state & society

C. N. Yang discusses physics in People's Republic of China

Before the cultural revolution started in 1966, high-energy theorists in the People's Republic of China were very active, according to Chen Ning Yang, who recently returned from a month-long visit there. He learned that in 1965 or 1966 Chinese theorists had developed a theory of "stratons" (for strata) that very much parallels the quark theory, which was proposed by Murray Gell-Mann and by George Zweig in 1964.

Yang, who shared a 1957 Nobel prize with Tsung-Dao Lee for their work on nonconservation of parity, is at the State University of New York at Stony Brook.

During his visit Yang saw Futan University, the Institute of Biochemistry and the Institute of Physiology in Shanghai, and Peking University, Tsinghua University and the Institute of Nuclear Physics in Peking. In addition he visited factories and hospitals, gave lectures, and had dinner with Premier Chou En-lai.

The straton theory, which comes up with three elementary particles the same way as the quark theory, was developed mainly by the elementary-particles group in the Institute of Physics in Peking (which like all institutes is part of the Academy of Sciences). Yang met Lee Yu-an and Ho Tso-syu who are members of the group; its members are mostly about 35 to 40 years old. He found a number of them to be very bright and relatively well informed about work abroad. When the cultural revolution ended last year, they resumed their research work.

The theoretical groups at the Institute of Nuclear Physics, the Institute of Physics and the physics department of Peking University are all physically close to each other; so the members talk to each other all the time, Yang said.

Accelerators. China has no high-energy accelerator, but it does have low-energy equipment. At the Institute for Nuclear Physics Yang saw a cyclotron that was recently modified to produce 14-MeV protons, a small Van de Graff accelerator and a 12-MW (formerly 7-MW) nuclear reactor. He learned of considerable neutron research being conducted with the reactor, both nu-

continued on page 62

Chen Ning Yang at Peking University (formerly called Yenching University) during his visit there during August. In the background is a water tower dressed as a pagoda.

Internships at federal labs for unemployed

The White House recently announced a $3-million program that would provide about 420 unemployed scientists with one-year internships at federally-funded R & D laboratories. Presidential Science Adviser Edward E. David Jr said that the fields in which the internships would have the greatest impact are those of current social concern, such as pollution, trash disposal, management and integration of large projects, and nuclear techniques ranging from new power systems to medical and criminal laboratories.

Funds will come from the Department of Labor's Technology Mobilization and Reemployment Program and will be administered by the National Science Foundation's Division of Graduate Education in Science.

Candidates can apply directly to federally-financed laboratories for the non-renewable internships. The laboratories will be given $7000 towards a stipend for each intern and must provide matching funds ($7000 or more) as stipend supplementation, overhead costs or an appropriate mixture of both, as determined by the laboratory.

In a memorandum from NSF to directors of federally funded laboratories that employed more than 100 professional staff members (although smaller laboratories are also eligible), NSF said, "Appointments are expected to be made only to young, unemployed scientists or engineers holding advanced degrees (master's or higher), whose qualifica-

tions and promise are clearly superior. When applicants have equal qualifications, veterans and those from areas of high unemployment of scientists are to be given preference."

NSF said that it expected that care would be exercised in assigning interns to jobs that would improve their potential for later job placement.

Grants are to be allocated on a first come, first served basis to the various laboratories.

AEC considers environmental impact of power reactors

The Atomic Energy Commission has amended its regulations on licensing of power reactors, uranium mills, fuel fabrication plants and fuel-processing plants and will take on responsibility for examining their total environmental impact. Also, an unpublicized section of the 1972 AEC authorization bill, recently passed by Congress, amends the Atomic Energy Act of 1954 to broaden the authority of AEC to conduct environmental and energy-related research for itself or others.

Court faults AEC. The amended regulations implement a recent court decision holding that AEC had "failed to live up to the congressional mandate" contained in the National Environmental Policy Act of 1969. James Schlesinger, recently appointed AEC Chairman, in announcing the decision not to appeal the ruling, said that the Commission's revised regulations would make AEC "directly responsible for evaluating the total environmental impact, including thermal effects, of nuclear power plants, and for assessing this impact in terms of the available alternatives and the need for electric power."

The decision was handed down 23 July in the course of a suit brought against AEC by three groups who charged that the Baltimore Gas & Electric Company's Calvert Cliffs reactor, being built on the Chesapeake Bay in Maryland, was not in accordance with NEPA.

