Bernal (Great Britain), on (1) X-ray analysis of materials, and (2) the structure of proteins; Prof. K. Bratanov (Bulgaria), on the application of vegetative and sexual hybridization in stock-breeding; Dr. M. Degerbøl (Denmark), on prehistory and zoology; Prof. E. Grillot (France), on luminescence of crystalline minerals; Acad. L. Infeld (Poland), on the influence of Copernicus on the development of physics; Prof. Y. Le Grand (France), on recent researches on optical physiology; Acad. V. P. Nikitin (U.S.S.R.), on electrical welding; Sir Robert Watson-Watt (Great Britain), on the education of scientific workers; Dr. W. A. Wooster (Great Britain), on diffuse X-ray reflexions and the physical properties of crystals.

Excursions were arranged for the delegates to various centres of interest, in particular to the new steel town of Stalınvaros, to the ancient royal seat of Vesperen, to the district surrounding Lake Balaton and to a collective farm. Receptions were given by the Hungarian Academy of Sciences and by various delegations. Visits to the opera and ballet were also arranged. Just before the last session of the Assembly, a concert was given by the following distinguished musicians: Annie Fischer, Alexander Svéd, Ede Zathureczky, Mihály Székely and Maria Gyurkovits. The hospitality extended to the guests was truly magnificent and they will long remember their stay on the island Margitsziget in the Danube.

Prof. F. Joliot-Curie (France) was re-elected president. Other officers re-elected included Prof. J. D. Bernal, Prof. C. F. Powell (vice-presidents), Dr. W. A. Wooster (treasurer), and Dr. E. G. Edwards (honorary secretary). The total membership of the scientific and technical organizations affiliated to the Federation has risen from 44,000 in 1951 to 136,770 in 1953, and it is distributed over thirteen countries.

W. A. WOOSTER

SYMPOSIUM ON GEOCHEMISTRY AT ZURICH

A SYMPOSIUM on geochemistry was held in Zurich during August 11–13 under the auspices of the International Union of Chemistry. It was presided over by Dr. M. Fleischer and by the local chairman, Prof. C. Burri, with Prof. T. F. W. Barth acting as secretary. More than sixty members, representing eighteen countries, were present. This meeting was the first international gathering of geochemists.

The material read at the symposium was divided into two groups: (1) reports relating to the problem of organizing, completing and making available geochemical data; (2) papers on geochemistry and allied subjects. The first group of communications included the following reports: by M. Fleischer on the geochemical work of the Geochemistry and Petrology Branch of the U.S. Geological Survey and on the progress of the revision of Clarke's "Data of Geochemistry" (Bull. 770, U.S. Geol. Surv.); by Marjorie Hooker on the progress made in the revision of Washington's "Chemical Analyses of Igneous Rocks" (Prof. Pap. 99, U.S. Geol. Surv.); by W. Müller on the geochemical work of Gmelin Institute; by P. Rosbaud on the publication of geochemical papers in *Geochimica and Cosmochimica Acta* (Pergamon Press, London); by K. Rankama on the compilation, revision and organization of current

geochemical work; and by T. F. W. Barth on current geochemical research throughout the world. The second group comprised some twenty-five papers dealing with a variety of subjects, such as the geochemistry of certain elements, the distribution and abundance of elements in ground water, sea water, sedimentary and igneous rocks, the association of uranium with mineral hydrocarbons, the uranium content of deep-sea sediments, the geochemistry of petroleum and allied substances, the minerals of pegmatites, the composition and origin of meteorites, petrochemistry and petrogenesis, and the use of the periodic system of geochemistry. A fuller report of this meeting will be published in *Geochimica and Cosmochimica Acta*.

The meeting took place in the Mineralogical and Petrographical Institute of the Federal Technical College in Zurich by invitation of Prof. C. Burri and with the assistance of the staff of the Institute. After the meeting, a group of members of the symposium took part in an excursion to the Eastern Gotthard Massif (August 14–15), led by Prof. C. Burri.

