



Victory celebrations in Hanoi: pace of scientific organisation quickens

## Vietnamese journey

*Any country aspiring to an industrial and technological competence must have an underlying strength in basic science. The North Vietnamese know this, and taking their characteristic long view, have been organising their war-depleted scientific cadres into a versatile research nucleus. Their effort proceeded all through the war at whatever pace was possible, but wholesale evacuation of educational and research institutes to the countryside prevented rapid progress. As American participation in the war diminished and then ceased altogether, the pace of Vietnamese scientific organisation quickened. In June 1975, a scant six weeks after the formal end of hostilities, there were already strong indications that the Vietnamese will soon have high competence in the basic physical and biological sciences, as well as in the related applied fields of engineering, medicine and agriculture.—Arthur W. Galston reports.*

AS a representative of the Scientists' Institute for Public Information (SIPI) and carrying a gift of books, chemicals and equipment from the Society for Social Responsibility in Science, I had been invited for a return visit to North Vietnam in June 1975. My first visit, made in April 1971 together with Ethan Signer of MIT, had led to interviews with Prime Minister Pham Van Dong, the Ministers of Higher Education, Public Health, and Culture, and visits to numerous scientific institutions. Now in a Vietnam freshly at peace, I had been invited to lecture in my speciality, plant physiology and biochemistry, to instruct young scientists in techniques of plant cell and tissue culture, and to initiate a scientific aid programme from the United States (through SIPI) to the new Vietnam.

About four miles north-west of Hanoi, a large, modern science research centre is nearing completion. Financed

by the USSR and constructed under Soviet supervision with Vietnamese labour, the centre was originally planned and administered by the State Committee on Science and Technology, the leading scientific policy making group in Vietnam. Since the end of the war, and to insure rapid progress, the centre, under its newly appointed director, Nguyen an Hieu, has been placed directly under Prime Minister Pham Van Dong, to whom Hieu reports directly. At a private conference with these two men, I was struck by their close rapport, and by the Prime Minister's understanding of and direct concern with scientific matters. Almost unconsciously, I had to contrast this with the situation in the United States, where in spite of its vastly greater competence and importance, American science has had no science adviser close to the President since Richard Nixon dismantled the structure that had been

created and successively strengthened by his five predecessors.

Hieu is a 39-year-old theoretical physicist who received his training under the noted Professor Bogolyubov at Dubna, the huge research centre near Moscow run by a consortium of Warsaw Pact nations. In addition to his role as director of the centre, Hieu directs the Institute of Physics, one of the six operating units of the centre. Since the completion of his PhD training in 1961, Hieu has made substantial contributions to the field of elementary particle theory, and now, as a member of the governing council at Dubna, visits that establishment every year. Five of his students have also received their basic training at Dubna, and in recognition of this growing Vietnamese competence in physics, the Dubna consortium recently donated advanced research equipment worth, conservatively, half a million dollars to the centre. This equipment is now largely set up and functioning in a series of huts and basement rooms of the centre, but with the imminent completion of that structure, will move into more spacious, even elegant, quarters.

Aware of the potential practical importance of research in solid state physics, Hieu has recently shifted to that field, and the laboratory's organisation reflects that emphasis. Already, large germanium and bismuth-tellurium single crystals have been grown, their impurities removed in a diffusion separation furnace, and the resulting purer crystals thinly sectioned to furnish the elements of semiconductor diodes for amplifiers. Sprinkled around the laboratory is a mixture of advanced equipment from many nations in the Soviet bloc, as well as the latest in scientific publications from all over the world, efficiently and cheaply reproduced by the Chinese without royalty payments. I saw a large Soviet neutron generator in the activation analysis of minerals and proteins, several multichannel data analysers from East Germany, a computer of Hungarian design based on American integrated circuits, and an advanced spectroscopy laboratory with many components from France, Great Britain and West Germany. A large X-ray laboratory is involved in analysing the structure of crystals and a solar energy group is using semiconductors to translate light energy directly into usable quantities of electricity. These activities would be thoroughly familiar to western physicists, and it is clear that besides playing a role in the development of science in their own country, Vietnamese physicists are eager to enlarge their contacts with the rest of the world.

I could get no exact figures on the cost of the Science Research Centre but I judge its approximate area at

500,000 square feet of usable space. At even \$20 a square foot, a ridiculously low level by western standards, the building alone will be worth \$10 millions when completed. Together with its abundant scientific equipment, it should eventually be worth about \$25 million. Though not especially impressive by American standards, this is enough to make it one of the largest installations in Vietnam. In the North, it will probably be second only to the \$75 millions paper mill being donated and built by the Swedes under an official aid programme.

In addition to the Institute of Physics, the centre will house the Institute of Mathematics, founded in 1969 under Le Van Thiem, a German-trained PhD. The still embryonic institutes of biology, earth sciences and oceanography are as yet still without directors. A chemistry laboratory devoted to the study of catalysis will serve as a nucleus for the ultimate development of an Institute of Chemistry, for which the Vietnamese judge they do not yet have sufficient competent personnel. A computer centre will complete the presently contemplated facilities.

