Science in Bohemia.

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THE years during the war and after were not very favourable to our scientific investigations. The grants for the scientific institutions were reduced by the late Austrian Government in the same degree as the prices of instruments, etc., increased; many a young man of science has left the High Schools and never returned again. We are now enjoying the fourth year of our liberty and independence, but our country was bled by Austria, so that in order to keep our liberty, which we owe to the magnanimous support (moral only, alas!) of the Allied Powers, our Republic had to start its life from the very beginning. Paper and printing became so

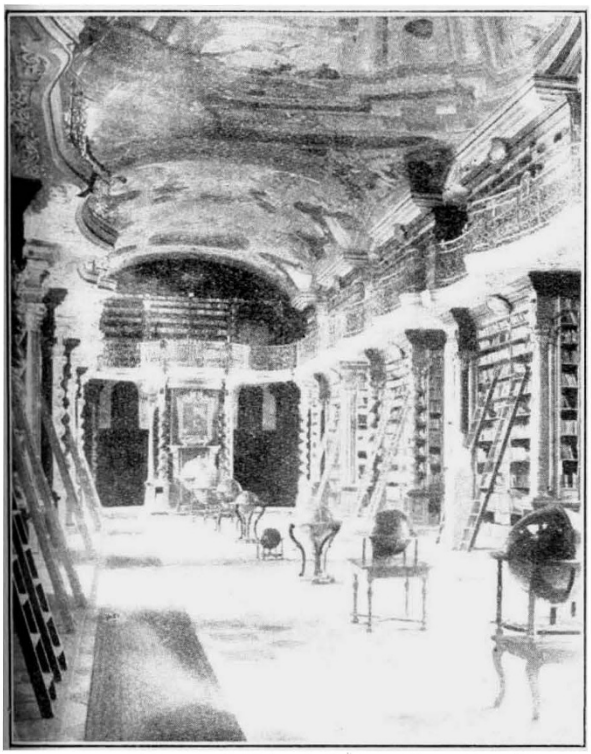

FIG. 1.—Central Hall of the old University Library, Clementinum, Prague.

enormously expensive that the two chief scientific societies, the Royal Society of Bohemia, founded in 1770, and the Bohemian Academy of Science and Art, founded 1890, are able to print only very short scientific communications.

I beg, therefore, to place before English men of science a very condensed account of the most prominent papers published during the last few years by Bohemian men of science. (Our German countrymen publish their scientific papers in Germany or in Vienna—as before the war.)

ASTRONOMY AND ASTROPHYSICS.—With the 8-inch telescope of the Observatory of the University no important work can be done. Prof. Brauner refers to a communication published in NATURE of April 8, 1909 (vol. 80, p. 158), entitled "The Gases of the Ring Nebula in Lyra," in which he showed that of the four gases, separated by rotation as visible from Th. Wolf's spectra, the innermost gas ($\lambda=460$) must be lighter than hydrogen, whereas the outermost gas D ($\lambda=373$) will have a density between that of hydrogen and helium. We know to-day that the densities of the gases hydrogen and helium in nebulæ are proportional to their atomic weights. The line $\lambda=469$ in the gas A is now generally regarded as a line in the principal series of helium and identical with the line $\lambda=4685{\cdot}90$ obtained by Fowler by condensed spark discharge, but other helium lines, especially $\lambda=5876$ (10), are missing, and so the gas is called "protohelium." That the line $\lambda=373$ or $\lambda=3726{\cdot}1$ and $\lambda=3728{\cdot}838$ really corresponds to a gas heavier than hydrogen and lighter than helium was proved by Bourget, Fabry and Buisson, who found in 1914 that its density is 2·74, whereas Nicholson calculates 2·95.

METEOROLOGY.—After the Austro-Hungarian Empire went to pieces it became the duty of the young Czechoslovak Republic to establish an institute that would take charge in its territory of the stations that were previously under the agency of the Vienna and Budapest central meteorological offices. At the beginning of 1920 the Board of Education established the State Meteorological Institute (Prague II. U Karlova 3.), the first duty of which was to re-examine the list of the stations that suffered badly during the war. The central office is now running 120 stations, of which four are first-class observatories, Prague, Milešovka (mountain station, elevation 2550 feet), Brno and Stará Dala. To the central office more than 20 stations send their observations daily, and a report of these is dispatched by "radio" three times daily from Prague. Monthly reviews of the weather are published meanwhile for the whole Republic and the climatography of the country is being prepared. The credit for this important work is due to Prof. Hanzlík and Director Schneider.