During the symposium six members of the Commission on Geochemical Localization of the Elements of the International Union of Chemistry, who were present, met and, among other business, elected Prof. H. C. Urey as a member of the Commission in succession to the late Prof. P. Niggli, and Prof. C. Burri as an observer attached to the Commission. The composition of the Commission (subject to confirmation by the Committee of the International Union of Chemistry) is as follows: M. Fleischer (Washington), president; T. F. W. Barth (Oslo), vice-president; K. Rankama (Helsinki), secretary; and members, H. S. Brown (Pasadena), C. W. Correns (Göttingen), D. Guimaraes (Belo Horizonte), A. Holmes (Edinburgh), E. Raguin (Paris), S. I. Tomkeieff (Newcastle upon Tyne) and H. C. Urey (Chicago).

EFFECTS OF ATMOSPHERIC POLLUTION ON VEGETATION

ON September 9, the last day of the Liverpool meeting, Sections K (Botany) and K* (Forestry) of the British Association jointly discussed the increasingly important topic of the deleterious effects of chemical substances in the atmosphere on plant growth. It is all too well known that soot and gaseous products of combustion, such as sulphur dioxide, when released into the air over and around large cities and industrial areas, not only cause damage to buildings but also impair the health of animals and human beings. The damage to vegetation due to the same causes is less widely known but is very familiar to those who have to cultivate plants in forest, field, garden or glasshouse where atmospheric pollution occurs. In Great Britain the damage to glasshouse plants was especially noticeable during the unusually severe fogs that occurred during the winter of 1952–53. That the problem is not confined to Great Britain is shown by catastrophes such as those which occurred in the Meuse valley in Belgium in 1930, at Donora in Pennsylvania in 1948 and at Poza Rica in Mexico in 1950, in all of which localities much human illness and numerous deaths were shown to be due directly to short periods during which the atmosphere was more highly polluted than usual. A large-scale investigation of the damage to vegetation caused by

atmospheric pollution in California was undertaken under the auspices of the Selby Smelter Commission, the conclusions of which were published in 1915. More recently, an international commission was appointed to investigate similar damage at Trail in British Columbia. The outcome of this research was made known in a book published in 1939 by the National Research Council of Canada.

Dr. C. R. Metcalfe (Royal Botanic Gardens, Kew), who opened the symposium by referring to the facts outlined in the paragraph above, then described how evergreens, and particularly conifers, in the Kew neighbourhood become stunted in growth owing to the deposition of soot on the leaves, and indicated that soot forms an adherent scum on the roofs of glasshouses, from which it can be removed only by vigorous washing soon after it has been deposited, or by chemical means if the deposit is one of long standing. Experimental work at Kew has shown, however, that the more acute symptoms of ill-health that so frequently appear in plants that have been subjected to a polluted fog are due not so much to reduction in availability of light as to the presence of toxic substances in the atmosphere. Examples of these acute symptoms are the shedding of flowers and leaves by begonias and many other plants that make a fine display during the winter months, the blackening and death of buds and flowers of certain orchids, notably *Calanthes*, the scorching of the foliage of cinerarias and primulas and the almost complete destruction of such plants as *Coleus blumei*, particularly the varieties 'Sunset' and 'Golden Ball'.

One of the most important of these toxic substances is sulphur dioxide. Treatment of susceptible plants with low concentrations of sulphur dioxide such as are known to occur in a London fog induces similar symptoms to those exhibited by the same species of plants during foggy weather, provided the atmosphere is sufficiently moist and the temperature sufficiently high. Other experiments have shown that the damage sustained is progressively more severe as the concentration of sulphur dioxide in the air goes up. Yet another series of experiments showed that sulphur dioxide can be removed from air by passing it through a column of sphagnum moss soaked in a solution of sodium carbonate, and that air purified in this way is no longer toxic to plants. Then again it was found that the damage done can be substantially reduced by protecting the plants with paper bags, which appear to have the power of adsorbing small quantities of sulphur dioxide. After pointing out that the experiments at Kew have led to conclusions concerning the toxicity of sulphur dioxide that agree except in a few minor particulars with the views expressed by investigators in Canada and the United States, Dr. Metcalfe ended his survey by referring briefly to practical remedies that can, or might be, used for alleviating the unhealthy symptoms exhibited by glasshouse plants in foggy weather. The amateur and small-scale cultivator should not despise the protection that can be afforded by a paper covering; cracks between panes of glass can be reduced to a minimum by stopping them up; chimneys from boilers should be so situated that they do not emit sulphur dioxide in the immediate vicinity of the glasshouses they are intended to heat. The temperature and humidity of the atmosphere should be reduced as much as the nature of the plants being cultivated will allow, and the value of this practice has repeatedly been demonstrated in greenhouses and by experimental methods in the laboratory.

