

a further report on physics teaching in JAVA

Nearly two years ago, W. C. Dickinson wrote in *Physics Today* of the work of a team of Americans engaged in a program of co-operation in physics education in Indonesia. The following article is intended to bring that story up to date.

By **Richard Hanau**

SPRAWLING 2900 miles along the equator, Indonesia is a big country, rich in natural resources, overpopulated in Java, and struggling to take its place among the nations of the world. East to west it covers more than one tenth the circumference of the earth; from north to south, slightly less than one tenth the distance from pole to pole. An archipelago republic, it consists of four large islands—Sumatra, Java, Kalimantan, and Sulawesi—and 3000 small ones, many uninhabited. In between in size are the well-known islands of the former Dutch East Indies: Bali, Timor, and the other smaller Spice Islands.

Any ship plying the route between the Indian Ocean and the North Pacific passes through Indonesia. I was told by a Dutch sea captain, as we went through the Malacca Strait between Sumatra and Malaya, that this sea lane was one of the most traveled waterways in the world; any ship between Singapore and India or Suez must use it. The second route through Indonesia is the Sunda Strait, further south, between Sumatra and Java near Krakatau. The third and less traveled route, for ships from South Africa, lies between Bali and Lombok, along the Wallace Line.

Education in Indonesia is still suffering from 350 years of colonial rule, and from the Revolution following the Japanese occupation. Before the Revolution higher education was only for the already partially educated groups. Above the primary schools, where instruction was in the regional language, the teaching was in Dutch, and this limited the enrollment to those students who had a sufficient mastery of the language. These students naturally came from Dutch homes and from other above-average educated groups. In 1949, when independence was attained, there were 80 000 000 people, 93 percent of whom were illiterate, and a bare handful of Indonesian doctors, scientists, engineers, and technicians, to attempt to fill the positions of the departing Dutch.

Since 1949 great gains have been made. At present there are seven large universities, four of them in Java

Richard Hanau is a member of the Physics Department at the University of Kentucky, Lexington, Ky. In 1956 he went to the University of Indonesia at Bandung for two years under a Kentucky-International Cooperation Administration contract with the government of Indonesia for the purpose of educational and technical co-operation. At present Dr. Hanau is on leave at the Institute of Optics, University of Rochester, Rochester, N.Y.



The Aula, the technical faculty auditorium, University of Indonesia. High, shingled roofs of campus buildings are variations of minangkabau roofs from Central Sumatra. International Cooperation Administration photo.

where more than two thirds of the total Indonesian population live on only 7 percent of the land area. The three branches of the University of Indonesia—at Jakarta, Bogor, and Bandung—attract students from throughout Indonesia and from west Java in particular. Central Java is served by the University of Gadjah Mada at Jogyakarta; and Erlangga University is located in Surabaya, east Java. A new school, Padjadjaran University at Bandung, hardly a year old, will be a second training center for west Java. Sumatra has two universities, Andalas University at Bukittingi in central Sumatra, and the University of North Sumatra at Medan. Hasnudin University is on the island of Sulawesi, at Makassar. In addition there are perhaps ten to twenty smaller colleges in Indonesia, mostly in Sumatra and Java.

The courses of study offered by these universities cover the usual fields found in large American institutions: law, humanities, medicine, science, engineering, agriculture, veterinary science, education, social science; but the method of instruction is not nearly so well defined. At present the entire system of higher education is under close and serious scrutiny to determine the general direction of university instruction best suited to Indonesia at the present time. In the educational field, as well as in the political sphere, Indonesia is trying to select the best that the various older countries offer. Two main directions for university programs are being considered: (1) guided study similar to the US system, and (2) free study patterned after European universities. Many Indonesian educators feel that a workable compromise is one in which the first two years would be guided study, and the remaining years free study, but the problem is not yet settled. Meanwhile the specific curricula at individual universities develop somewhat haphazardly according to the inclination of the individual professors.