I was, in fact, the first visiting foreign scientist in what Hieu envisions as an expanding programme central to the intellectual life of the centre. My lectures on plant physiology and biochemistry were attended mainly by those biologists close to that area, but I was impressed with the fact that physicists attended when I spoke on effects of light on plants, and both animal and microbial biochemists attended when I talked on the biochemistry of plant growth hormones.

I instructed a small research group in some new biological techniques and found the young scientists well trained in basic concepts and eager to learn, though several years out of date. They were proud to be the occupants of the first three finished rooms in the entire centre. These had been completed much before schedule in connection with plans for my visit, and the Soviet engineer and architect came around during one working day to ask whether I found everything satisfactory. That struck me as meaningful *detente* in action.

Though the centre is the most competent of the research facilities in North Vietnam, it is certainly not the only one. Much work in strength of materials goes on at the Hanoi Polytechnic Institute, in vaccines at the National Institute of Hygiene and Epidemiology, in liver cancer at the Viet Duc Hospital, in natural plant products and pharmaceuticals at several institutes, and in agronomy and herbicides at the Agricultural University. By contrast, the University of Hanoi has pitifully few laboratories for modern research, despite its major educational role. The biologists there listened with obvious envy as the American programme of aid to the Science Research Centre was outlined. Couldn't we help them too, they wanted to know. But they understood that our present limited resources would make no impact at all if too widely disseminated. They felt somewhat better when I promised to seek specific aid for them from other American sources.

Though scientific groups were understandably eager to receive American aid, official or unofficial, there was general agreement that American scientists have a special responsibility to continue investigations on the yet largely unknown consequences of the massive military defoliation operations in the South. In the decade starting about 1971, we dropped from aeroplanes about one hundred million pounds of chemicals toxic to plants over an area of South Vietnam greater than that of the state of Connecticut. About a quarter of South Vietnam's dense upland forests, one-third of its coastal mangroves, and perhaps one-tenth of its agricultural lands, were sprayed in an attempt to deprive the guerillas of forest cover and food resources. In spite of several Department of Defense-sponsored studies by US scientists, the ultimate ecological effects of this massive operation are not yet known, but several immediate effects, especially in the mangroves, are known to be severe.

Perhaps more important is the danger to public health, for it is now known that one of the herbicides used, 2,4,5-T, contained significant quantities of an impurity called TCDD (2,3,7,8-tetrachlorodibenzodioxin). Very small quantities of this material, in the parts per thousand million range, can cause death, the malformation of developing embryos in laboratory rats and mice, and chromosomal aberrations in dividing plant and animal cells. The latter observation raises the possibility that

TCDD can also cause mutations and cancer. Dr Ton That Tang is suspicious that the recent marked upsurge in liver cancer all over Vietnam may be related to TCDD persistence in the soils of sprayed areas. If this chemical were slowly released into streams, it would find its way into the algae and fish of the ocean, and ultimately into the human diet. Furthermore, since the ocean currents carry waters from south to north, Tung feels that TCDD sprayed in the South could affect civilians in the North. All this evidence is circumstantial, but since TCDD was detected in fish collected in 1973, two years after the herbicide spraying programme had been terminated, and since its persistence in soil and water is not known with certainty, the possibility of contained danger to public health and ecosystems continues.

Can the US turn its back on this problem? Or does American responsibility for investigation continue? Whether or not the US ever decides to give official scientific aid to Vietnam, many feel that it has a moral obligation to follow through on this research, much as it did after dropping an atomic bomb on Hiroshima.

Ta Quang Buu, a dynamic, Cambridge-educated mathematician, has served as Minister of Higher Education in North Vietnam since 1965. When I first met him in Hanoi in 1971, he impressed me with his keen, driving intelligence and his energetic devotion to the ideal of the best possible educational system for his country's youth, even in the midst of a debilitating war. But like many officials in the new Vietnam, Ta Quang Buu is finding the problems of peace more formidable than the problems of war.

Consider some of the difficulties facing him. One quarter of North Vietnam's population of almost 25 million is now at school. The figures for the South are not yet precisely known, but they are assumed to be rather similar. For the past 20 years, North and South have gone their separate educational



Plant physiologists at a Galston lecture

ways; their aspirations, philosophies of education and methodologies have been as different as communist and capitalist orientations can make them. Can two such systems possibly be unified? Should they be? If so, should change be gradual or sudden? What good points in the southern educational system can be adapted to the North? How should one handle the problems of adult education, given the imminent demobilisation of hundreds of thousands of soldiers? Although the end of the war came with dramatic suddenness, Buu's deputies have already travelled to the South for liaison with their counterparts. As staggering as the problems seem to be, Buu and his colleagues are tackling them with the same stubborn determination that characterised Vietnam's long military struggle.

