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.

question that the specific features are the expression of distinct factorial differences in parts of the germ plasm of the northern and southern ostrich.

Like most of the Ratitæ the two-toed ostrich is degenerate in some respects and highly specialized in others, compared with ordinary flying birds. Degeneration is especially indicated by the small size of the wings and the practical absence of feathers from their under surface and specialization (degeneration) by the reduction in the number of toes. The development and progress of ostrich farming in South Africa had produced prior to the war about a million domesticated birds which afford an abundance of living specimens for examination, now supplemented by the importation already mentioned as well as by much embryological material. The result has been the demonstration that the ostrich is undergoing slow degeneration in numerous directions in connection with its plumage, wings and legs, survivals of practically all stages in the process being procurable.

The principal directions along which plumage degeneration is taking place include the general under-covering of the wings, the single row of under-coverts, the remiges or wing quills, the second and higher rows of upper-coverts, the feathers covering part of the leg and the under-covering of down. The third digit of the wing exhibits important evolutionary stages, while in addition to the loss of the first, second and fifth toes of the foot it can be shown that the small fourth is also in process of disappearance, particularly as regards its claw. Losses of the scales over the big middle toe reveal that retrogression has already begun on what will in time be the only remaining toe. In any individual bird the changes in any one direction take place quite independently of those in the other directions, and all proceed in a definitely determinate manner which is the same for all the representatives of the two species. The experiments already carried out serve to establish that the losses are factorial in their nature and that in crosses they follow strictly Mendelian lines. They are to be regarded as retrogressive mutations resulting from the dropping out of factors, the changes proceeding in regular succession along various directions, the succession being particularly impressive in the case of the gradual loss of plumes from certain of the rows of feathers and in the digits of the foot (*rectigradations* Osborn[2]). It is highly questionable if up to the present any selection value can be attributed to any of the changes.

The present interest lies in the fact that the mutative changes are common to the germ plasm of both the northern and the southern ostrich and are taking place in one independently of the other. They may indeed be presumed to be the same throughout the continent, suggesting that they are intrinsic in their nature and independent of environmental influences. If we regard the two species of ostriches as distinct then we can understand how the term parallel mutations may be applied to the changes going on in both, but at the same time it may appear to carry with it the notion that similar mutations are proceeding in two disconnected and independent germ plasms. If, on the other hand, we retain the idea of the origin of species from a common stock which Darwin had in his mind in the quotation given, then it becomes more in harmony with fact to think of the changes as taking place in germ plasm of the same nature and of a common genetic origin.

We must conceive the germ plasm to be fundamentally the same for the African ostrich as a whole, though certain changes have taken place in parts of it which give us the differences delimiting the species. On this view it is easy to comprehend how the same mutative changes will occur in what for the sake of convenience we now distinguish as two species. The mere fact that one assemblage of ostriches is bald-headed, larger and differently colored as compared with another and that the hens lay a different egg indicates only slight differences in the germinal make-up of the birds. In both the constituents of the

[2] *Amer. Nat.*, August, 1917.

germ plasm controlling the plumage and the structural details of the wings and legs remain unchanged, and it is in these that we have similar degenerative changes in progress. In studying the small differences which distinguish species we may overlook the main essentials in which they agree.

The individuality and separability of the germ factors in the ostrich are well exemplified in the fact that while differential changes have taken place in some respects common changes have taken and are taking place in other respects. We may respectively designate as parallel the mutation found in the two species of *Drosophila* and the numerous ones met with in the two species of *Struthio,* because they occur in different species, but it must be with the understanding that the changes proceed in similar parts of the germ plasm which are common to both, and would go on were there no specific differences.

Whether parallel mutations ever occur in germ plasms not genetically related may well be doubted. It may be that similarity of changes always implies similarity of origin in corresponding parts of the germ plasm. There is abundant evidence that the fourth, outer toe of the ostrich is well on the way towards disappearance, and when this is effected we shall have only the single middle toe in two such widely separated animals as the ostrich and the horse. While to institute a close comparison of the limbs of the two animals seems to strike at the roots of our morphological ideas it may well be that the degeneration in the toes of *Struthio* is an expression of changes in its germ plasm of a fairly similar nature to those which have been effected in the germ plasm of *Equus,* and is referable to separable parts of the germ plasm which the two have or had in common. All that this involves however is the recognition of the fact that the fundamental parts of the limbs of digitate vertebrates take their origin from corresponding parts of the germ plasm common to all. Osborn[3] must have had occurrences of this kind in mind when he wrote:

> "Similar rectigradations may arise in all the descendents of similar ancestors at different periods of time; they always give rise to parallelism or convergence between the members of related phyla." To go beyond digitate limbs, we may presume that the characteristics of the chordate phylum—dorsal tubular nervous system, notochord, visceral arches and clefts—arise from separable parts of the germ plasm which are common to all the members of the phylum, and distinct from other parts which give rise to the characters serving to distinguish the classes of the chordates.

