gives a large field of sharp definition over a spherical focal surface the centre of which is at the centre of curvature of the primary. For investigations of stellar distribution, galactic structure, etc., it is unsurpassed. Used with an objective prism, it is ideal for the classification of the spectra of faint stars. There have been various modifications of the Schmidt design, such as the Schmidt-Cassegrain systems discussed by Linfoot, with which a large flat field of good definition can be obtained. For the Isaac Newton reflector at the Royal Greenwich Observatory, it is proposed to make the primary mirror spherical with a radius of curvature of about 50 ft. and to use it in conjunction with a Schmidt correcting plate for direct photography. In spectrographic observations, this plate will be removed and one of two or more aspherical Gregorian secondaries, corrected to give good axial definition, will be used, according to the equivalent focal length required.

Different types of mounting have been used for large reflectors: the German mounting; the simple English mounting; the English yoke mounting; and the open fork mounting. The 200-in. reflector at Mt. Palomar has a modified form of the yoke mounting, the upper bearing being in the form of an open horseshoe, enabling the telescope to be pointed to the pole. The fork mounting is in many ways the most convenient.

Many different instruments have been designed for special purposes in astronomy. Among these, one of the most important has been Lyot's coronograph, which has made it possible to study the sun's corona without a total eclipse of the sun. There have been important developments in details of design and construction, in methods of driving and guiding telescopes, in the design of spectrographs and other ancillary equipment. The design of almost every instrument presents special problems, and it is by the closest collaboration between the user, the designer, and the constructor that progress in observational astronomy can best be made.

COMBUSTION

As the background on which to develop the subject of this presidential address to Section B (Chemistry), Sir Alfred Egerton uses the records of the previous meetings of the Section in Newcastle. Whewell was president of the Section in 1838, *Williamson in 1863, Lothian Bell in 1889*, and Henderson in 1916. Sir Alfred directs special attention to the remarks of Sir William Armstrong, as president of the Association in 1863, on fuel economy, and to discussion in 1916 on the subject.

Omitting historical discussion of the influence of the early work on combustion on the birth of chemistry as a science, which has been a subject of earlier addresses to the British Association by Sir Edward Thorpe and others, Sir Alfred takes the work of Davy as having been the keystone of the particular field of combustion chemistry which still thrives. Davy, in his paper on combustion published by the Royal Society in 1817, described investigations on the limiting composition of combustible mixtures, observations on the structure and speed of flames, on the influence of inhibitors of combustion and on surface combustion, on the effect of pressure, the pressure developed on explosion which leads to measurement of flame temperatures, etc. Bunsen and his school developed Davy's work, and the knowledge gained had an influence on the establishment of the laws of thermodynamics and the development of physical chemistry. Combustion chemistry was further advanced by Berthelot's discovery of the detonation wave, and Mallard and le Chatelier's application of photography to the determination of the velocity of flames. These and other advances made by H. B. Dixon, W. A. Bone, A. Smithells and others, and by Haber, Nernst and others on the Continent, had their influence not only on chemistry, but also on technological progress during the period 1890–1920.

The study of combustion has had an even greater influence on the progress of chemistry since 1920; for in this latter period the study of gas reactions has led to a deeper understanding of the mechanism of chemical reactions, particularly in connexion with the combustion of phosphorus, of hydrogen and of hydrocarbons. Chain reactions provide an explanation for the limits of explosibility and for the behaviour of systems undergoing slow combustion, and the same notions have been applied to other problems which have had a great influence on recent advances, for example, the fission of atoms and production of new elements.

Sir Alfred refers to the conservation of fuel resources and their efficient utilization, pointing out the past wasteful methods of domestic heating. The possibilities in the development of gas turbines and distribution of energy in the form of gas produced by methods of total gasification are also mentioned. Looking back on the developments in the past fifty years, and bearing in mind the wonderful processes by which Nature synthesizes so many products, there is reason to believe that the achievements of chemistry will be no less great in the future.

RECENT WORK ON THE LOWER PALÆOZOIC ROCKS

In his presidential address to Section C (Geology), Prof. W. J. Pugh points out that the history of the Lower Palæozoic is the evolution of a geosyncline with its marginal shelf-seas, which extended from south-west to north-east across the western part of Great Britain. This prolonged period of marine sedimentation was accompanied by extrusive and intrusive igneous activity and was closed by the Caledonian mountain-building movements.

The Cambrian seas of the Welsh-Midlands region and of Scotland with their contrasted faunas were probably separated from one another by a land-mass which occupied the Irish Sea and adjacent regions. This land-mass was doubtless the main source of supply of the sediments which were deposited to the south and north of it; to the south, the thick development of North Wales, and to the north there may have been an equally thick development of comparable lithology since part, at any rate, of the Dalradian of the Southern Highlands is of Cambrian age. Geosynclinal conditions prevailed on each side of and adjacent to this Pre-Cambrian land-mass, while farther south and farther north, a smaller thickness of deposits accumulated in shelf-seas, although it is not known whether the Highland Border seas were continuous with those in the North-West Highlands. Movements of this Irish Sea geanticline controlled the characters of the sediments derived from it.