PHYSICS.—This science does not possess any long tradition in Bohemia, for the first really modern physical institute was built by Prof. Strouhal—who is known for his work "On Steel" carried out with Prof. Barus forty years ago—only in the first decade of this century. His successor was Prof. Bohumil Kučera, whose early death in 1921 is lamented. His principal work was on radioactivity. This highly talented physicist, a good English scholar, was preparing a text-book on mechanics for English students. Prof. Posejpal is working chiefly on the dependence of the refraction of gases on their pressure. Prof. Macků, one of our best physicists, is studying the oscillation of 2 and 3 conjugated circles. Another promising young physicist is Prof. Záček, who investigated the influence of the spark on the oscillation frequency and deduced a general formula for it. He has also done important work in radiotelegraphy. The professor of natural philosophy (theoretical physics), Záviška, has studied the theory of electromagnetic waves, especially their flexion on parallel ring-cylinders.

INORGANIC CHEMISTRY.—The war was very unfavourable to chemical investigations: coal was sent to Germany and we were freezing in our laboratories and lecture rooms. There was no gas-supply during the daytime, platinum, accumulators, copper apparatus, etc., were confiscated by the late Austrian

Government, and no foreign periodicals (except German) were admitted. Inorganic chemistry had no tradition until 1877, when Brauner showed the aims of modern inorganic chemistry: chemical (and later physico-chemical) investigations of elements with regard to their position in Mendelejew's Periodic System. A series of results obtained was published in the Trans. Chem. Soc. Lond. since 1881. During the war Brauner published a revision of the atomic weight of praseodymium which yielded the number Pr = 140·94 with a material separated from cerium and lanthanum for the first time by direct methods (not fractionation). The value obtained agrees exceedingly well with that obtained by Baxter and Stewart in 1915, who found Pr = 140·924, but were unable to remove cerium and lanthanum entirely.

A revision of the atomic weight of tin carried out by Brauner and Křepelka, and later on by Křepelka alone, gave the value Sn = 118·699, agreeing exactly with that obtained by other authors. In conjunction with Th. W. Richards, Křepelka determined the atomic weight of Al = 26·963 based on the analysis of the bromide, $AlBr_3$; this revision carried out at Harvard University is being continued in Prague on the chloride, $AlCl_3$.

Scandium was prepared by Prof. Štěrba-Böhm in a state of "spectral" purity (Hönigschmid found with this material Sc = 45·10).

The close analogy between boric and aluminic acid has been shown by Dr. J. Heyrovský, who made a physico-chemical examination of solutions obtained by dissolving (amalgamated) aluminium in aqueous solutions of the hydroxides of the alkalies, alkaline earths, and of ammonium. He ascertained that the process in all cases is additive, consisting in the formation of a complex anion $Al(OH)_4^1$, provided that the cation is strongly positive. He also determined the basicity and acidity of aluminium hydroxide and its bearing on the electrolytic potential of aluminium. Aluminium must be regarded as the true "Ekaboron"; in the constitution of the above compounds, apparently pentavalent, it is really positively trivalent aluminium (4 + and 1 − = 3 +), as was explained by Brauner in his preface to a text-book of analytical chemistry.

ORGANIC CHEMISTRY. — Prof. Votoček, of the Bohemian Polytechnic High School, is continuing his well-known work on sugars and has analysed with Burda the sugar components of lichens.

ANALYTICAL CHEMISTRY.—Prof. Stěrba-Böhm and Vostřebal worked out an exact method for the quantitative determination of molybdenum as trisulphide, using an admixture of formic acid on account of its high dielectric constant.

For the analysis of minerals the result of Štěrba-Böhm and Rosický's investigation of the new mineral "ultrabasite," from Freiburg in Saxony, is important; "basic" sulphides of silver and lead preponderate over the "acid" sulphides of tin and germanium. It contains 2·2 per cent. of germanium; thus ultrabasite becomes the fourth known germanium-containing mineral.

ZOOLOGY.—Our most prominent investigator in this branch of science is Prof. František Vejdovský, of the Bohemian University, who finished during the war his life-work, "The Structure and Development of the Living Substance" (in English). This work contains many coloured drawings (illustrations), but owing to the want of the necessary means the author was hitherto unable to publish it.

