so ; the Minister of Foreign Affairs held the reception on his behalf.

On the conclusion of the conference delegates had the choice of visiting the Tatra Mountains in south-eastern Czechoslovakia, or the principal health resorts, including Joachimstal, Keilberg, Karlsbad, and Marienbad.

For the next meeting the conference received invitations to meet at Stockholm and at Lisbon ; both were accepted in principle, but it was left to the executive committee to decide later which of the two should be definitely accepted, since the wish had been expressed by the United States Research Council that the Union's meeting should take place near in time and place to that of the International Astronomical Union, whenever this should be practicable.

International Congress of Genetics.

THE fifth International Congress of Genetics, held in Berlin on Sept. 11-18, was a very important and successful meeting. The opening addresses of welcome were given in the auditorium of the Berlin Medical Society in Luisenstrasse, while all the other sessions were held at the University (Unter den Linden). Members of the Congress were welcomed by Prof. E. Baur, chairman of the committee of arrangements, as well as by the German Minister of the Interior, the Prussian Minister of Agriculture, the head of the Berlin Medical Service, and Prof. Kniep, representing the University of Berlin. At this meeting an address was given by Prof. R. von Wettstein on the problem of evolution. Prof. S. Navashin, the distinguished cytologist of Moscow, was elected president of the Congress, a fact which is significant of the fundamental part which cytology has played in the modern development of genetics. The membership of the Congress numbered more than 1000. Mornings were devoted to general addresses, while in the afternoon the Congress met in six sections and about 135 papers were read.

The sections devoted to general genetics, cytology, and cultivated plants were particularly strong. The largest number of papers were devoted to wheat, maize, Drosophila and Œnothera, as many as ten investigators of Œnothera being present. A number of papers were concerned with the subject of mutation; several were concerned with the statistics of inheritance, and several with crossing-over. A double attack on the theory of crossing-over led to an extensive and lively discussion in which the great strength of the theory was brought out. In this connexion an important paper by Prof. F. Bernstein pointed out new mathematical relationships which follow from the mechanical theory of crossing-over.

The address of Prof. H. J. Muller, of Texas, on the production of mutations in Drosophila by treatment with X-rays, was generally regarded as the most important contribution to the Congress. Mutations were produced in large numbers by subjecting males or females to X-rays for different periods. Four periods were used, and with the longest period of treatment the rate of mutation was 150 times that in the controls. Genes were affected equally throughout the chromatin and an increase in the X-ray dosage was found to increase the rate of 'point' mutations. Sperm used in fertilisation 6 days or 12 days after treatment showed no difference in the rate of mutation-production. The presence of large numbers of mutations was also found to have little or no effect on sperm viability.

In the X-chromosome of Drosophila, mutations normally appear at the rate of not more than 1 in 1000. In these experiments many more mutations appeared in the X-chromosome than have occurred in it naturally in all previous experiments. Such well-known mutations as rudimentary wing, broad wing, cross-veinless, white eye, and vermilion eye appeared repeatedly, but there was an enormous increase in the number of lethal factors. It was also found that the effect of X-rays on the ovaries persisted after treatment, a fact which has an important bearing on some of the present methods of X-ray therapy. X-rays also increased the number of *c*-factors, which reduce the frequency of crossing-over. Rearrangements of loci were also found to occur in the chromosomes. From various experiments the conclusion is reached that the gene is probably compound in the chromosome, composed of 2 or 4 parts, in preparation for later cell divisions. The great majority of the mutations produced are lethal or otherwise invisible, their presence being proved by later breeding experiments.

In the genetic work on Œnothera, the greatest interest centred around the linkages between chromosomes, which were demonstrated by Cleland and Gates. Each species and mutation is found to have a fixed arrangement of its chromosomes during diakinesis and on the heterotypic spindle. In some wild species all the chromosomes are linked into a ring of 14, while in others there are 7 free pairs. Still other species, such as *Œ. lamarckiana* and *Œ. ammophila*, have 1 free pair and a ring of 12. In the mutations from *Œ. lamarckiana* the arrangement is also a definite one, *Œ. rubrinervis* and *Œ. rubricalyx*, for example, having 4 free pairs with a ring of 6 chromosomes, while *Œ. deserens* has 7 free pairs.

This constitutes essentially a new type of nuclear differentiation. It appears that it will also be of fundamental importance as furnishing the basis for the unique phenomena of linkage of characters into complexes in Œnothera, which has not hitherto received an explanation. It is already indicated that where a large amount of chromosome linkage occurs there will be only two (twin) or three hybrid types, while in crosses between forms with many free pairs of chromosomes much segregation will occur. Shull described a new gene mutation from *Œ. lamarckiana*, a simple Mendelian recessive showing linkage of the ordinary type.

Among the studies of cereals, Dr. C. L. Huskins showed the existence of speltoid and dwarf wheats having respectively 41, 42, 43, and 44 chromosomes, parallel to the fatuoid series which he has recently discovered in oats. He also described a fatuoid chimæra in oats, and this appears to complete the parallelism in the behaviour of fatuoid oats and speltoid wheat.

Dr. M. Navashin made an important demonstration of the nuclear differences in species and hybrids of Crepis. Some of the species differ in the presence of a satellite or a terminal 'head' to the chromosome, and in the hybrids it is shown that the former may be transformed into the latter. This is the first time that a definite change in the structure of a chromosome as the result of hybridisation has been shown. The study of this type of chromosome differentiation is in its infancy and will lead to large results.

