antiquities. Cross-sections of a corroded bronze were shown in illustration.

The occurrence of the so-called 'bronze disease' in museums is connected with the presence of cuprous chloride as a component in this mineral structure. This material not only reacts with moisture and oxygen in the air to form basic cupric chloride (which is the light green material that appears as the characteristic spots of bronze disease) but also attacks the underlying bronze with the formation of cuprite. Hence action directed towards preserving a bronze object must be aimed at nullifying the activity of this particular salt.

In those cases where it is desirable to retain the mineral patina on a bronze, the reactivity of the cuprous chloride may be overcome by the use of special chemical reagents, namely, (*a*) sodium sesquicarbonate solution or (*b*) specially prepared solid silver oxide.

In the first method the object is immersed in successive solutions of sodium sesquicarbonate, which has little visible effect on the patina, but is sufficiently alkaline to neutralize the hydrochloric acid produced when the cuprous chloride is slowly converted into cuprite : $2\,CuCl + H_2O \rightleftharpoons Cu_2O + 2HCl$. The second technique, involving the use of silver oxide, was specially developed in the British Museum Laboratory for the treatment of objects which for some particular reason cannot be immersed in an aqueous solution; for example, a bronze object inlaid with enamel-work. The aim of this procedure is to seal off the corroding areas containing cuprous chloride by applying over them a layer of silver oxide powder which reacts to form an impervious layer of silver chloride.

When it is desirable to remove patina, which may be not only unsightly but also concealing valuable detail on the object, the various layers of mineralization can be successively removed by chemical means. First, the green basic carbonate is dissolved by immersing the object in alkaline Rochelle salt, then the cuprite is destroyed using dilute sulphuric acid, and, finally, the cuprous chloride layer is removed by cathodic reduction in alkaline solution. When this treatment has been completed, there will still be residual chlorides remaining in the porous metal; these must be removed completely if the object is to remain in a stable state under normal museum conditions. This can only be successfully achieved by a special process of intensive washing in many successive baths of distilled water. The progress of the washing is followed by measuring the electrical conductivity of the successive baths of wash-water until it falls to a minimum and the absence of chloride is established. It has recently been found that this process, which used to take up to eight months for completion, can be speeded up by a factor of as much as ten by the use of ultra-sonics.

When the mineralized layers are removed, the object may sometimes be in such a frail state that some form of mechanical support is necessary. In the past, material such as wood or plaster and adhesives such as shellac and nitrocellulose were pressed into service *faute de mieux*. An improved technique was recently developed in the British Museum Laboratory using a suitable epoxy resin which can be supplied as a liquid which sets *in situ* to form a reinforcement. This material is ideal for the purpose because it adheres well to the metal, sets without shrinkage so that no contractile stresses are exerted on the fragile object, and it is transparent so that no details of design are obscured. This technique was successfully used to strengthen a unique silver hanging bowl excavated at St. Ninian's Isle, Shetland, which, after removal of corrosion products, was as thin as an egg-shell.

A. E. A. Werner

GENETICS AND THE ORIGIN OF SPECIES

To assess the magnitude of Darwin's contribution to biology one hundred years after the publication of "The Origin of Species", it is necessary to recognize that Darwin developed his ideas in a very different climate of biological thought from our own. Darwin's recognition of the dynamic nature of species was made at a time when species were regarded as the static products of natural creation.

Species, as aggregates of individuals subject to variation and constantly being replaced by those of their progeny which escape from the hazards of their environment, represent a concept which we owe to Darwin and which still lies behind our knowledge of evolution.

Modern theories of genetics have sprung from Mendel's demonstration of the particulate nature of inheritance and the subsequent discoveries that the hereditable determinants, or genes, are located in the chromosomes. The idea that genes are subject to mutation and liable to re-assortment at meiosis represents the crude mechanism of the variation on which natural selection must operate, but behind this lies the more fundamental aspect of gene evolution and the biochemical mechanism of their operation.

If the symposium in Sections D (Zoology) and K (Botany) of the British Association at the recent York meeting gives an insight into modern evolutionary thought, it is clear that geneticists are at present largely concerned with the manner of gene action and the process of modification in genetic constitution which selection induces. Several speakers pointed out that the precise effect of a gene is modified by the genetic environment of the gene so that successful species come to possess a highly integrated gene-assemblage. As Prof. K. Mather (Birmingham) emphasized, the main features of an organism affected by selection are controlled by swarms of genes acting together. The effects of separate genes are balanced, and selection shifts the balance, giving gradual and not jerky evolutionary change. Moreover, it is only in this way that we can understand how an organism can achieve the complex selection-advantage we find, for example, in mimicry, where a strong degree of visual similarity with the model must be obtained before selection will operate. In the case of the African butterfly, *Papilio dardanus*, in which the female mimics several models, Dr. P. M. Sheppard (Liverpool) described how the range of variation in mimic characters of the progeny of hybridization of geographical races indicated polygenic control. Dominance of mimic features has been selected, so that hybrids between races which naturally meet ensures mimicry in offspring; in hybridization of races which do not naturally meet, this dominance is lost, but reasserts itself when replaced in its original genetic environment by progressive backcrossing to the race which originally possessed it.

