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JAPANESE HIGHER EDUCATION AND RESEARCH IN THE PHYSICAL SCIENCES

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IT is now sixty-eight years since the Shogunate was overthrown in Japan (1868) and the Emperor Meiji came into direct relation to the nation. In prior days, the feudal organization and civil wars had held the masses of Japanese population in educational darkness and superstition. The emperor Meiji proved to be a man of such force and high character as warrants him a place among the great national fathers of the world. With the aid of commissions sent to study practices in the western countries, and commanded to recommend new processes of national finance and education for Japan, progress in these lines was made rapidly and a parliamentary government ultimately was established. By the year 1872 a unified plan for education in Japan was promulgated (following rather clearly the French standards), and by 1880 compulsory education became a feature of the Empire for children up to certain ages. The mass of population was rapidly changed from the illiteracy of a feudal period to a proud proportion of literacy which vies with the record of the most literate nations of the western world. National university activities were given a suitable place in the original plan for national education, and the growing place of elementary and intermediate education in the affections of the people served as a foundation for equally effective development of university influences. The Japanese are a people of healthy, workmanlike, athletic thought, notwithstanding their reputation for sentimentalism.

At the present time in the Japanese empire there

are eight Japanese Imperial universities—six being in Old Japan and one each in Chosen (Korea) and in Taiwan (Formosa)—which are reinforced by many universities, higher scientific and commercial schools, research institutes and other higher institutions which have not yet reached the scope required for designation as Imperial universities. Some of these latter institutions are the result of private endowments, but many are supported by government funds in a manner corresponding in a degree to the support of Imperial universities. Some are sustained for particular purposes, such as education and research in the field of engineering or as institutes of research in particular branches of science; and these have no intention of expanding into the scope of three or more faculties requisite for those that are designated as Imperial universities. Important research in fields of science, with emphasis on applied aspects, is also supported by government ministries and by private industrial establishments. An official organization also exists which is somewhat analogous to our National Research Council.

The youngest of the Imperial universities is that of Osaka, which will soon celebrate the completion of five years under the Imperial designation. The oldest and culturally richest is the Tokyo Imperial University, which stands on a foundation established some sixty years ago. The physical plant of this great institution was in large measure swept away by the cataclysmic earthquake of 1923 and accompanying conflagrations. At the present time the physical plant has been mostly replaced in improved form, and further new construction is in progress. The library building of this university and its contents having been (as one item of that fateful day) swept away by the earthquake and fire to a substantially total loss, Mr. John D. Rockefeller, Jr., provided funds for rebuilding, and a central feature of this university is the great library resulting thus from Mr. Rockefeller's gift. Most of the remainder of construction funds have come from government in so adequate amounts that the Tokyo Imperial University now possesses one of the great university centers of the world. The faculties of the university are in keeping with the excellence of their setting.

The other university centers in Japan are not so extensive and magnificent as that of the Tokyo Imperial University; but they all are in keeping with their purposes and the greatness of the Japanese nation. All possess faculties actively working within their various fields. The Japanese scientific education and scientific output are of distinguished character within the fields cultivated and to the extent of their cultivation.

Two visits to Japan six years apart, each of many weeks' duration, have enabled the writer to closely observe the status of science in the universities and the research institutes at the present time, and the rate of progress which characterizes Japanese science. The opportunities have been those of personal observation at the sites of all six of the Imperial universities in the principal islands of Japan and of various other Japanese universities, research institutes, departmental laboratories and other institutions supporting education or research in science. While few if any of the universities attempt to cultivate all fields of science, the cultivation is very wide-flung in the aggregate for the pure sciences, and in the scope of applied sciences great emphasis is placed on agriculture, forestry, fisheries, medicine (including sanitation) and engineering.

The writer's interest being primarily in engineering, attention in this article is directed to the physical sciences (physics and chemistry, interpreting these words broadly) and their applications in engineering. A country coming in the last half of the nineteenth century, as a novice, to develop a western type of education in science, appropriately should give much emphasis to the applications and rely at first on the already established nations for the background of discoveries on which to build. The wisdom of the Japanese led them to that practice; but they are now, after a half-century of experience, established in full appreciation of the advantages to themselves of participating with the other nations in research relating to the fundamental aspects of science, but without lessening their attention to the useful applications. As yet this attitude relates mostly to experimental science. Pure mathematics, mathematical-physics and other philosophical sciences are not yet so fully developed, but an obvious interest in the farther development of these subjects is observable.