Vejdovský's successor, Prof. Mrázek, is very active in the zoological investigation of Bohemia with special regard to the ecology of the lower animals in ponds and lakes.

SYSTEMATIC BOTANY.—Prof. Josef Velenovský, the chief of our school of systematic botany, who is well known for his leading work "Flora Bulgarica," has just published another great work, "Bohemian Mushrooms," 4 vols. 920 pp., Prague, 1920–1922, which is richly illustrated. In order to study all kinds of fungi growing in Bohemia, he lived for a series of summers in the chief big forests of our country. He finds, *inter alia*, that far more mushrooms are edible than is generally accepted, but there are some which are poisonous or edible according to the weather and season. From his institute a series of papers was published by Domin, Kavina, Schuster, Daněk, containing interesting morphologic, cytologic, etiologic, and phytogeographic studies.

Prof. Domin, also of Bohemian University, continues his plant geographical investigations, especially with regard to Australian plants and also the Alpine flora of the Tatra Mountains.

PLANT-PHYSIOLOGY.—In this department excellent modern work has been done by Prof. Bohumil Němec, who has published two recent text-books: "Introduction into General Biology" and "Plant-anatomy and Plant-physiology." He has also published a series of papers on the Cecidia of the Eriophylages, on the infection of root-tubercles of Ornithopus, and on the influence of centrifugal force on plant cells. It is known that he was the first to explain geotropism. It should be mentioned that from his school O. Vodrážka proved the presence of a special statolithic starch in the blossoms and sheaths of positively geotropic plants with nyclinastic motions. J. Peklo isolated a symbiotic bacteria (azobacter) from the mycetocytus of the plant-louse *Schizoneura lanigera*. The work of Vl. Ulehla on the analysis of lateral and negative geotropism of Pharbitis and its *rôle* in the climbing character, and also that on heredity of A. Brožek, who succeeded in obtaining a mosaic bastard from two pure lines of Monulus, and studied the case of a simple Mendelian heredity in blossom-patterns, should also be mentioned. E. Senft has described the *rôle* of slime-trichoms in germination. The object of other work in this institute is the physico-chemical investigation of plant-life and also its connection with the chemistry of colloids.

GEOLOGY, PETROGRAPHY, AND MINERALOGY.—These three have the best traditions of all sciences in Bohemia, for they were cultivated by the most prominent men of science since about 1800. The conditions of publication during the war and after permit only of printing special papers of a very limited extent in the Transactions of the Bohemian Academy or of reviewing articles in journals with a broader programme.

Of the geological formations in the Bohemian countries the best known are those which Barrande united under the title "Système silurien," making them classical territory in his gigantic palæontological work, "S. S. du Centre de la Bohême." To-day, putting those formations together under the designation "Barrandien," on account of a tectonic common to them, we distinguish them into a succession from the Algonkian to the Devonian.

The research of Barrandien hitherto done was principally palæontological; for the solution of stratigraphic and tectonic questions a petrographic knowledge of eruptive and sedimentary rocks and the conditions of their origin was wanting. During the last few years this work has been organised and carried out by Dr. František Slavík, professor of mineralogy and petrography in our University, with

his collaborators, for the lower horizons from the Algonkian to the Ordovician in their whole extent. Slavík and Prof. Kettner completed in a series of publications the older research of Slavík on the Algonkian; Kettner worked up in monographs the lowest Cambrian (layers of Žitec) and the lower siluric horizon of Krušná Hora from the point of view of the genesis of the sediments; Dr. Slavík, with Mrs. Dr. Slavík, has described the oolitic chamoisite ores, their sedimentary genesis and the circulation of phosphorus.

Numerous other papers on the Barrandien by Kettner, Kodym, Purkyně, now director of our State Geological Institute, and Prof. Woldřich, give detailed tectonic pictures of the single districts; Kettner and Kodym have proposed a change of Barrande's designation of the horizons which is in agreement with the recent results of their investigation.

Another formation which is extended over large areas in Bohemia and Moravia and richly divided is the Cretaceous formation. The detailed stratigraphy and facial change of this formation has been for more than thirty years the object of thorough studies by Čeněk Zahálka, who has published great monographs of the Cretaceous formation in Podřipsko, Středohoří and Eastern Bohemia, whereas the environments of Prague were in this direction investigated by his son, Břetislav Zahálka; special studies were made by Woldřich.

