Federal Science during the World-war: Geology in Austria-Hungary in 1914-19.

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IN NATURE, vol. xciv., p. 94, on the last day of the eventful year 1914, a sketch was given of the publications of the Geologische Reichsanstalt of Vienna from 1911 to 1913. The reduction in the scope of the institute, necessitated by political rearrangements, was recently referred to with some regret, and, now that international communications are restored, we are enabled to welcome the volumes issued during the years of war. The maintenance of the *Jahrbuch* in its well-known handsome form is a remarkable testimony to the energy of Dr. Tietze and his staff. While machine-guns rattled above the glaciers of the Ortler and slaughter surged from Caporetto to the sea, the Reichsanstalt not only discussed questions of philosophic interest, but even printed the results in anticipation of the return of happier times. Colour-printed maps and sections and photographs of fossils accompany these volumes, which from January, 1914, to December, 1918, occupy a width of 15 cm. on our shelves. The *Verhandlungen* give us an extra thickness of 7 cm. This method of statement may appear crude in a matter of scientific output; but could we have claimed as much from H.M. Stationery Office in London if a lithe and indefatigable enemy had been battering our defences no farther away than the line Middlesbrough—Baugh Fell—Morecambe Bay?

Many of the recent papers in the *Jahrbuch* naturally treat of local details, and describe observations made during long mapping in the field; but few of them are devoid of wider applications. The fascinating mass of the Wetterstein on the northern wall of Tirol occupied O. Ampferer and O. Schlagintweit in the *Verhandlungen* in 1912. K. C. von Loesch (*Jahrb.*, 1914, p. 1) has now made a close study of its "Schollenbau" and that of the parallel Mieminger range immediately to the south, which is well known to travellers down the Innthal between Imst and Innsbruck. Von Loesch is particularly concerned with the lateral movements that followed, after an interval of repose, the main overfolding from the south. His summing up fails to give a comprehensive view of the westerly movements of the isolated blocks—a feature first indicated by Ampferer. One would like to know whether these may be fairly compared with the settling down and spreading of the front of a wave that has subsided on a shore. The question of how far the tension evidenced by "explosive" outbreaks of rocks in Alpine mines and tunnels is a heritage from the Miocene movements is considered a few pages later by K. A. Weithofer, of Munich ("Ueber Gebirgsspannungen und Gebirgsschläge," *Jahrb.*, 1914, p. 99). His paper discusses such occurrences in general, and concludes that no single explanation applies equally to all.

E. Fugger (1914, p. 369) describes the delightful country of the Tennengebirge south of Salzburg, where the Triassic rocks of the Eastern Alps first reveal their beauty and fascination to the traveller on the road to Radstadt. He quotes from F. Wähner an explanation of the double gorge of the Salzach above Golling, where a climb is made to the Lueg Pass along a dry ravine partly choked with glacial detritus. After the Ice age the river failed to return to its old groove, from which it was banked out by debris, and it carved the deep and impassable gorge of the Oefen close alongside. A rock-ridge only 200 m. wide separates the two ravines.

As an example of research into the stratigraphical

problems of the Eastern Alps we may cite W. Hammer's far-seeing paper on the Bündnerschiefer of the Upper Innthal, with its numerous sections, and two coloured maps on the large scale of 1:25,000 (1914, pp. 441-566). The Bündnerschiefer, corresponding with the *schistes lustrés* of the Western Alps, occupy small areas south of Landeck on the margin of the gneiss, and present the usual difficulties of correlation. Hammer records interesting breccias with limestone fragments containing radiolaria; but fossil evidence is practically wanting. He inclines to the view that the beds are metamorphosed elements of Upper Cretaceous rather than older Mesozoic strata. Exotic Triassic masses appear among them in a disconcerting way (section on p. 453, etc.), and pebbles of Triassic rocks occur in conglomerates of the Bündner series.

