striking manner the varied and comprehensive character of the work carried on by the U.S. Geological Survey. The first volume constitutes a general review of the surface water supply over a very considerable tract of country, comprising the drainage basins of the rivers James, Roanoke, Yadkin or Pedee, Santee, Savannah, Ogeechee, Altamaha, Satello, St. John, Peace, Withlacoochee, Suwanee, Ocklockonee, Apalachicola, Choctawhatchee, Escamba, Mobile, Pascagoula, and Pearl; while the second is a comparatively local and complete investigation into the wells and springs of Connecticut.

An introduction to the former volume gives a brief *résumé* of the scope of investigations and the purposes of the work, with a description of the field methods employed for measuring stream flow, from which it appears that the system most generally in use is that of gauging by means of sectional areas and velocity readings. These last are taken by the Price current meter. Fig. 1 illustrates in a typical manner the plan of operations. At the selected station the river bed is divided transversely into any convenient number of points, at which records are taken both of the depth and the velocity. The latter is determined by two observations in each case, at one-fifth and four-fifths of the total depth respectively. The average of these two readings gives the mean velocity of the current very closely for open-water conditions. The discharge is obtained by a simple computation of the cross-sectional area of the strips multiplied by the average of the mean velocities at their ends.

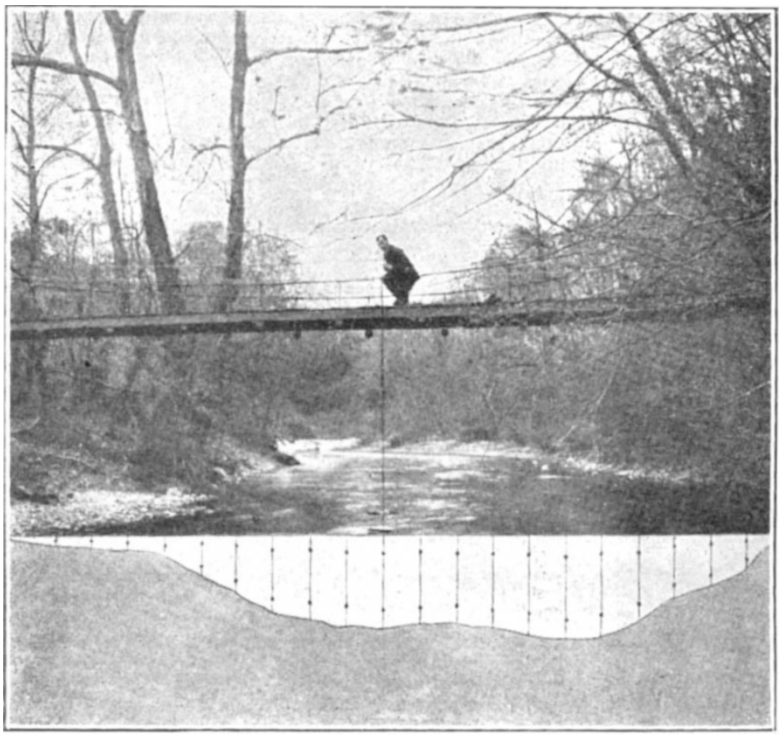

FIG. 1.—Bridge Station and Cross-section of Stream.

The second volume contains interesting chapters on the physiography, meteorology, and geology of the State of Connecticut, and not the least valuable feature is the study by Mr. Ellis of the conditions affecting the occurrence of water in crystalline rocks. The term crystalline is taken as covering both igneous (granite, diabase, gabbro, &c.) and metamorphic (schists and gneisses) varieties. More than two-thirds of the area of the State is underlain by rocks of this type, and a large number of wells have been driven into them. It is pointed out that the porosity of crystalline rock is very slight (averaging 0·5 per cent. or less), and that the only circulation of water which has sufficient rapidity of movement to be of value as a source of well supply must be through joints and fractures. A study of the occurrence of these joints, accordingly, is of great utility and value, and the data collected cannot fail to prove of more than local interest on account of the scarcity of information on the subject. B. C.

RECENT WORK OF GEOLOGICAL SURVEYS.

I.

GREAT BRITAIN AND INDIA.

THE wide range of work done by the Geological Survey of Great Britain is again seen in the "Summary of Progress for 1908" (1909, price 1*s.*). The numerous notes made on observations in England, Wales, and Scotland are, of course, only preliminary to their development in future memoirs; but we may here direct attention to the careful re-examination of two marine Devonian intercalations in the Upper Old Red Sandstone near Milford Haven (p. 35), and to the description of the Achanarras beds (Middle Old Red Sandstone) of Caithness, by Mr. R. G. Carruthers (p. 87). Caithness has also yielded a mass of sandstone with Lower Cretaceous fossils (p. 62). Even if this proves to be transported, like the blocks of chalk in Aberdeenshire, it will remain a remarkable addition to our knowledge of the extent of the early Cretaceous sea. The Petrographical Department has shown the presence of nepheline in several rocks of the Midland Valley of Scotland (p. 44).

The memoirs published recently include one of economic importance on the water-supply of Bedfordshire and Northamptonshire, with rainfall-maps supplied by Dr. H. R. Mill (1909, price 4*s.* 6*d.*). Dr. Strahan has written a second edition of the memoir on the country around Newport, in the South Wales coalfield (1909, price 1*s.* 6*d.*), which shows how knowledge advances, even during a decade. An interesting break near the top of the Carboniferous Limestone is pointed out, and the Old Red Sandstone is now divided into an upper and a lower series. It is probably not generally known that the characteristic Upper Old Red Sandstone mollusc, *Archanodon jukesii*, was found near Talgarth in 1895, the specimens being now in the British Museum. A terse and effective account is given on p. 89 of the passage from the continental beds of the Trias in this district through the Rhætic shales to the marine Jurassic system, and a comparison is made between this complete sequence and that observable where the Cretaceous sea spread across the Weald.