The internal organization of the Japanese universities usually is European rather than American in type. The Ministry of Education of the Imperial government has a strong influence in Japanese university affairs. There is more formality in administering university affairs than we are accustomed to, and there is more of watertight division and less of cooperation between departments than our experience leads us to believe is desirable. Research with them is a formal enterprise and there is less association between professors and students in research than we are inclined to cultivate wherever students are found suitably prepared for research in their subjects. There is quite a difference in some of the terminology describing the universities as translated by the Japanese from their language into English and as used by Americans in relation to our institutions. For illustration, the Japanese are likely to apply the word institute to a

university division which we would commonly refer to as a department, and the Japanese sometimes use the word department in application to a section of a university such as we would call a school or college. However, the branches of learning supported in Japanese universities are truly universal and such as may be found in the universities of any of the great nations of the world, with changes of emphasis which may be appropriate to the circumstances. And in love for their work, on the part of professors and students, the personnel of the Japanese universities seems much like the personnel of American universities.

The Hokkaido Imperial University, located in the relatively new city of Sapporo in the Island of Hokkaido, is the farthest north of any of the Imperial universities on the principal islands of Japan. It was founded with the improvement of agriculture as a prime objective and its first leader was American—one brought to Japan from the Massachusetts College of Agriculture. This was decades ago, but his name is still revered in informed circles of Japanese higher education. His mark also is maintained, *inter alia*, by the excellent apples of American varieties which are now grown in Hokkaido and in the northern part of Honshu, the main island. In the meantime the university has expanded to the full Imperial scope and excellent work is found in several branches of physical science. The early faculty of this university contained many Americans and other westerners. Indeed, the early faculties of several Imperial and other Japanese universities contained numerous westerners, and various Europeans and Americans who later in the West held high reputations in fields of science were, as young men, in university posts in the developing universities of Japan, while native Japanese of sufficient capacity and experience were being developed to fill the posts. Now, it is substantially universal for the university posts of importance in Japan to be filled by native Japanese, many of whom have been tested by the pursuit of graduate studies and research in Europe or America. Westerners of distinction in their branches are now freely invited to the Japanese universities as temporary professors or special lecturers. The bar of language differences interferes with the efficiency of such temporary imports in education, but they plainly have a good influence within the field of science by maintaining a certain degree of international contacts.

At Sendai, a night's railroad trip north of Tokyo, is located the Tohoku Imperial University, which is known by reputation wherever metallurgists congregate on account of the great work of Professor Honda (now president of the university) and his institute of research in the metallurgy of alloy steels and particularly of magnet steels. Professor Honda's work is turning toward the influences of very low temperatures on the characteristics of steels and other metals, for which work his laboratory now is well equipped. The university and research institute affiliated with it also support various other men of productivity in the fields of chemistry, physics and engineering, and the institution is an important center of science for Japan. Its geographical location makes it easier of access than Hokkaido University, and the foreigner studying Japanese higher education on the ground is more likely to become familiar with it.

The most southerly of the Imperial universities on the principal islands is the Kyushu Imperial University at Fukuoka (or Hakata) on the populous island of Kyushu. This is in the midst of a fertile agricultural and horticultural region and at the edge of an active coal-mining and steel-manufacturing area. The university is full of scientific activity and appears to have progressed greatly in influence during the past decade, so that it is more nearly an even rival of Kyoto Imperial University, located in the lovely city of Kyoto, which city retains to itself its old-time Japanese artistic and leisurely character to a fascinating degree.

Osaka Imperial University and Kyoto Imperial University are in locations about an hour's distance from each other by fast railroad train. The city of Osaka is the kernel of a densely industrialized area, with a crowded population of several million people, which gives an impression somewhat like Chicago. On the other side of Kyoto lies Nagoya, another modernly industrialized area but in which a good deal of the old-time artistic, individual craftsmanship of Japan is still maintained in a manner reminiscent of Kyoto. Here there is located a higher technological school and other higher schools. At Kobe, the important port to the west of Osaka, are the notable Japanese meteorological laboratory and an important higher commercial school; and in Kyoto, in addition to the great Kyoto Imperial University, there is located Doshisha University, where science is embraced to a moderate extent. This great area of art and industry is thus well supplied with facilities for higher education relating to the physical sciences. Osaka Imperial University is still young, but at Kyoto Imperial University research in the physical sciences goes on with vigor and productivity.