Hammer continues (1918, p. 205) his studies in the Landeck district by a description of the zone of phyllites, associated with mica-schists, that runs along the north side of the Silvretta and Oetzal gneiss from St. Anton on the Arlberg to the village of Roppen in the Innthal. The series dips towards and under the gneiss, just as the Bündnerschiefer do from an opposite direction. The phyllites are overlain unconformably by the Verrucano, which was formed between the Armorican movements and the Triassic period. Their relations with the gneisses seem due to the early earth-movements, but here and there intrusive gneisses have invaded them. An interesting type (p. 216), the "Feldspathknotengneiss," occurs in the phyllite series, and is marked by the development of albite in an originally sedimentary rock. The growth of the felspar has no connection with contact-action.

F. Angel and F. Heritsch, both of Graz, found an almost ideal working-ground on the Stubalp, part of the noble wall of crystalline rocks that hems in the basin of Graz on the west. The position of Austria in the world-war was so enforced and so anomalous that we may sympathise with these geological enthusiasts when they write of their mountain fastness: "Die Liebe zur Heimat, die Freude an den Bergen hat uns immer wieder dorthin geführt, wo wir den Jammer des Krieges vergessen konnten. Die Forscherlust war die Begleiterin unserer Wanderungen." F. Angel contributes detailed petrographic studies of the rocks encountered, which include both a sedimentary and a gneissic series; but the chief point of general interest lies in Heritsch's conclusion (p. 203) that the whole mass and its present structure are of pre-Cambrian age. The Stubalp thus seems to be an antique block worked up, perhaps, but by no means obliterated in the later tectonics of the Alps.

The attention given in these recent volumes to Bohemia, mainly through the work of Czech geologists, leaves a serious heritage to the revived States that look to Prague as their intellectual centre. The old question of the Silurian "colonies," and the work of J. E. Marr in giving them a tectonic significance, come up again in E. Nowak's researches on the southern edge of the basin (1914, p. 215) and in F. Wähner's paper (1916, p. 50) on the structure of central Bohemia, which recognises in the basin the remains of a formerly extensive and crumpled mountain range. This seems to have existed in Upper Devonian times, and one is tempted to ask if, with the north-east strike impressed upon its constituents, it cannot be regarded as part of the Caledonian con-

continent so well revealed in north-western Europe. The main folding, however, in Bohemia and Moravia, accompanied by great intrusions of granite and the formation of large areas of gneiss, occurred in connection with the "Variscan" movements—that is, in Upper Devonian and Lower Carboniferous times—thus heralding, and still at a long distance, the Armorican movements of the west. This fact is emphasised by Radim Kettner, writing from Prague (1917, p. 251).

In the same year (p. 267) J. Woldrich examined the Cretaceous fauna of Neratovic, where concretions containing 50 per cent. of calcium phosphate interestingly occur. This discovery is compared with the presence of phosphatic nodules in the Cretaceous of France and England, and (p. 321) the fauna is described in relation to its western representatives. In the volume for 1915 (p. 1) C. Zahálka contributes a far-reaching memoir on the Cretaceous system in the Sudetic region and its equivalents in the western lands of Central Europe. This includes many pleasant references to the comradeship shown to the author by French geologists, and the name of Valmy, where the First Republic answered the proclamation of the coalised kings, appears here happily (p. 109) in connection with field-work on the zone of *Inoceramus labiatus*. There is much in this extensive paper to interest English geologists, who must, by the way, not overlook Richard J. Schubert's paper (1915, p. 277) on otoliths of Barton Cliff in Hampshire, collected by H. Elliot Watson and sent to the author by Col. C. D. Shepherd. Schubert's death at the head of his company in the heroic fight at Gorlice on the Russian front (obituary by O. Ampferer, 1915, p. 261), removed a very active and much-loved personality from the ranks of the Reichsanstalt.

British and Indian geologists may also note Rudolf Zuber's contributions to the geology of the Punjab (1914, p. 327), resulting from explorations organised by an English oil company in 1913. There are two highly suggestive diagrams showing the interlocking of different types of Eocene strata, including the salt-

clay series, and their folding in the great Himalayan movements to form the present Salt Range.

