A JOURNEY TO CHINA

by Glenn T. Seaborg

I have just returned from a 17-day visit to the People's Republic of China as a member of a delegation organized by the Committee for Scholarly Communication with the People's Republic of China (jointly sponsored by the National Academy of Sciences, Social Sciences Research Council and American Council of Learned Societies). Throughout our visit, the 21 people in our delegation were the guests of the People's Republic of China through its Scientific and Technical Association. We visited research institutes, universities, hospitals, communes and factories, as well as many other points of historical and cultural interest.

A primary objective of our visit was to negotiate an agreement with our Chinese hosts for the exchange of visiting groups of scholars in the natural sciences, the social sciences and the humanities.

A high point of our visit was a two-hour meeting with Premier Chou En-lai in one of the rooms in the famous Great Hall of the People. Many of our host Chinese scholars were also present. The Premier showed a remarkable and detailed familiarity with the proposed exchange agreement, indicating which of our suggestions he found acceptable.

In Peking, I visited the Institute of Geophysics, the Institute of Agricultural Applications of Atomic Energy, the Institute of Chemistry, the Institute of Physics and the Institute of Atomic Energy, as well as Peking University and Tsinghua University. At each place we were given informative tours, and our questions were freely and completely answered. Since the Cultural Revolution (1966-70), the work at these and at the other places we visited has taken on a very practical aspect, with less emphasis on theory than is found in comparable establishments in the United States or in Europe.

At the Institute of Geophysics, the emphasis is on seismology and the problem of predicting the location, magnitude and time of earthquakes. China has maintained earthquake records for 2,000 years, somewhat fragmentary for the earliest years, but in enough detail to include estimates of magnitude as well as records of place and date during the last 500 years. These records are being analyzed to show alternating periods of high and low seismicity; such data should be of value to seismologists in the United States.

At the Institute of Agricultural Applications of Atomic Energy, the emphasis is on production of new strains of wheat and other crops, using selective breeding and radiation-induced mutations.

Premier Chou En-lai and Glenn T. Seaborg in Peking, May 27, 1973.

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The work at the Institute of Chemistry is focused on high polymer chemistry, particularly photosensitive polymers with applications in the printing industry, cross-linked block polymers that have both plastic and elastic properties, polymers with photoconductive properties that might lead to the development of a chemical method for the conversion of solar energy to electrical power and nylon-like polymers with unusual strength. They are also working on organic silicon compounds used for lubrication oils, rubber, insulation in electric generators, resins for printed circuits, water repellent coatings and rust resistant varnish.

At the Institute of Physics, research is carried on in plasma physics, magnetism, lasers, crystallography, low-temperature physics, high-pressure phenomena, acoustics and theoretical physics. The X-ray crystallography program has concentrated on the structure of insulin, in collaboration with the group at the Institute of Biochemistry in Shanghai, who achieved the first synthesis of insulin a few years ago. Of special interest are their efforts in controlled thermonuclear reactions (nuclear fusion). They are investigating three approaches—two using magnetic confinement and one using the concept of laser-induced implosions. For magnetic confinement they have apparatus of the theta pinch and strong focus type, and they have observed the production of neutrons (which could be evidence of fusions taking place) with both of these machines. They readily conceded, however, that these could be the result of nuclear reactions produced by deuterons accelerated in the electric and magnetic fields in the apparatus. The work on laser-induced fusion is of a preliminary nature and has not reached the stage of testing for the production of neutrons.

The Institute of Atomic Energy is located some 40 kilometers (an hour's ride) from the center of Peking. Associated with this institute is a group in Peking concerned with theoretical physics, including elementary particle physics and cosmic rays, and a cosmic-ray laboratory in the mountains (3,200 meters altitude) of Yunnan Province in Southern China. The institute is organized into divisions of reactor engineering, accelerator engineering, neutron physics, nuclear reactions, theoretical nuclear physics, elementary particle physics, nuclear electronics, nuclear detectors, radioactive isotope production and stable isotope production. Since 1958, they have had a seven-megawatt heavy-water reactor and a

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120-cm cyclotron, both of Soviet design. There is also a 2.5-million volt Van de Graaff of Soviet design. The cyclotron delivers 24-million-electron-volt (MeV) helium ions, 12.5 MeV deuterons (with an external beam of 80 microamperes) and, as a result of a recent modification to include a 3-sector magnet, variable energy protons of 3 to 19 MeV energy. Present emphasis at the cyclotron is on deuteron stripping reactions.

A neutron crystal spectrometer has been used with the reactor to measure neutron absorption cross sections, including the fission cross sections of uranium 233 and uranium 235, over the energy range of 10^{-2} to 10 eV. No work with plutonium is done here. A neutron diffraction apparatus is used to measure crystal structures and disorder in alloys. The reactor is also used for neutron activation analysis and, together with the cyclotron, as a source of isotopes for processing in the radiochemistry laboratory. In the radiochemistry laboratory such radioactive isotopes as P-32, S-35, Cr-51 and I-125 are separated, purified and synthesized into compounds for use in Chinese hospitals.