Upon turning to Tokyo we find that city associated with Yokohama and two intervening lesser industrial municipalities into an area of continuous urban population which is one of the most populous urban areas of the world, rivalling New York and London in total number of inhabitants. This is Japan's greatest center of commerce, finance, industry and diplomacy. Tokyo is the seat of the Imperial government with its im-

perial residence, its ministries and its parliament house. Tokyo Imperial University occupies an important site in Tokyo, and other institutions of higher education and research occupy additional fitting localities in Tokyo and Yokohama. Here are Tokyo University of Engineering, the corresponding technological college in Yokohama, the famous research institute of physics and chemistry, the equally famous earthquake research institute, the extensive research laboratories of the Ministry of Communications, the Ministry of Railways and of other Ministries (certain of which do work similar to that of our own Bureau of Standards). The headquarters of meteorological research are located here, although the major meteorological work is carried on at the Kobe site, under the eye of Director Horiguti. Tokyo is also the home of Waseda University and other universities depending on private endowments for their support, in most of which science is given a fitting place.

It is impracticable to enumerate all the important research laboratories which the government and the various Japanese industries support in this area. The area is one of great intellectual effort in science, with achievements that are in keeping with the excellence of the facilities provided. Altogether, Tokyo is a center of culture to which western scientists might well give more serious attention; and which western students in science might fruitfully visit for observation and study, except for the inconvenience of a language in which the structure differs so radically from any western language in both its spoken and written forms. This difficulty, however, is softened by the fact that most of the cultured Japanese are somewhat familiar with the English language and many are facile in their use of English.

Japan is deeply affected by the electric forces set up by industrialization, which forces draw people into increasingly populous urban areas; and the Japanese people are now at a disadvantage because their government is mostly in the hands of men who thus far have had little personal experience in dealing with those forces or in moulding their influences. Education in science seems to possess a satisfactory status of independence and liberality, but a disturbing aspect is arising which affects philosophical and historical scholarship. Comprehensive scholarship in historical, ethnological and archeological fields is still in a germinal stage in the Japanese universities, and efforts to fertilize its development along investigational lines are frowned on from some official circles. This situation has analogies to the situation in America sixty years ago when, in theology, the "higher criticism" was in its early stages; except that the situation is more serious in Japan because it is official efforts at repression that there invade the privileges of the universities to investigate freely and to express developed opinions openly. An independent newspaper published in Japan recently expressed the situation editorially in the words, "These are days when orthodoxy is very nervous and freedom is looked upon as a rather regrettable principle to have been adopted," referring to freedom of thought and opinion in religion and politics. Remembering that "he who keeps the hills, burns the wood," the situation is one for great concern in all scholarly circles. As yet it does not seem to have brought restraint into the circles of the physical sciences, but western experience has shown that the scholarly pursuit of learning in every branch is ultimately affected disadvantageously when forcible restraint is applied to the pursuit of truth in any of the learned branches. On account of the well-demonstrated wisdom of the Japanese people, there is good ground for hope that the disturbing effort at restraint on freedom of research and the discussion of results will blow over, as it did in America, before great permanent harm has resulted.

THE SPIRIT OF WARD IN SOCIOLOGY[1]

By Professor STUART A. RICE

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WHEN Dr. Wells suggested my topic, "The Spirit of Ward in Sociology," I did not quite know how to deal with it. Later, it occurred to me that perhaps the topic held a deeper significance than either he or I had appreciated. We of this generation of sociologists are trying to build a science of sociology. Science as it is known in the physical world—I do not want to exclude the social world from the domain of science—evolves by a slow accretion of knowledge. Science *grows*, bit by bit, each brick in the structure being laid upon the bricks which were laid before. Some-

[1] Remarks as guest speaker at the founding of the Lester F. Ward Sociological Society of The George Washington University, Washington, D. C., on April 16, 1936.