While chemical treatments in glasshouses to counteract the acids in the atmosphere have not shown much promise, it should not be impossible to construct special houses into which purified air can be introduced. Those concerned with town planning should choose sites for horticulture where atmospheric pollution is not likely to be severe. In this connexion the direction of the prevailing wind is most important. It is clear, however, that no single remedy can be found except by reducing and, if possible, eliminating the sources of pollution.

Mr. T. R. Peace (Forest Research Station, Farnham) raised the question of how near to urban areas can trees be planted with any prospect of securing an economic return on the outlay. It was pointed out that this important problem is still far from being solved. Mr. Peace also stressed the difficulty of distinguishing symptoms such as those of Dutch elm disease, or die-back of foliage and shoots caused by damage to roots in a heavy clay soil on one hand, and similar symptoms induced by a polluted atmosphere on the other. He described in some detail an occasion in June 1953 when considerable damage was sustained by trees on the Duke of Bedford's estate at Woburn. This damage occurred suddenly, and is believed to have been caused by the emission of fluorine from a neighbouring brickworks during a period when there was a wet fog, the relative humidity rising to 99 per cent at a temperature of 57° F. at 3.0 a.m., followed by a gradual rise in temperature and fall in relative humidity to 53 per cent by 3.0 p.m. on the following day. Conifers were more severely damaged than hardwood species. European larch was severely affected, the young shoots being killed outright. The distal ends of the current season's needles of Scots pine turned brown, and there was slight damage to Norway spruce, but Corsican pine sustained no damage at all. Similar damage occurred in the forest nursery as well as to more mature trees. Among hardwood species, slight damage to *Corylopsis* and *Rhus* was noted in the nursery, and *Pterocarya* shed its leaves.

Dr. J. K. C. Bleasdale (Botany Department, University of Manchester) described experiments in which seeds of various species of plants were buried in boxes of soil and grown in localities where the concentrations of pollution were known to be different. No visible effect of the pollution was noted in the plants raised in this way during the summer months, when the concentrations of pollution at all of the centres were relatively low; but, after the plants had passed through the winter, marked differences, corresponding to the degree of pollution, appeared in the health and vigour of the plants during the following spring. When hill pastures on farms in East Lancashire were ploughed and planted with selected strains of clovers and grasses from Aberystwyth, the increased pasture yields that were expected to accrue were not, in fact, realized.

Dr. Bleasdale agreed with the general belief that sulphur dioxide is one of the most noxious ingredients of smoke, and concentrations of from 0.5 part per million upwards are known to cause lesions on various types of plants. At concentrations below 0.5 part per million, lesions do not usually occur, and some of the previous investigators have claimed that growth is not seriously impaired below this critical concentration. Experiments in two small air-conditioned glasshouses in the Fallowfield district of Manchester showed, however, that prolonged treatment of the Aberystwyth strain of rye grass known

as S23 with air containing concentrations of sulphur dioxide that ranged from 0.01–0.06 part per million gave a dry weight yield that was 45 per cent below that of plants grown in air that had been purified by passing it through a water scrubber. Some evidence was found, however, that the effect of polluted air may be masked if the rye grass is grown on soil of especially high fertility. The greenhouse experiments were supplemented by others in the field at nine different sites. These showed that plants such as rye grass, cabbages and wallflowers, in which active photosynthesis occurs during the winter months, are seriously stunted when grown in a polluted atmosphere, the reduced growth being most marked where the pollution is most concentrated. Dr. Bleasdale ended by referring to the competition for land between building and agricultural interests, and reminded his audience that the spread of suburbia combined with smoke pollution is reducing food production to an ever-increasing extent that might well become serious. Possible remedies would be to breed smoke-resistant varieties of food plants, and to apply chemicals to the plants to counteract the sulphur dioxide in the atmosphere.