As regards the petrography and geology of plutonic eruptive rocks and crystalline schists, two territories were intensively studied within recent times: the Bohemian Forest and the granitic massive of Middle Bohemia.

The work of Sokol on the Bohemian Forest has yielded a basis for broader studies of the primary inhomogeneity of the magma.

The ore deposits were also intensely investigated, especially the gold-veins and beds of iron ores (Mrs. Dr. and Prof. Slavík, Kettner, Stočes).

In special mineralogy a series of crystallographic papers was published (Ježek on Johannite, Ondřej on the Bohemian quartzes, Rosický on the topaz and gypsum, Slavík on the lacroisite), and chemical papers (Splíchal on the products of decomposition of the felspars, Rosický and Štěrba-Böhm on the ultrabasite).

GEOGRAPHY.—During the war this science centred round the "Bohemian Geographical Society," which, in spite of the difficult conditions, was able to issue its transactions in the "Sborník." Owing to the Austrian censorship political geography was very limited and chiefly physical geography was cultivated. The fall of Austria means, of course, a new era for our political geography. Prof. Daneš's studies on the population of the industrial districts of Bohemia and Prof. Dvorský's on Yugoslavia as well as his book, with a political programme, on the territory of the Czechoslovak people, are the prominent works in this branch. A great work was started in ethnography with the first volume of the "Ethnography of the Czechoslovak People" (editor K. Chotek).

The chief geomorphological works based on geology and tectonics are: Prof. Daneš's on the "Kras" (Kars) of Australia and Java, Absolon's on the Moravian "Kras" (Kars), Dědina's on north-eastern and Sokol's on western Bohemia, and Vitásek's on the upper Odra district. An interesting monograph on Czechoslovak earthquakes has been written by Koláček. The military geographical State Institute, founded at the beginning of the Republic, published a series of fine maps of our new state, both charts of large areas as well as special maps, 1 : 25,000 and 1 : 75,000.

Wheat Prices and Rainfall in Western Europe.

IN an article on "Weather and Harvest Cycles" in the *Economic Journal* of December last Sir William Beveridge gave index-numbers showing the fluctuation of wheat prices in each year from 1500 to 1869, and made a preliminary mathematical and arithmetical analysis of these figures with a view of discovering periodicity in the yield of harvests, which might be attributed to periodicity in the weather. In a paper read to the Royal Statistical Society on April 25, he has now given the results of a much fuller analysis, involving a test of the same figures by harmonic analysis, for the discovery of practically all possible periods between 2 and 84 years' length. The following is a summary of the paper.

The amplitudes for more than 300 trial periods altogether have been calculated for a sequence of about 300 years from 1545 onwards, while for a number of these trial periods amplitudes have been calculated separately for the first 150 years and for the second 150 as well. These are shown on a periodogram from $q=150$ (2 years) to $q=3{\cdot}6$ (84 years). Each of the apparent periods indicated by the periodogram is considered in the light of four tests of periodicity: namely, the test of intensity (that is to say, comparison of the actual amplitude with the expectancy); the test of changing signs (both the elements a and b being required by theory to change signs in the neighbourhood of a period); the test of continuity (that is to say, indicating the same period, with agreement of phase as well as length, in each half of the sequence); and the test of agreement with other records (that is to say, the discovery of a similar periodicity in rainfall, temperature, or some other meteorological element). Particular importance is attached to the third of these—the test of continuity.

The results of this analysis are summarised in a table showing some 20 apparent periods ranging in length from 2·2 to 68 years. These are arranged in four groups:—

(1) Periods the reality and persistence of which is beyond doubt, strong evidence from the analysis of wheat prices being confirmed by close agreement of first-rate meteorological evidence. This group includes the period of 2·200 years discovered originally by Mr. C. E. P. Brooks, and later by Mr. J. Baxendell in rainfall; the period of 5·1 years discovered by Mr. J. Baxendell in wind and rainfall and by Capt. D. Brunt in Greenwich temperature; and the period of about 35 years discovered in 1890 by Dr. Brückner in temperature, rainfall, and barometric pressure.

(2) Periods strongly indicated by the wheat prices but for which meteorological confirmation is, at present, weaker or lacking. This group includes seven periods of 5·671, 9·750, 12·840, 15·225, 19·900, 54·000 and 68·000 years. Most of these periods are relatively long, a fact which helps in explaining failure