CONTRIBUTION OF NEW INSTRUMENTS TO PROGRESS IN CHEMISTRY

DURING the past twenty years, the progress of chemistry has been dominated by the demand for, and the evaluation of, new techniques. This trend has been based to a very large extent on the development of new physical instruments and, if the present progress in this field is maintained, there are an infinite number of problems in chemistry which will be solved. Sir Harry Melville's presidential address to Section B (Chemistry) deals with the wider implications of instrument development and shows how progress in certain areas would have been impossible without the introduction of these new methods.

The often tedious chemical approach to the problems of measuring molecular weights has been completely superseded by the use of physical instruments. High-resolution mass spectrometry has enabled accurate determinations to be carried out in a matter of hours. The high-resolution electron microscope, for example, can be used to determine directly the weight of completely coiled high polymer molecules by measuring their diameter. Radioactive labelling is a method of micro-chemistry entirely dependent on instrumental techniques. In the field of polymer chemistry, where the weight of material being manipulated may be less than 10^{-7} g, it has put an end to many speculations about the course of chemical reactions occurring to minute amounts in high polymer systems.

The interaction of gases with solids has been investigated for years, but the preparation of uncontaminated surfaces has been a barrier to progress. The great improvement in vacuum pumps over the past few years has enabled this barrier to be surmounted, and clean uncontaminated surfaces can now be prepared and examined at leisure, using sensitive techniques such as mass spectrometry, gas/liquid chromatography, and electron field emission and ion emission techniques. The mechanism of homogeneous chemical reactions has yielded in many cases to complete analysis as the result of the development of new techniques. However, reactions which involve activated molecules, or which go through ionic or ion-pair mechanisms, have not yet yielded to these techniques, and here there is an enormous field for study.

Methods for tackling these problems are described. One involves the application of external stimuli to the system and observing the way it returns to the steady state. The problem is to devise equipment sufficiently sensitive to measure the small amounts of chemical change during the recovery period. The second method involves the application of electron spin resonance—here a considerable improvement in the sensitivity of present equipment is desirable. A third method involves the investigation of energy transfer in given systems. This involves the design of shock tubes and plasma-discharge apparatus, and the instrumentation to go with them.

These problems illustrate why a modern chemical laboratory is equipped in a very different way from ten or more years ago. The important point is that all the basic requirements of chemistry can now be carried out by more direct and sensitive methods. Increased sensitivity and greater resolving power of instruments are still very necessary and these depend on still further advances in physical techniques. To be effective, a modern laboratory must have this physical equipment, but the equipment must not be allowed to dominate the scene—the purpose of the equipment is to help the research worker to get on more quickly and precisely with his basic chemistry.

SOME ASPECTS OF EAST AFRICAN VULCANOLOGY

IN his presidential address to Section C (Geology), Mr. Wilcockson chooses to describe the Eastern, or Gregory, Rift Valley. This is a downfaulted trough extending from northern Kenya down to the latitude of Dodoma in Tanganyika. It is associated with minor structures on both sides. In the latitude of Nairobi, on the west side is the rift valley containing the Kavirondo Gulf of Lake Victoria and on the east, nearly opposite, a general fracture zone in which is situated the volcano Mt. Kenya. In northern Tanganyika, just south of the Kenya border, there is a similar pair of structures, on the west side the Eyasi Rift and the east side a fracture zone along which is a line of volcanoes culminating in Kilimanjaro. These crossings, as they may be termed, are the loci of intense volcanic activity.

On the west side of the southern crossing, the Eyasi Rift is filled with the eruptive products of the 'Giant Craters', a group of volcanoes mainly composed of alkaline lavas with little fragmental material and including the great Ngorongoro crater. In the nearby section of the rift valley are volcanoes, relatively recent in date, among which is the still active Oldonyo L'Engai. Among their outpourings are highly alkaline rocks associated with carbonatites, a type which has been reported recently as lava flows from Oldonyo L'Engai.

On the east side, Kilimanjaro has produced mainly lavas, but also some pyroclastics. Its early history is, of course, buried under later products, but the considerable proportion of the succession that can be seen shows a general change from trachybasaltic lavas to highly alkaline nepheline phonolites; the other volcanoes in this group contain similar rock types. One striking late feature is the presence of a very large number of parasitic cones which often show a reversal to basaltic types and ultra-basic crystal accumulates.

At the northern crossing the general course of events has been similar, though differing in detail. The volcanoes of the Kavirondo Gulf are alkaline in character and are associated with the intrusion of carbonatites. Mt. Kenya on the east contains phonolitic rocks, including the curious type kenyte, associated with basalts and an intrusive mass of nepheline syenite, while further to the east the Nyambeni Range is largely basaltic. Again, as on Kilimanjaro, the main activity is followed by a widespread parasitic episode.

In this latitude volcanoes associated with the rift-valley faulting poured out great floods of basaltic and phonolitic plateau lavas with some pyroclastics which cover enormous areas in the Aberdare Mountains and west of Nairobi. It is difficult to give any general succession of rock types for the whole region, but the early stages of the vulcanicity often seem to have been associated with the eruption of basaltic rocks which later gave place to more alkaline types, sometimes associated with carbonatites. In the rift valley west of Nairobi and elsewhere an acid trend developed resulting in quartz trachytes or even rhyolites.

The age of the vulcanicity has been the subject of much controversy. It is fairly certain that round the northern crossing the eruptions began in the lower Miocene while the outpouring of Kilimanjaro began on the end-Tertiary peneplain and much of its activity and that of the "Giant Craters" was of Pleistocene age.