In considering how best to mobilise and unify the educational and scientific resources of the North and South, Buu has analysed the situation in the South. Before 1973, he told me, university education in the South was completely dominated by the French model. The outstanding characteristics of this model are, first, an emphasis on general education, with only scant technical or vocational training being offered; second, the complete autonomy of the various faculties in devising standards, curricula and entrance requirements; third, no selective examinations at entrance, but rather massive elimination of students along the way (recently 60% have been eliminated after the first year and between 75 and 90% have never graduated); fourth, no assurance of a job after graduation and thus no limitation on the number of students choosing an option.

This unplanned system has resulted in an asymmetric and, according to Buu, chaotic expansion of the student population in southern universities. They now number more than 120 000, and of these, fully 50,000 are studying literature and law, preparatory to a legal career. "What can we do with so many lawyers?", exclaims Buu. "Ways will have to be found to alter the course of their studies, to divert them to other occupations". In similar fashion, the many students in training for financial careers will be retrained "to make good clerks and civil servants for the new system", and some of the many potential secondary school teachers will be encouraged to seek other occupations.

By contrast, the North Vietnamese system emphasises educational quotas in the various specialities as part of the planning for the filling of anticipated job vacancies. It also includes stiff, competitive entrance examinations, minimum dropouts along the way, and limited autonomy of the individual faculties under a more centralised and highly codified system of national edu-

cation. Following this system, which Buu believes resembles the American more than the French, the North Vietnamese have admitted only 55,000 students to higher educational institutions. This represents a decline from the 70,000 students enrolled in 1973, caused by the raising of educational standards. Obviously, to integrate the northern and southern educational systems, some compromises must be made in standards for admission and dropout projections, as well as in educational objectives and practices.

Paradoxically, American educational innovations introduced into the South about 1973 have shaped the system more toward the northern model. For example, the introduction of two-year community colleges at Da Nang, Nha Trang, Tu Duc and several other locations accords well with plans in the North to reserve the established universities for the final year of more specialised training. Also, under American guidance, polytechnic institutes were established for the training of engineers and other specialists. This too fits in well with the North Vietnamese approach. Hanoi Polytechnic Institute, built during the war, with Russian aid, would seem familiar in basic organisation to a student at MIT or Caltech. With typical Vietnamese eclecticism, Buu proposes to combine the best aspects of these various systems into a new, indigenous approach. "Bilateral accommodation" and "smooth interpenetration" were some of the phrases he used to describe how the process might work.

Even before the final formula has been devised, educational institutions closed by the war have been reopened. For example, Hue University was back in operation by April 14, and the Medical and Pharmacy faculties in Saigon reopened in June, barely a month after the end of the war. Though a few teachers fled with the departing South Vietnamese officials, almost all, according to Buu, are fitting in well with the new system, and are actively seeking guidance in making the accommodation. This is especially important since the student body, previously limited to the privileged classes, will now include many peasants and workers, for whom new educational techniques will have to be introduced.

Buu believes that equality of educational opportunity has already been widely implemented in the North, through improvement of rural secondary schools, through extensive adult education programmes, and by giving preference in university admissions to those with some work or military service experience. This year, approximately 35-40% of the 10,000 students to be admitted to universities in the North will have such work experience.

Since there will be about 80,000 applications in all, this will give a substantial competitive advantages to the more experienced applicants. Yet, Buu is all for flexibility, and definitely rejects the Chinese model of requiring work experience before admission to the university. Especially gifted or critically needed students should not, he feels, be held to that requirement.

There are as yet no postgraduate training centres in Vietnam for work leading to the PhD or equivalent degree. During the war, it was the practice to send promising students abroad, especially to the Socialist countries of eastern Europe, for such training. In 1969, there were about 12,000 such students abroad; the number is now down to about 7,000 and Buu expects it to go even lower as centres for such training develop in the time when some promising candidates can be sent to western Europe Vietnam. But he also looks forward to and even the United States, especially for training in science and technology.

Can the United States play a role in the postwar educational reconstruction of Vietnam? Like Prime Minister Pham Van Dong, noted surgeon Ton That Tung and other officials I interviewed, Buu insists that the Vietnamese do not hate, and in fact in many ways admire Americans. Under proper conditions, he would be glad to receive American aid. Gifts of books and scientific equipment, lectures and seminars by visiting specialists and exchange by communication are possible and desirable immediately. Exchanges of teachers and students are not desirable or possible now, but may be within two or three years, after the reunification of North and South has been accomplished, and their major educational patterns have been firmly charted.

Since American science and technology has been so extensively used for destructive purposes all over Vietnam, Buu believes it would be uniquely appropriate for groups of scientists to lend their talents to the reconstruction efforts now under way. In the light of President Ford's and Henry Kissinger's stated opposition to any such official aid, assistance would have to be unofficial and "people to people". The joint project of the Scientists' Institute for Public Information and the Society for Social Responsibility in Science was, he felt, an appropriate model. But he is neither doctrinaire nor proud in this matter. He will accept any appropriate aid given in good faith, confident that the future will bring a normalisation of relations between his country and the United States. "Then", he says, his eyes lighting up, "the vast wealth and power of the United States can really be focused on the job of rebuilding our underdeveloped and battered country".