The task of organizing and developing a modern university is enormously complicated by the large number of non-Indonesian faculty members that must, for several years to come, fill the existing gaps in the teaching staffs. Each national group brings to Indonesia its own culture, ideas, language, and prejudices. Because of the need for these foreign teachers to help train



In the *Aula*, students take their final examination, usually the only test during semester. At left is Indonesian coat of arms, a modern version of Garuda, the mythical eagle which carries the Hindu god Vishnu. ICA photo.



Interior court of Bosscha Laboratory, Department of Physics. The tower was formerly used for meteorological observations. Students study in the pavilion to escape the small, overcrowded library. ICA photo.



Crowded corner of the physics library. The problem of ordering books, paying for them in hard currency or equivalent, and distributing them once they arrive, Indonesia is in many cases almost insurmountable. ICA photo.

scientists, engineers, and doctors, several contract groups are represented in Indonesia in the field of higher education. These groups are sent by agencies such as Unesco, WHO, Ford Foundation, Colombo Plan, and International Cooperation Administration. There are ICA groups from the University of California at Gadjah Mada University in Yogyakarta, and at the University of Indonesia in Djakarta. At the branches in Bogor and Bandung there are ICA groups from the University of Kentucky. At Bandung the Kentucky group has just completed two years of service in the various science and engineering departments—mathematics, physics, chemistry, zoology, mechanical engineering, electrical engineering, mining and metallurgy, and architecture. The first-year group of eleven members has been enlarged to 16 for the second year, 1957–58. The majority of the first group remained for two years; those coming in 1957 will remain there two years. With this overlapping of personnel it is hoped to maintain continuity of the program.

In addition to regular teaching assignments as at US universities, major aims of the ICA university groups include the purchase of medical, scientific, and engineering equipment and supplies for use in laboratories; the procurement of textbooks, library books, and periodicals; and the implementation of a participant program whereby promising students and young faculty members are encouraged and financially aided to go to the US for advanced training. After studying abroad the Kentucky Contract participant must return to the University here at Bandung or Bogor and serve as a faculty member for a minimum of three years for each year abroad. This program will eventually result in a completely Indonesian faculty and the ICA university groups will be disbanded.

DURING the two years that have elapsed since Dickinson's article¹ was written, the Physics Department has continued the extensive reorganization of its curricula in order to implement the four-year programs agreed to in principle by both the Science and Engineering Faculties. There is now little difference between the courses offered and texts used here and in the US. The elementary physics programs continue as

described by Dickinson. We have added to the program a midsemester examination, practically unknown here prior to 1956. To the students this seemed at first a weird innovation. Our intermediate physics consists of full-year courses in mechanics, thermodynamics and statistical mechanics, optics, electricity and magnetism, atomic and nuclear physics, and undergraduate colloquium. In addition there are intermediate courses in applied physics in acoustics, illumination, properties of materials, theory of measurements, refrigeration and airconditioning, and glassblowing and machine shop. Three intermediate laboratory courses are offered in electrical measurements, atomic physics, and optics. With the completion of the nuclear-physics laboratory program our undergraduate laboratory courses will be adequate.

Graduate courses in electromagnetic theory, quantum mechanics, nuclear physics, cosmic rays, x rays, and other areas continue to be offered depending on the available staff. Upon completion of about two years of full-time study beyond the undergraduate degree, the student receives a graduate degree approximately equivalent to the master's degree or somewhat beyond.

Dickinson's article showed a picture of some of the 15 graduate students then in the department; there are now 22. In the past two years seven students have received their graduate degree. Of those in the original group of 15, two left for the US in August 1957 under the participant program. They will remain for at least a second year studying for the PhD. Two more left in August 1958. And two other students in that picture married each other to become perhaps Indonesia's first husband-wife physicist team.