The court agreed and found that AEC licensing procedures had not applied the provisions of NEPA strictly enough. The Commission was ordered to conduct its own investigations of all environmental factors in its licensing reviews; previously the Commission did not make an independent evaluation in areas under the jurisdiction of other federal agencies or state and local bodies. In its decision the court also criticized the Commission for its handling of power projects that had been started before NEPA went into effect on 1 Jan. 1970, and ordered AEC to conduct strict environmental reviews of all plants, regardless of their stage of construction.

Early in September, AEC announced that revisions to the regulations had been drawn up, and more recently, Commission officials have clarified the new procedures for *physics today*.

AEC will now review all the possible environmental effects of a nuclear plant in its "detailed statement of environmental considerations," which is prepared by AEC based on information supplied by the builder and AEC's own staff.

In addition the Commission must examine fully any alternative possibilities such as fossil-fuel plants, buying of power and other sources. Finally a cost-benefit analysis must be made in which the predicted environmental and economic effects of the plant are balanced against the need for power, to make a final determination as to whether or not the plant should be granted a license.

Plant construction delays. In the light of the court's ruling, the greatest difficulty that the Commission and the nation's power companies now face is how to handle the roughly 100 nuclear power plants that are completed, near completion or beginning construction. The court ruled that plants under construction must be examined now for future environmental effects, so that major expenses that would be incurred by altering a finished plant could be avoided. The court expressed concern that high alteration costs might restrict the Commission's options.

AEC has requested most projects holding construction permits and operating licenses to show cause why their permit or license should not be revoked pending the complete environmental review required by the court. Permit and license holders must also prepare information on which AEC can base its reviews.

How much of a delay the new processing will cause is still not clear, and no one queried at AEC appears willing to say. Meanwhile, an industry source told us that the additional review could double costs involved in getting a plant licensed, presently about $250 000.

Research reactors may also come under court ruling. Columbia University has asked for a postponement of licensing hearings for its TRIGA research reactor to allow time to make an environmental study (see *physics today*, June, page 61). Columbia is concerned that its license, if granted by AEC (whose new rulings do not affect research reactors) may be questioned, in the light of the Calvert Cliffs decision, by a third party.

New AEC role. Amendments to the Atomic Energy Act of 1954 provide additional authority for AEC to use the resources of its national laboratories for research and development of clean energy sources that are not directly related to nuclear energy. The Joint Congressional Committee on Atomic Energy, in its report on the bill, cited underground electric transmission and magnetohydrodynamics as examples of research projects that the laboratories could undertake. The Joint Committee noted that the amendments were a response to the President's Energy Message to Congress in June (*physics today*, August, page 69). —SMH

C. N. Yang *continued from page 61*

clear physics and solid state. The accelerators and the reactor were built in the late 1950's with Russian assistance.

At Tsinghua University Yang went through some of the electronics shops and saw scaling circuits and other electronic equipment being assembled. Yang was told that practically all Chinese electronic equipment is now made in China.

China is now considering the possibility of constructing a high-energy accelerator and if so, what kind it should be. Yang says that the physicists are confident that whatever they decide to make, they will succeed in making. This is in contrast to the feeling in the 1950's when the Chinese did not feel the same technological confidence.

Before he went to China, Yang had the impression that industrial production over the last 12 or 14 years had not made much progress, but he soon revised his assessment. In quantity, he said, it is true that great progress has not been made in steel production, for example. But industrial products being made today are considerably more sophisticated; for example, China is making very large generators (125-MW generators are being made in relatively large quantities) and hydraulic presses. China, however, is still an industrially backward country, he said.

Although a high-energy accelerator is being actively discussed, Yang feels that Chinese physicists are even more interested in building a heavy-ion accelerator. But the discussions are not in a very mature state yet, he said.

The physicists are very interested in new trends in accelerator designs. They asked about the National Accelerator Laboratory and the CERN Intersecting Storage Rings. Yang was queried about both high-energy and low-energy nuclear-physics research, and his own work, of course. They asked about solid-state physics research and were very much interested in low-temperature physics, especially as applied to accelerator design.

Yang found the physicists generally well informed. They receive American publications with a time delay of three or four months, and he presumes they also receive Russian publications.

The scientific program at the Institute for Nuclear Physics is directed by Chang Wen-yu, a physicist who was at Princeton and Purdue until 1956. His official title is the Deputy Chairman of the Revolutionary Committee. Yang explained that every organization in China—institutes, schools, communes, shops and so on—has a revolutionary committee that serves as the administration. The chairman of the institute's revolutionary committee is an Army man named Cheng.

Yang found similar arrangements at other organizations that he visited and at first found it strange to find so many Army people in charge. But the Chinese army, unlike that in many other nations, is primarily a well organized, well disciplined, well equipped portion of the population.

