak interaction is universal, acting in the same way in all the phenomena it governs, and that it is related to the electromagnetic according the unified field theories now current.

With that basis Wilkinson comes to a relation between the forces and their coupling constants and how those data relate to quark charges. He then uses data from particularly simple kinds of beta decay, which, Blin-Stoyle says, "have been carried out to extremely high accuracy [and] have been the preoccupation of Joan Freeman and her colleagues at Harwell and more recently by other researchers in Canada and the U.S.A." Wilkinson arrives at a charge for the p quark of 0.69 $\pm$ 0.07 and for the n quark of minus 0.29 $\pm$ 0.15. This is compatible with the classic quark theory but not with the integral-charge theory.

Blin-Stoyle points out that this is only one of the properties of elementary particles that can be derived from low-energy work in nuclear physics. Others are being studied (time-reversal invariance, parity-violating nuclear forces, exotic interactions). ". . . There are those of us who feel" he says, "that quite apart from achieving a full understanding of the nucleus as a many-body system, there are these other important reasons for continuing detailed studies of nuclear phenomena." □

A second gamma pulsar

The term "pulsar" now bears two somewhat different and perhaps confusing meanings. Originally it was applied to the pulsating celestial radio sources first discovered by Antony Hewish and colleagues. Later it was applied to pulsing X-ray sources. Generally the radio pulsars do not emit pulsed radiation in other ranges of the electromagnetic spectrum, and the same goes for most X-ray pulsars. The X-ray pulsars are usually part of binary systems, whereas only one radio pulsar is known to be. Radio pulsars are generally held to be neutron stars, but two X-ray pulsars are suspected of being black holes.

Among all this there have been two objects with a broad spectrum of pulsations, both of which were first discovered as radio pulsars. The Crab nebula pulsar pulses in light, X-rays and gamma rays, as well as radio. The Vela pulsar, known to pulse in light and radio, now, according to the latest report (ASTROPHYSICAL JOURNAL 200:L79), joins the Crab pulsar as the second known gamma-ray pulsar.

Gamma rays are the shortest-wavelength end of the electromagnetic spectrum. They carry more energy and are therefore "harder" than X-rays. Exactly where the boundary between X-rays and gamma rays lies is sometimes a matter of taste, but what is at issue is radiation with energy greater than 35 million electron-volts per particle as measured by the second Small Astronomy Satellite. The pulsed emission comes in two peaks that follow the single radio peak by 13 and 48 milliseconds.

The observers, D.J. Thompson, C.E. Fichtel, D.A. Kniffen and H.B. Ögelman of the NASA Goddard Space Flight Center in Greenbelt, Md., report that the luminosity of the pulsed emission above 100 million electron-volts is about a tenth of that of the Crab nebula in the same range, but the luminosity of the pulsed light from Vela is only about two ten-thousandths that of the Crab. The high intensity of the gamma-ray emission from Vela and its double- pulse structure suggest that it may be produced by means different from those of lower-energy emissions, the observers conclude. The gamma rays could be incoherent synchrotron radiation emitted by electrons of 100 to 1,000 million electron-volts energy orbiting in a magnetic field of 10 billion to a trillion gauss. □