© 1949 Nature Publishing Group

There were important earth-movements at the close of the Cambrian in the Welsh – Midlands region, involving uplift and erosion of the Cambrian sediments. These movements defined the limits of the Welsh geosyncline during the Ordovician, the margins of which lay approximately in Anglesey and in Shropshire. The Builth-Llandrindod inlier of Central Wales reveals an early Ordovician shore-line which is preserved with remarkable clarity, while dolerite intrusions of Ordovician age display laccolithic structures of unique types. The Ordovician rocks of the Lake District were deposited in the north-eastward continuation of the Welsh geosyncline; on the west, the St. George's Channel – Irish Sea area was geanticlinal, and to the east and north-east of Shropshire lay the main land-mass on that side of the trough. There was widespread volcanic activity as well as important contemporaneous earth-movements.

The Durness Limestone in the North-West Highlands must be referred mainly to the Ordovician, and while these calcareous rocks were being deposited, clastic sediments, accompanied by volcanic activity, were being laid down in early Ordovician times in the Southern Uplands, Girvan and probably the Highland Border. Then followed uplift and erosion in southern Scotland; but the facies distribution of the upper Ordovician suggests land to the north of Girvan, and the presence between it and the Irish Sea geanticline of a geosyncline, which continued south-westwards into Ireland. It would appear that the area north of the Highland Border was affected by these middle Ordovician movements, but it may also have been affected by those in the Cambro-Ordovician interval which were so evident in the Welsh–Midlands region. These earlier movements may possibly be responsible for the incomplete Cambrian succession in the North-West Highlands.

The Welsh geosyncline was maintained during the Silurian although there was a considerable change in the character of sedimentation, and in certain places uplift and erosion of the older rocks; but beginning with the Upper Llandovery and continuing throughout the Wenlock and Ludlow, the sea spread eastwards and southwards over areas which had been land during the Ordovician. There is evidence of the westerly derivation of material from the St. George's Channel – Irish Sea region; in Central Wales during the Middle and Upper Llandovery and in North Wales during the Wenlock and Ludlow; the Ludlow rocks reveal extensive submarine sliding and slumping of the sediments. The Welsh geosyncline still extended into the Lake District, but there is no evidence that the sea transgressed widely over the eastern stable area.

The Girvan-Moffat geosyncline persisted, and there are indications of an easterly derivation of material during the Upper Llandovery and Wenlock, suggesting separation from the Wales – Lake District trough; Ludlow rocks are only found in the Midland Valley, and it is not known whether they were deposited in the Southern Uplands.

The Downtonian rocks, which were deposited in basins and lagoons where at times conditions approached continental, are restricted to the south-eastern and north-western flanks of the Silurian tract. They may not have been deposited in the central region of North Wales, the Lake District and the Southern Uplands because it was being uplifted and eroded as a result of the onset of the Caledonian orogeny.

ZOOLOGY OUTSIDE THE LABORATORY

IN his presidential address to Section D, Prof. A. C. Hardy stressed the importance of zoological field studies. Ecology, by developing quantitative and experimental methods, is converting natural history into science. Its aim is not simply to express the inter-relationships of organisms with their environment in numerical terms—in itself a tedious refinement—but from such analysis to discover more of the laws operating in animate Nature.

It may seem strange that animal ecology should be so much more advanced in the hidden world of the sea than it is on land. We know more about the food relations of many fish than we do of any terrestrial animals. We have a better idea of the populations, per unit area, of different molluscs on parts of the sea floor than of the snails of our countryside; our knowledge of the numbers of small crustacea per cubic metre of water in many seas is far in advance of that regarding insect numbers on land. Possibly we know more about the ecology of the Dogger Bank and its overlying waters than about that of any English county.

We should not claim a greater marine enthusiasm. Of our food supply, the fish and whales are alone unfarmed and still hunted in the wild. It is, of course, the economic urge to find out more and more about them, so as to exploit them more efficiently, that financially has stimulated ecology under the sea. If only cattle and sheep had never been domesticated, what a wonderful series of terrestrial investigations we might have had by now, to enable us to conserve the stocks of wild game and use them to the best advantage. But is not ecology on land really just as vital—but not quite so obvious? While the main sources of our food are cultivated plants and domesticated animals, they are attacked by a multitude of wild pests. It is true that there are now dotted about the world many research stations, but most of these deal either with the control of certain pests, or with the biology of some particular kind of plant or animal. How many are devoted to the science of wild life for its own sake? At present very few. Yet it can only be through a better understanding of the basic principles underlying the complex interactions of wild life that really sound progress can be made towards a better knowledge of the factors governing our food supply.

That, indeed, is urgent; but such pure research in field zoology is important for a much more fundamental reason. Man does not live by bread alone—not man as most of us respect him. If he does come so to live—and it is a possibility—our civilization will change. Who can doubt that the roots of the two World Wars were not nourished to a large extent upon a philosophy of materialism and too small a knowledge of the working of evolution? If we could spend upon fundamental biology half as much as we spend upon research on atomic energy, how much more we would know about the very nature of life and the process of evolution. The study of evolution in action is one of the most exciting themes in ecology, for many of its problems can only be solved outside the laboratory.

We want more evidence in quantitative terms of the actual operation of selection in Nature. Are the very small isolated populations in which genetic drift can give rise to non-adaptive variations really important? Can they usually survive for long enough

© 1949 Nature Publishing Group