At Peking University there are seven departments of science, twenty departments all together, and the physics department is relatively large. It did not function as an educational institution as we know it, Yang said, between 1966 and 1970. But in 1970 it began with a new student body, admitting 2800 freshmen last year.

The Peking University physics department has a group in high-energy theory headed by Hu Ning, who was in the US in the early 1950's. The department is clearly more oriented toward practical things (emphasizing semiconductor work, for example) than would be a corresponding department in the US. One expert there, Huang Kun, was Yang's roommate when they were both students at Southwest Associated University in Kunming during World War II. The two men had not seen each other since Yang left China 26 years ago to become a student of Enrico Fermi.

Physics and factories. Huang, who was in England for a while, wrote with Max Born a famous monograph about ionic crystals. He now leads a large group of theorists in semiconductor physics. But he also works in a factory. This is in line with the Chinese goal of amalgamating teaching, research and production. Toward that goal the universities either establish very close relationships with existing factories or they establish a small factory of their own, Yang said. Professors and students work side by side in these factories with the workmen.

In the past, Huang only drew diagrams on the blackboard, he told Yang. Now he knows how the devices are made, although he is not very good with his hands. He gives courses at the factory to the workmen and the students to explain the theoretical meaning of what they are doing. In this amalgamation of people from very different backgrounds, they try to help each other learn what one is capable of learning but has not yet learned, Yang said. Huang is full of enthusiasm about the method.

Some research institutes, too, are connected with factories, Yang said. He doesn't think any high-energy physicists are working in factories, but semiconductor physicists are likely to be connected with them.

Yang feels that American universities could benefit from some of the Chinese experience, and suggests that educators and university administrators visit China and study Chinese educational innovations. After all, he said, there is a movement here to become more practical and to be more integrated with social problems. Such directions are in line with the Chinese approach, he said, although "it is carried out there with a thoroughness that would frighten and surprise people here."

Chinese spirit. China is a country poor in material resources, Yang noted, although things are already infinitely better than they were when he lived there. But it does have a spirit and discipline that American society lacks. When President Nixon announced his new economic policy, he asked the American public to practice self-sacrifice and self-reliance and to be industrious. In China, Yang said, such a spirit is taken for granted as the fundamental tenet of the society.

Yang decided to visit China when he learned that his father was seriously ill in a hospital and then later heard that the travel ban had been lifted. He had been in contact with his parents all along, through letters and telegrams. Picking up his visa in Paris, he then flew to Shanghai on 19 July. He remained in China until 17 Aug.

At the dinner for him given by Premier Chou En-lai, about 25 guests were present, including 15 scientists. But the topic for discussion during the three-hour banquet and the two subsequent hours of conversation, was almost entirely not about science. Chou said he would like to know a little more about America, and proceeded to ask Yang about the student movement, university reform, the black movement, unemployment, the political atmosphere surrounding elections, the American attitude toward Japan, and so on.

It has been suggested that the invitation from Chou was a way of honoring science. Yang does not agree with that interpretation. Science was never in disfavor in China, he said, although a number of scientists were criticized for wanting to be treated as a privileged group. In this country society at large now has an antiscience attitude, he said, but that is not true in China. He feels that the Chinese believe that science is important and good for mankind and that therefore China should foster science. Such an attitude is based on the popular saying of Chairman Mao Tse-tung: "China should make greater contributions to Mankind." That is, especially through scientific development China should contribute to Mankind, Yang said.

Huang Kun (left) and C. N. Yang in front of Peking University physics department. Kun, a leading semiconductor theorist, also works in a factory.

"It sounds a little bit Puritanical and Boy Scoutish. The society is that way. China is a country with a purpose, and it has a pervading attitude that people should be moral." Perhaps such ideas are being instilled in everybody's mind because Chinese society lacks so many material resources. One may well ask whether China will still be practicing this idea 50 years from now, Yang said, but that question is irrelevant.

This attitude of making contributions to Mankind is one reason for supporting such esoteric fields as high-energy physics. But another justification, Yang noted, is the technological fallout from scientific research. He cited the example of the Institute of Biochemistry, where he met several of the scientists who participated in the synthesis of insulin in 1965.

When they embarked on this project in the late 1950's China had no appropriate experience and none of the fundamental chemicals with which one could start. But they felt that unless China started from somewhere, there would be no hope. Out of that experience, China is now manufacturing many chemicals, especially enzymes, a technique that was formerly nonexistent in China. —GBL