Re-adjustment of the gene-complex under the pressure of selection will account not only for change within a species with the passage of time, but also for divergence of parts of a species. Any tendency for genes not to diffuse throughout all the members of a species will encourage the development of restricted gene-complexes. In introducing the symposium, Prof. J. Heslop-Harrison emphasized that these barriers to gene-flow, or isolating mechanisms, are of several types.

Physiological isolation by hybrid failure or sterility is the main genetic criterion by which species status is recognized, and this may be attained at a single evolutionary step in cases of polyploidy.

Dr. R. Riley (Plant Breeding Institute, Cambridge) directed attention to the high frequency of polyploidy in plants, where successful polyploids usually arise by the combination of genomes, which, even if derived from the same species, are sufficiently different to allow diploid behaviour (chromosome pairing) to be established at meiosis. Dr. Riley showed how cytogenetical techniques had allowed the three genomes present in common wheat, which is hexaploid, to be identified as those of *Triticum monococcum*, *Aegilops speltoides* and *A. squarrosa*. By taking advantage of chromosome deficiencies, the mechanism controlling genetic isolation in wheat had been located and the way opened for hybridization with other cereals.

Isolation by breeding preference was discussed by Dr. A. J. Bateman (Christie Hospital and Holt Radium Institute, Manchester). Experiments with the fly *Drosophila*, where a choice of mating partner is offered, indicate that, for example, body-colour mutants influence preference. Field observations of nesting pairs of birds where a plumage-colour variant is present have shown similar preference to operate in natural populations. Constancy of pollinator in plants must play a similar part as, for example, between the two campions, *Silene dioica* and *S. alba*, which are respectively bee- and moth-pollinated.

In both outbreeding plants and animals, however, spatial isolation by ecological or geographical factors is the most widespread external mechanism which allows initial divergence either by chance restriction of genes in limited populations, or because ecological conditions differ between populations or their parts. The nature of soil preference and importance of competition were discussed by Dr. C. D. Pigott (Sheffield), who described the manner of elimination of *Vaccinium vitis-idaea* from mixed populations with *V. myrtillus* and occasional hybrids, by reduction in grazing pressure after enclosure and exclusion of sheep from upland oak-woods.

That divergence can precede isolation, however, is evident from experiments with *Drosophila* described by Dr. J. M. Thoday (Sheffield). By disruptive selection (elimination of the mean phenotypes and retention of extremes) within a single breeding population over several generations, a steady trend of divergence of the extremes is produced. Furthermore, experiments, in which the most extreme individuals are those used for breeding, demonstrate that this difference can be maintained.

Experimental studies of this type demonstrate very clearly that evolution is no longer a theory propounded by Darwin but an indisputable fact.

C. D. PIGOTT

OBITUARIES

Dr. Louise Pearce

DR. LOUISE PEARCE, former associate member of the Rockefeller Institute, who had worked there from 1913 until 1951, died in New York City on August 9 at the age of seventy-four years. Having graduated M.D. at the Johns Hopkins University in 1912, she began in 1913 her chemotherapeutic studies in association with W. H. Brown of the Institute. A few years previously Ehrlich had had great success in the treatment of disease, including syphilis, with organic arsenicals. In collaboration, these two workers studied experimentally the effect of arsenical compounds on laboratory infections in animals with the parasite causing African sleeping sickness. One compound of this series, namely tryparsamide, prepared by Jacobs and Heidelberger in 1919, proved very effective against rabbit syphilis and was able to save the lives of animals infected with the pathogenic African trypanosomes. Tests on the response of the human disease to this new substance were now urgently required. Louise Pearce, of resolute character and endowed besides with great physical strength and vigour, was chosen to go out to the Belgian Congo in 1920, where thousands of natives were dying of the disease, and there carried out the tests at great personal risk.

The success of the new drug was soon obvious and, as Peyton Rous has written, "she brought about one of the most shining and spectacular of the early purposeful achievements of the Institute, the conquest of sleeping sickness". Tryparsamide owes its importance to the fact that it can reach the cerebrospinal fluid in considerable concentration and has the capacity to affect trypanosomes in the central nervous system. For this work Dr. Pearce was awarded in 1953 the King Leopold II prize of 10,000 dollars and made an officer of the Royal Order of the Lion, having previously received the Belgian Order of the Crown. Her colleagues, W. A. Jacobs, M. Heidelberger and W. H. Brown, were also honoured. With the last-named she discovered a rabbit cancer, known as the Brown–Pearce carcinoma, which could be transplanted to other rabbits and has proved of considerable value experimentally. The virus causing rabbit pox was another of her discoveries.

She was keenly interested in medical education and served during 1946–51 as president of the Women's Medical College of Philadelphia. Besides her successful mission to Africa she served as visiting professor of medicine at Peiping Union Medical College during 1931–32. Her interests were wide and embraced many aspects of national and international life. As an officer of a number of organizations concerned with the study of bacteriology, medicine, tropical medicine, cancer and other diseases, she proved a good citizen of the world.