SCIENCE

FRIDAY AUGUST 20, 1920

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE COOPERATIVE COURSE IN ELECTRICAL ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FOR the past year the Massachusetts Institute of Technology and the General Electric Company have conducted a cooperative course in electrical engineering, which has proved unusually successful. In this course, a logical working out of the underlying principles has led to several interesting innovations in the conduct of the work. In brief the scheme is as follows:

The course covers a total of five years, the first two being identical with the regular course in electrical engineering at the institute, the last three being divided between instruction in theory at the institute and practise at the Lynn works of the General Electric Company. The instruction at the institute during the first four years of the cooperative course is similar in method and content to the general course in electrical engineering at the institute with certain omissions and abridgments for which equivalents are provided at the works. The work of the final or fifth year comprises postgraduate research work and training in design. Training at the works is also conducted with a primary view to its educational value and is closely correlated with the instruction in theory. During the final year of this course considerable latitude may be exercised by the students in the selection of their line of work, assignments being made either to shop management in the works' office or to research in the company's research laboratories, depending upon the aptitudes and preferences of the individual students.

The schedule of the cooperative years, *i. e.*, the last three years, is as follows:

The year (12 months) is divided into four three-month periods, the students spending

alternately thirteen weeks at the Lynn works of the General Electric Company and eleven weeks at the institute followed by a two weeks' vacation. Compensation is paid by the General Electric Company to students in this course at an hourly rate which considerably more than pays for their tuition. For a successful completion of the course, the institute confers the degrees of Bachelor of Science and Master of Science.

The educational concept upon which the course is founded combines the rudiments of Spencer's theory of education with the central idea of Josiah Royce's. It is an endeavor to develop simultaneously all the desirable sides of an engineer's mind, character and body and at the same time inculcate in him the spirit of loyalty to his life's work. The course was planned so that these several activities are carried on uninterruptedly throughout the cooperative period. Thus, throughout those periods spent at the works as well as those at the institute, instruction is given in theory, classes are conducted in some humanistic study, time is given and facilities provided for collateral reading, and arrangements are made for systematic physical exercise and recreation. The change therefore, at the end of each period, does not mean so much a change in occupaton as a change in the subjects upon which greatest emphasis is laid.

To facilitate the carrying out of these ideas, the General Electric Company has provided a club house where all the students are housed during their sojourn at Lynn. Here classes in theory of electrical engineering and general studies are conducted. Here the men get to know the full meaning and value of teamwork in play and cooperation in business. Life here is very much like that of a small fraternity with its opportunities for quiet study and recreation. A small library is provided consisting of a collection of technical books and works of interest to the engineer, and also of nearly one hundred volumes from the Lynn Public Library upon more general subjects and in divers fields of literature.

Everything at the club house tends to lessen the sense of separation from the institute and to make the men feel that they still have a part in the activities and student life at Technology. In the works, the students are also made to feel the controlling presence of the institute. On three or four days each week, a member of the staff of the electrical engineering department of the institute spends a half day at the plant in the various shops and offices in which the students are assigned. The student is thus ever conscious of the supervision which the institute exercises over his work even in the shop.

It is in this particular method of supervision, that the Technology cooperative course differs from others. The General Electric Company is doing some real cooperation in the training of manufacturing engineers. The company recognizes that for three years these students are placed in its plant for the prime purpose of being educated and trained as electrical engineers of a particularly high grade and specially informed in manufacturing practise. It has been clearly understood that these students are in the shops and offices to learn and learn thoroughly manufacturing methods. Because he can best obtain this knowledge by actually doing the work himself, and because the skill which he attains in any process is the only fair indication of his knowledge of that process, the student is put on the company's pay roll and becomes a part of its organization. The length of time spent in each of the work's departments is regulated not by the needs of that department but by the value of the experience to the students. As soon as it is deemed that a student has sufficient knowledge of the details in one department he is changed to another. The cooperative students work as earnestly and consistently as the other men in the various departments, as is shown by the reports from the foremen. They are graded on the amount and quality of the work which they do in the various shops and thus the inducement to do good work is as strong in them as in the regular workmen. This spirit of genuine cooperation on the part of the cooperating company, it seems to me, is a fundamental contribution which the Tech-

nology cooperative plan offers to engineering education.

The officials of the company confess that they expect to be the gainers by this policy. Already there is an abundant evidence that their hopes will be realized. The students have been thrown together in a very intimate relationship at the club house and have developed an intense loyalty to one another and to the course which they are pursuing.

There remains to be mentioned the effect which this plan of study has upon the mental condition of the student and upon his progress in acquiring theoretical knowledge. The members of the instructing staff who have come in contact with these students on their return from Lynn are almost unanimous in reporting that they show an increased mental alertness, a greater fund of information concerning all matters connected with their profession, and a wider interest in things in general. That the General Electric Company considers this educational experiment a success is evidenced by the fact that they have raised next year's limit of forty to sixty students. The fact that the applications for next year's class are five times as great as they were last year is some indication of how nearly the course has met the students' anticipations.

Thus, although the plan has been in operation for one year only, it has already gained the approval of the three parties most vitally concerned: the students, the institute, and the cooperating company.

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PARALLEL MUTATIONS IN THE OSTRICH

THE account by Dr. A. H. Sturtevant of a mutation (notch) in *Drosophila funebris* similar to one which has occurred several times in *D. melanogaster* recalls the following sentence in Darwin's "Origin," p. 179: "As all the species of the same genus are supposed, on my theory, to have descended from a common parent, it might be expected that they would occasionally vary in an analogous manner."

The problem of parallel mutations has lately been impressed upon one by certain conditions met with in the two-toed African ostrich, *Struthio*. Four species of the genus have been described, among which the most distinctive are the North African ostrich, *S. camelus* Linn., and the South African, *S. australis* Gurney. Owing to a recent importation by the Union Government of South Africa of over a hundred specimens of the northern bird which have been placed in charge of the writer a unique opportunity has presented itself of studying the northern and southern ostrich side by side and also of observing the behavior of their characters in cross-breds.

Well-marked characters separate the two species. The most important are: a difference in size, especially as regards the length of the legs and neck; a different skin coloration from the chick onwards, culminating in a conspicuous contrast between the cocks at the nuptial season; a bald patch on the head of the northern bird, that of the southern being covered with short, hair-like feathers; and differences in the size and shape of the egg, accompanied by a pitted surface in the one and an ivory smoothness in the other. The characters represent germinal differences, those of the imported birds being retained under the new environmental conditions and reappearing in all the progeny which have been hatched. The birds cross freely and in the first generation hybrids (F_1) the bald patch is found to be dominant, appearing in all the hundred or more crosses reared, while the dimensions and colors of the body and the features of the egg appear as intermediates of varying degree. Sufficient time has not intervened for the rearing of many second generation hybrids, (F_2) only two having yet been obtained. They however give every reason to expect that segregation of the characters will take place in the second generation. In what ever manner this may occur there can be no

[1] "A Parallel Mutation in *Drosophila funebris*," SCIENCE, July 19, 1918.