The coming physicists will teach in the universities and high schools and will be absorbed by other departments of the government, and later, by industry. There is already set up and functioning the Indonesian Atomic Energy Commission, which has general supervision of research and development projects in the fields of radiology and reactor physics. There is an awareness of the necessity of fostering the growth of science, and in August 1958 the first meeting of the Indonesian Academy of Sciences was held. The Academy includes sections in the physical and biological sciences, engineering, medicine, economics, and social science. Admittedly

¹ Dickinson, William C., *Physics Today*, 10, 2, p. 18 (1957)

Indonesia has a long way to go in the fields of pure and applied science; but it has made a beginning.

Last year, during the second semester 1956-57, the department organized a successful three-week course in atomic and nuclear physics sponsored and financed by Unesco. Participating students came from Southeast Asia, representing Indonesia, Hong Kong, South Korea, Philippines, Singapore, Thailand, and South Vietnam. Faculty members, in addition to the staff of the department at Bandung, included three professors from Gadjah Mada and Andalas Universities, who originally came from Indonesia, Italy, Sweden, and the United States. Morning lectures and afternoon experiments were augmented by special seminars, discussion groups, and social gatherings. Allowing two weeks for atomic physics and one for nuclear physics, the lectures and laboratory covered—if somewhat hurriedly—the material of a one-semester intermediate course in this field.

Because the weights and measure system is purely metric, the teaching of elementary physics is partly simplified, and some sections and problems in an English text must be omitted. For example, no problems using British units are discussed; and it is only after eliminating these sections that one realizes how much time we in the States spend on this material. I was asked during an examination in thermodynamics what was meant by specific gravity. No one in the class of 30 odd students—then in their third year of physics and engineering—knew the meaning of this term. The reason is obvious: unless the density is numerically different from the specific gravity, there is no advantage in introducing another quantity, so that in metric countries there is no use for the concept of specific gravity.

THERE has been a fast and radical shift from Dutch to Indonesian. A few years ago the university records, course titles, and interdepartmental memos were written in Dutch; now everything is in Indonesian. The reaction against the Dutch over West Irian in December 1957 sounded the death knell to any remaining official use of Dutch. But unofficial use will

continue for some time. If a student is having difficulty getting his ideas across to me in English we try Indonesian, and usually eventually hit some key word which he does not know in English and which is not in my Indonesian dictionary. I ask for the Dutch word, hoping to recognize it by its similarity to German, and in that way we sometimes hurdle the ever present, ever important barrier of communication.

Indonesian and English are now the official languages of instruction at the University. But even Indonesian is a new language for many of these students. The older ones were trained through school in Dutch. Dutch was the language of the educated class, and Indonesian, as the official language of the country, is only 25 years old. With the influx of European and American professors, English has become a teaching language. German, Austrian, Swiss, Italian, Dutch, Russian, Swedish, Australian, English, Canadian professors, as well as those from Minnesota to Alabama, New England to the West Coast, all lecture in variously accented English. The student studies from English texts, frequently writing above the words the Dutch or Indonesian translation. It is an arduous and difficult procedure to learn this way, dealing with new subject matter in new languages.

During our last few days in Indonesia, preparing to leave the tropics and the East, we are again looking sharply about as we did on arrival. I have taken my last train ride through lush west Java and watched the vivid sunrise. The deep gorges and thick muddy rivers, the terraced rice fields in almost endless variations, these things we will remember. At the other end of the spectrum we will also remember the abject and intense misery of the East, where a man literally has no clothes except one pair of shorts and a single patched shirt—and these he is wearing—and where he is hungry almost all his life. To western eyes the poverty, disease, and misery is so great that it seems that no hope can exist. But to counterbalance this there is one fact which is evident when one looks for it; some progress is being made, and the accomplishments of the East have begun.



The students and faculty members participating in the Unesco orientation course in atomic and nuclear physics given by the physics department. This 3-week intensive course, covering lectures and laboratory experiments of a one-semester intermediate-level course, was international in participating personnel. Faculty members came from Indonesia's three largest universities and were originally from Indonesia, Italy, Sweden, and the US. The sixteen students were from Indonesia and various other regions of Southeast Asia: Hong Kong, South Korea, Philippines, Singapore, Thailand, and South Vietnam.

Preanger Studio photo.