Of special interest are the two 180-degree magnetic separators for stable isotopes—one with a 220-ton magnet, 6 kilogauss field, and orbit radius of one meter; the other with a 280-ton magnet, 3 kilogauss field, and orbit radius of 1.7 meters. They separate the stable isotopes of such elements as Cu, Fe, Yb, Ce, Mg, Ni, Cr, Se, Li, Sr and Rb with average yields of the order of 10-20 milligrams per hour, for use in research laboratories throughout the country.

In Shanghai, I visited the more recently established Institute of Nuclear Physics in the company of Victor Weisskopf (Massachusetts Institute of Technology) and Robert Sachs (director, Argonne National Laboratory), fellow members of our delegation. We had the impression that we were the first Americans to visit this institute. Here there is also a 120-cm cyclotron (a copy of the cyclotron at the Institute of Atomic Enegry in Peking), built by themselves in the period 1960-64, after the break with the Soviet Union (which occurred in 1958-60). Here they are measuring the fast neutron fission cross sections of Th-232, U-238 and Pu-239. The cyclotron is also used in a program of charged particle activation analysis. This institute includes divisions of nuclear physics (including a theoretical group), instruments, radiation and isotopes applications and radiochemistry. In the latter divisions, C^{14}-labeled amino acids and tritium-labeled steroids are synthesized for use in other institutes such as the Shanghai Institute of Biochemistry. Especially noteworthy is their work on nuclear batteries, in which they plan to use Sr-90 with thermoelectric conversion to electricity of the heat of radioactive decay.

I gave talks in my specialty—the transuranium and superheavy elements—on three occasions, each lasting at least a couple of hours including time for translation. I spoke to a combined meeting of the Chinese Physical and Chemical Societies in Peking, to the science faculty at Nanking University in Nanking, and to a group representing numerous research institutes and educational institutions at the Science and Technology Center (Station) in Shanghai. In Shanghai, my presentation in the morning lasted two and a half hours and the discussion was pursued for two hours in the afternoon. At each place, the questions and discussion following my talk were carried on at a very informed and sophisticated level.

We did not see any direct work on atomic power during our visit to the People's Republic of China. We were told that China has adequate supplies of fossil fuels, so the development of atomic power is not an urgent matter. We received indications, however, that they are beginning to move toward the development of atomic power, with preference for the enriched-uranium water-cooled reactors (the pressurized-water reactor (PWR) was mentioned) rather than the natural-uranium graphite reactors.

OFF *the* BEAT

Members of our delegation were interested in visiting Chinese hospitals and to learn about medical practices. Acupuncture plays a central role in Chinese traditional medicine, which has been revived by Chairman Mao since the Liberation. It has been used for thousands of years for curative purposes, which may be of limited value, but was not expanded for use in anesthesia until the 1960's. Its use in anesthesia seems to have definite value and should be introduced into Western medicine. Many Western doctors are planning to visit the People's Republic to learn this technique. Although I was not able to do so, several members of our delegation saw caesarean sections and abdominal operations, performed under acupuncture anesthesia, throughout which the patients were conscious and perfectly content. We saw graphic movies of such operations.

All of the universities and colleges were closed down throughout the Cultural Revolution (1966-70). Peking and Fu Tan Universities reopened in 1970, the others that we heard about in 1972. During the Cultural Revolution, these institutions retained their teaching personnel, who spent the time reflecting on Chairman Mao's teachings and how they could reform their own teaching to better serve the masses. They usually also spent time working in the factories (especially the scientists and engineers) or fields (the social scientists and humanists). The post-Cultural Revolution philosophy emphasizes the practical; it downgrades theory, even in science, downgrades social science, and most of all, literature and the arts. The entrance requirements for students are entirely changed. Important in this process is their standing with "the masses" and their peers, and their acceptance of Chairman Mao's philosophy. Because the teaching faculties were retained during the Cultural Revolution and the schools have only recently reopened, the ratio of teachers to students at this time is usually one to one. This will decrease as successive classes arrive (up to the total of three for the uniformly three-year course), but apparently the ratio is not expected to drop below about one to five. These figures include assistant instructors and what we would call teaching assistants.

Our reception was very friendly everywhere by people in all walks of life. Our scientist hosts were uniformly glad to see us, volunteered information on their education in the United States, and asked about the state of health of their friends in the United States. The people in the streets were always friendly, without exception, and often stood in groups to welcome us with clapping of hands. Children almost invariably welcomed us with clapping of hands, individually and in groups, as we entered or left our cars, hotels or points of visit, and even as we rode past in our cars. Often we were objects of curiosity, and people on foot or on bicycles would turn around to catch another look at us after passing. We were afraid someone on a bicycle would have an accident as he or she looked back. Sometimes little children were frightened by the strange sight of seeing us, and would hide behind their mother's legs when we looked their way, but would invariably smile back and look joyfully at their mothers when we welcomed them with a smile.

Besides laying all the essential groundwork for the exchange agreement, I believe our delegation contributed to increased understanding between the scientists, and more broadly, between the people of the United States and the People's Republic of China. I personally found our journey to China a very interesting and rewarding experience. □