These three contributions were followed by a lively general discussion in which reference was made to many aspects of the subject, including the action of a polluted atmosphere in inhibiting the development of lichens and mosses, the increasingly poor outlook for planting woodlands in the future, and the complex nature of the combined influence of soil conditions and air pollution on plant growth. Prof. H. G. Champion (University of Oxford), who has seen the damage to vegetation in the neighbourhood of the Trail smelting works in British Columbia, said that considerable improvement had been effected there by the introduction of remedial measures at the works. From the views that were expressed it is quite evident that, apart from the damage done by soot and other solid particles emitted into the atmosphere, there is general agreement that sulphur dioxide is one of the most important causes of damage to vegetation. It must not be overlooked, however, that certain American investigators have claimed that other chemical substances, such as oxidation products of olefines, are also responsible. The discussion undoubtedly served a useful purpose in focusing attention not only on the serious damage to plant life that sometimes occurs but also on the complex of physical and chemical factors that play a part in causing this destruction. A complete solution of the problem is not likely to be quickly achieved for economic reasons; but it is to be hoped that success will come gradually through the combined endeavours of engineers, meteorologists, chemists and botanists.

C. R. METCALFE

COMPARATIVE PHILOLOGY AND POLYNESIAN STUDIES

By PROF. ALAN S. C. ROSS

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PHILOLOGY (or linguistics) consists of two parts, usually called descriptive linguistics and comparative philology, respectively. The latter is technical and esoteric (therefore its nature is not easy to describe shortly), whereas the former is of a nature altogether more obvious.

The main task of descriptive linguistics is, in fact, the answering of the question: What is the best, or even, what is a good way to describe language; or, to describe a particular language? It is very clear that the 'normal' answer to this question—namely: Languages may best be described in the terms in which Latin is conventionally described—is valueless when applied to the majority of languages. That is to say, 'Latin' grammar, with its sharp distinction between, for example, verb and noun, and its system of declension and conjugation, cannot afford us a frame for describing a language such as Tahitian, which has no trace of declension or conjugation and, apparently, has one massive part of speech corresponding to the Latin verb, noun, adjective and adverb taken together.

Some philologists consider that no satisfactory answer to the question: How may a language be described? has yet been given. Others, however, think that they have given an answer and have established, in several schools already somewhat at war with each other, the subject known as structural linguistics. The main centres of this new subject are, first, many American universities, and then the Universities of London, Paris and Copenhagen.

The second branch of linguistics, comparative philology, makes statements of which the following are the three main types: (1) 'English and German are related languages'; (2) 'the English word *stone* is philologically identical with the German word *stein*'; (3) 'an Anglo-Saxon long *ā* becomes a Modern English long *ō* (as in AS. *stān* MnE. *stone*)'. Statements of all these types are technical and entirely non-obvious; the learner of comparative philology must be prepared to expend a good deal of hard work before he can expect to understand them.

The 'axiom' underlying statements of the first kind is simple to state; it is merely that 'Two languages are defined as related if, and only if, they were once one language'. Thus French and Spanish are related because, and only because, they were both once Latin. Developing this axiom in an obvious manner, it is easy to establish the concept 'Family of Languages'; for example, English, German, Dutch, etc., form the Germanic family of languages.

Comparative philology, in its modern sense, came into being at the beginning of the nineteenth century. One of its main tasks has been the arranging of the languages of the world into families of related languages, and great progress has been made in this field. To-day, the thousands of languages in the world stand arranged into hundreds of different families (with no relationship proved to subsist between any pair of the families). The next—and incomparably the more laborious—task is the production of all possible statements of the second and third types for each family. Only when this has been done can the comparative philology of a family be said to exist.

Even in pre-1914 Germany (where the subject flourished most), the number of comparative philologists has always been small, in comparison with the number of, for example, natural scientists. It is therefore scarcely surprising that, in the century and a half which has elapsed, it has not been possible to bring into being (still less to complete) the comparative philology of more than seven families, namely: (1) Indo-European (to which, for example, English, Latin and Russian belong); (2) Uralian (for example, Finnish, Hungarian and Samoyede); (3) Semitic (for example, Hebrew and Arabic); (4)