In whatever way we conceive the germinal changes to be going on in the two-toed ostrich it is clear they are not limited to the African genus *Struthio* among the flightless birds. For we have degenerative changes of a fairly similar nature represented in the three-toed American ostrich (*Rhea*) and in the wing of the New Zealand *Apteryx,* while the *Moas* had apparently lost their wings altogether before becoming extinct. Where exactly similar, these may be termed parallel mutations, but it seems more in harmony with modern genetical ideas to think of them as taking place in separate parts of the germ plasm which the sub-class has in common. In the Ratitæ as a whole we seem to have one of those groups of animals, so often represented in the evolutionary series, in which high specialization in certain directions is accompanied by marked decadence in other respects and which in the end result in extinction. When they are alike the changes may be described as parallel mutations, but it is sought to emphasize that they take place in a similar manner in those parts of the germ plasm which the group has genetically in common.

Though the living representatives are so widely separated, the germ plasm controlling the plumage, wings and legs of the Ratitæ as a whole is manifestly subject to some common intrinsic influence which expresses itself in the gradual loss of these structures, the process proceeding more rapidly in some than in others and sometimes modified in different ways. Many of the facts of degeneration presented by the ostrich incline one to attribute

[3] *Amer. Nat.,* April, 1915.

the changes to a slow reduction of factorial potency, culminating in complete factorial loss. While in by far the majority of forms of life the germ factors are static, may there not be others in which certain of the factors are increasing in potency and some in which they are dwindling?

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SCIENTIFIC EVENTS

CENTRAL HEADQUARTERS FOR BRITISH CHEMISTS

At a dinner held in honor of Lord Moulton on July 21, Sir William Pope announced that a public appeal was about to be made for funds for the erection of central headquarters for British chemistry. According to a statement in *Nature* none of the chemical bodies has the accommodation for a meeting of more than two hundred persons, or adequate library space. The Chemical Society conducts its business at Burlington House, Piccadilly, in rooms provided by the government nearly fifty years ago, when the membership was about one fifth of what it is to-day. The Institute of Chemistry possesses a good building in Russell Square, completed during the first year of the war, but it is barely adequate for the present activities of the institute, which has to look to colleges for hospitality for any general meeting of unusual interest and for lectures. The Society of Chemical Industry and the Society of Public Analysts hold their meetings at the Chemical Society's rooms. Neither of these bodies nor any other which is concerned with chemistry, such as the British Association of Chemical Manufacturers, the Faraday Society, the Biochemical Society, and those devoted to the various branches of technology—brewing, dyes, glass, ceramics, iron and steel, non-ferrous metals, leather, concrete, petroleum, and so forth—possesses accommodation to compare with the spacious halls and headquarters of the Institutions of the Civil, the Mechanical, and the Electrical Engineers, and of the Royal Society of Medicine.

The appeal, which will be made by the Federal Council for Pure and Applied Chemistry, on which practically all the chemical interests of the country are represented, has the cordial support of Lord Moulton, who, as director-general of the explosives supplies, ministry of munitions repeatedly acknowledged the services rendered during the war by these scientific, technical, and industrial bodies.

The scheme, which aims at providing under one roof, so far as is practicable, a common meeting place, library, and editorial facilities for technical journals, is highly desirable, and indeed imperative, as a matter of supreme importance to the welfare of the whole country in relation to questions of defence and the maintenance and development of all branches of industry and commerce which depend on the applications of chemistry. The sum required for building is estimated at £250,000; a similar sum is required for establishing a chemical library and to provide for the compilaton and production of works of reference in the English language.

FORESTRY EDUCATION

The British Empire Forestry Conference, which met in London during July adopted the following resolutions on forestry education, which the delegates are to bring to the notice of their respective governments:

It should be a primary duty of forest authorities throughout the empire to establish systematic schemes of forest education. It has been found, for climatic and other reasons, that it would not be possible for each part of the empire to establish a complete scheme of forestry education of its own, and therefore it is essential that those parts of the empire which are willing and able to establish complete systems should, as far as possible, frame such schemes with a view to combining for meeting the needs of those parts which can only themselves make a partial provision for their requirements. Part of this subject has been dealt with by a committee, whose report, which refers mainly to the higher training of forest officers, is approved by the conference. The main principles embodied in this report are as follows:

1. That one institution for training forest officers be established in the United Kingdom.

2. That students be selected from graduates hav-