Broad questions of petrography have not escaped the attention of the Reichsanstalt, such as Bruno Sander's "Beiträge aus den Zentralalpen zur Deutung der Gesteinsgefüge" (1914, p. 567), in which the stratified and folded structures in many crystalline rocks are recognised as of earlier date than the crystallisation of their present mineral constituents; or the extensive study of peridotites and their allies involved in F. Kretschmer's memoir on "Der metamorphe Dioritgabbrogang im Spieglitzer Gebirge" (1917, p. 1). Palæontology is represented by a number of short papers, including one by J. V. Zelizko (1918, p. 113) on a small species of lion from the Pleistocene of Wolin, in southern Bohemia. One large folio memoir, on *Oxynotoceras*, by J. von Pia, was issued in 1914; it includes the usual considerations in regard to what constitutes a genus or a species, to which we are accustomed when ammonites are brought into the arena. In critical biography E. Tietze's "Einige Seiten über Eduard Suess" (1916, p. 333), a paper of more than 200 pages, is a very memorable review of the recent history of geology. Even the papers on economic subjects reflect the calm detachment of the institute, encouraged to carry on its work with a cosmopolitan outlook, during a catastrophe that has broken the bonds of man to man by more than inexorable death. Even F. von Kerner's study (1916, p. 145) of the water-supply in the Middle Dalmatian karst-region, with its valuable series of sections, will be to the advantage of the Slavonic peoples rather than to those who blasted their trenches on the Carso in the hope of retaining a sovereignty at Trieste. And so, indeed, it should be always. The Austro-Hungarian *Festland* has become broken into horsts and *Graben*; but will not time smooth the fault-scarps that now loom up as separating walls? The best guarantee of scientific co-operation is to be seen in the names of those who have, during years of bitterness and division, contributed in serene hopefulness to the sum of human knowledge.

Measurements of the Angular Diameters of Stars.

AFTER the successful measurement of Capella as a double star by Prof. A. Michelson's interferometer method applied to the 100-in. reflector at Mount Wilson, it was known that he intended to attempt the more difficult feat of measuring stellar diameters. The most hopeful stars to choose for the purpose are the giant red stars. Prof. Eddington made some estimates of their angular diameters in his inaugural address to Section A of the British Association last August (NATURE, September 2, 1920, p. 14). Taking the temperature and surface brightness derived from the distribution of energy in the spectrum, the angular diameter (which is independent of the assumed distance) is deducible from the apparent magnitude. The highest estimate for any star was that for Betelgeux, the value being $0.051''$.

The daily Press of December 31 announced that Prof. Michelson read a paper before the American Physical Society in which he stated that he had determined that the diameter of Betelgeux was 260,000,000 miles, or three hundred times that of the sun. As the assumed distance of the star was given as 150 light-years, we may infer that the measured angular diameter was $0.061''$ —a close agreement with Prof. Eddington's estimate.¹ Once the angular dia-

meter of a single Ma star is determined, those of all the stars of the same spectral type can be deduced from their apparent magnitudes. The huge bulk of Betelgeux is a striking illustration of Prof. H. N. Russell's theory of giant and dwarf stars. Its density is presumably very low, otherwise an improbably high value of the mass would result.

Some further details of the result obtained at Mount Wilson were communicated in a letter from Prof. G. E. Hale which was read at the meeting of the Royal Astronomical Society on January 14. The apparatus consists of two periscopes fixed to a frame at the object-end of the tube of the 100-in. Hooker reflector. The outer mirrors are some 20 ft. apart, but the distance is capable of being varied. The inner mirrors are about 4 ft. apart; this is merely a matter of convenience, the beams being brought down the tube on opposite sides of the Cassegrain mirror. An additional plane mirror is used for reflecting the light up the polar axis. The measurement of a star's diameter is effected by varying the distance between the outer mirrors and finding the points at which the interference fringes disappear. The actual observation is very tedious and difficult; it was stated that half an hour was required each time the mirror was moved before the visibility of the fringes could be tested. Moreover, in measuring a star disc, observations are

¹ A later communication gives $0.046''$ as the measured diameter.