Among general addresses to the Congress may be mentioned that of Prof. O. Rosenberg, of Stockholm, on species-formation with multiplication of chromosomes, and Prof. H. Federley, of Helsingfors, on the

chromosome relationships in hybrids. Owing to illness, Prof. C. Correns was unable to give his address on non-Mendelian inheritance, but addresses were given by Dr. Vavilov on the geographical gene-centres of cultivated plants, and by Dr. Blakeslee on the genetics of Datura. Dr. Crew, of Edinburgh, discussed the organisation and function of an animal-breeding research station.

Miss Pellew and Miss de Winton discussed recent work with the garden pea and with *Primula sinensis*. Many other subjects of special interest came before the Congress. Practically every phase of genetical fact and theory was represented, from the study of variegation, clones, and inbreeding to species-crosses, the geographical distribution of genes, and such evolutionary topics as convergence, the unpacking theory of Bateson, and a statistical study of fossil Ammonites.

In the section on human genetics there were several papers on twins and on the blood groups. Prof. van Bemmelen described the inheritance of curly hair as an apparently simple dominant through several generations. Other papers considered the inheritance of shortsightedness, musical ability, general ability, sex, and psychological peculiarities as well as inter-racial inheritance in man. In the smaller section of eugenics a number of less strictly genetical questions were discussed.

The excursions formed an important part of the meeting. A ladies committee arranged numerous excursions to places of interest, and a visit to Wannsee and Potsdam was largely attended. But most valuable was the visit to Prof. Baur's Institut für Vererbungswissenschaft, where his extensive experiments with Antirrhinum were demonstrated, and to the laboratories of Profs. Correns, Goldschmidt, Hartmann, Nachtsheim, and others at the Kaiser Wilhelm Institute in Dahlem. There were also excursions to Petkus and Ruhlsdorf to study pig-breeding.

A reception and dinner was given in the Rathaus by the Municipal Government of Berlin, and the Congress closed with a dinner in the Zoologischer Garten on Sept. 17. This was followed, however, by short visits to horticultural institutions and a four-day excursion to Quedlinburg, Halle, Weimar, and other places, where various plant and animal-breeding establishments were inspected.

The *Proceedings* of the Congress are to be published promptly and will constitute a valuable survey of the present problems in genetics. The next Congress is to be held in America in 1932—under the presidency of Prof. T. H. Morgan. The present Congress, which was the first since the 1911 meeting in Paris, has served to show the fundamental part which cytology has played in the development of genetics during the last fifteen years. It is safe to say that no complicated genetic problem can now be solved without the aid of cytological research, and nearly all the most important recent developments of the subject have had a cytological basis. This mutual support of cytology and genetics is one of the most promising features for the future of genetics.

R. RUGGLES GATES.

Conference on Adult Education.

A CENTURY ago the Mechanics' Institutes were developing among artisans a new enthusiasm for study of the sciences instrumental in bringing about the industrial revolution. One of the marked defects in adult education nowadays is the neglect of science, though here and there a class in biology or some related subject may be found. It is the more cheering, therefore, to learn that the British Institute of Adult Education not only devoted its recent Conference, held at Balliol College, Oxford, on Sept. 23–26, to discussion of this situation, but also can report a singularly interesting and useful series of meetings. The Institute had previously sent to each of those present a copy of the latest report produced by the Adult Education Committee of the Board of Education—"Natural Science in Adult Education" (H.M. Stationery Office. 6*d*. net). The main points which emerged from the speeches and discussions were that the study of science should be an integral part of adult education: that students will be forthcoming if the subject is taught in a humanistic spirit; that fuller co-operation between universities, technical colleges, local education authorities, and voluntary organisations is essential; and above all, that the supply of teachers capable of treating science in a broad as well as a thorough fashion must be greatly increased.

Commenting on the Board of Education report, Sir Benjamin Gott maintained that a real interest in natural science exists among ordinary people and can easily be developed if the prospective student is made aware that he will be studying something about his home, his health, his work—and if teachers will simplify their language. But boys and girls must be caught when they leave school, and not allowed to drift till they reach the twenties. Moreover, it must be recognised that over-specialisation in teaching is an evil: teachers are needed who can show the interrelation of sciences. Mr. Norman Walker stressed the importance of the experimental method—of which he gave a fascinating example—and its power to win the lasting devotion of very humble and unlearned people, though perhaps he exaggerated his advocacy when he remarked that "those who have no capacity for teaching should leave the profession—or lecture!"

In a brilliant address, Prof. Desch showed how even technological studies could be treated humanistically, by presenting them in a historical and biographical setting and explaining their sociological significance. He suggested that the bridge between science and other liberal studies might be found in sociology, and declared that our need is not met by the addition of scientific and humanistic studies one to the other but only by a synthesis of the two groups. Dr. Varley said that, for purposes of administration, education is cut up into too many divisions, and pointed to the importance of the fact that technical colleges are now recognised as centres of higher education without limitation of the curriculum. Classes in literary subjects are provided there and attended by many students for purely cultural purposes. The trouble is that young folk who finish their technical courses at the age of nineteen or twenty have been absorbed for some years in vocational preparation, have not developed an interest in humanistic studies, and see nothing further for them in our educational system. He therefore advocated the bringing of adult classes into the technical college and the provision there of a Common Room so that a social atmosphere might be created. Prof. Nunn, in the closing session of the Conference, urged that the science to be taught to adults must be the real thing, not merely the history of science (valuable as that aspect is), and that the natural result would be to make people scientifically minded. He observed a rhythmic process in which from wonder students pass to a sense of the practical value of science and then to a desire for systematised