The description of the geology of the country around Basingstoke (1909, price 2*s.*), accompanying the colour-printed Sheet 284 (1*s.* 6*d.*), has been entrusted to Mr. H. J. Osborne White. The area is a familiar one, at the junction of the London Basin and the great swelling rolls of Salisbury Plain. The chalk district was formerly strewn with sarsens, which have been traced to a sandstone in the Reading beds. The Plateau Gravels raise interesting questions of former river-courses, and it appears that the Wey basin (p. 90) has now captured waters that once brought Lower Greensand débris westward into the valley of the Loddon. The soft Eocene strata are responsible for considerable "mutability of the lines of drainage."

The memoir on the country around Bodmin and St. Austell, by Messrs. Ussher, Barrow, and MacAlister (1909,

price 4*s.*), accompanies the colour-printed map, Sheet 347 (price 1*s.* 6*d.*). The tin and copper mines are described, with sections. Considerable interest attaches to the origin of china-stone and china-clay (p. 105); the former is an altered granite, in which kaolinisation is not an essential feature. It must not contain tourmaline, or minerals liable to discolour it. China-clay, on the other hand, must be a kaolinised product, and tourmaline can be washed out of it during its preparation for commercial use. Mr. MacAlister (p. 115) attributes the main kaolinisation to "moisture with fluorides emanating from the granite," while Dr. Flett (p. 118) believes in the greater potency of carbonic acid. Hence we are by no means at the end of this much-discussed question. The metamorphism of the Devonian rocks by a granite associated with the Hercynian folding furnishes interesting material. We wish that Mr. Barrow could have been restrained from promulgating the Anglo-Swedish word "calc-flinta" (p. 99), which can hardly be taken as a serious term. It appears, however, on the index to the map, where it has become classed, with associated altered sediments, as of igneous origin.

The Scottish branch of the Survey recalls the ancient state of things, when romance and argument by flood and field were to be sought northward of the Tyne. The memoir on Sheet 45, including Oban and Dalmally (1908, price 2*s.* 6*d.*), has for its frontispiece the Pass of Brander, through which the Atlantic always seems to call, across the rain-swept moorland under Cruachan. Mr. H. Kynaston, before his departure for the Transvaal, surveyed this region with Mr. J. B. Hill, and several other authors have joined in the present memoir. Much of the interest of the area is petrographical, but nowhere is the petrographer more dependent on the relations of the rocks as determined in the field. Take, for instance, the marginal features of the Cruachan granite (p. 83), or the pitchstone with cordierite, augite, magnetite, and spinel (p. 129), which results from the fusion of a phyllite by a Cainozoic dyke. Bibliographers should be warned that one of the authors of this memoir, Mr. H. B. Muff, changes his name henceforward to the ancestral form of Maufe. Under this guise he appears as joint author with his colleagues, Messrs. Clough and Bailey, of a very striking paper on the Cruachan and Glen Coe cauldron-subsidence, in the Quarterly Journal of the Geological Society for November, 1909. It is not too much to say that the researches of the Geological Survey have added to our appreciation of one of the grandest regions of the Highlands.

The memoir on Sheet 36, covering the seaboard of Mid-Argyll, is mainly by Messrs. Peach, Kynaston, and Muff (1909, price 2*s.* 3*d.*). Effective illustrations are given of the remarkable boulder-beds traceable above the limestone-zone of the metamorphic series. The reality of the break marked by this conglomerate is shown by its frequent inclusion of local rocks, such as the limestone blocks in the Garvellachs. Rocks from unknown sources also occur. The chapter (p. 43) on the epidiorites of the area, and on their origin as "pillowy" basic lavas, will be of value to geologists in many countries who have to deal with this group of modified rocks, in which a similarity of character has been thrust on materials of very various modes of upbringing. The slate quarries of Easdale have been studied in their economic aspect, and Mr. Muff contributes (p. 16) a valuable exposition of the relations of the various parting-planes to the folding of the rocks, which is applicable to many other cases difficult of interpretation, even in the field.

The Records of the Geological Survey of India contain evidence of a great variety of observations, ranging from economic materials to fossil remains. In the mineral field Dr. Bleeck deals with jadeite, which is extensively worked in a dyke or in detrital boulders by Chinese enterprise in Upper Burma (vol. xxxvi., p. 254). He concludes that pure jadeite consists of the (metasilicate) $NaAlSi_2O_6$, and that the dyke in the Kachin Hills originally consisted of nepheline, $NaAlSiO_4$, and albite, $NaAlSi_3O_8$. One molecule of each of these would produce paragenetically two molecules of jadeite. Albite occurs in both margins of the dyke, as is shown in the interesting section on p. 276, and these marginal zones contain blocks picked off from an adjacent amphibolite. It is presumed that the original magma was unusually rich in soda. Mr. Fermor (vol. xxxvi., p. 295) verifies by new analyses the view of Laspeyres, that psilomelane is a definite manganate of manganese, barium, iron, potassium, and hydrogen, based on the acid H_4MnO_5. Hollandite is crystallised psilomelane, while coronadite of Arizona is held to be a form in which barium is replaced by lead. Mr. P. N. Bose's account of the mineral resources of Rájiplá (vol. xxxvii., p. 167) describes the carnelian mines of Ratanpur, which have been worked for 400 years. The stones are coloured by heating on the spot. The date of Mr. Copland's report is not given, but we judge it to be about 1830. At that time the miners walked seven miles to the mines and seven miles back every day, "on account of the tigers with which the country abounds." In the same volume (p. 199) Mr. Fermor describes three new manganese minerals from India, vredenburgite, probably $3Mn_3O_4.2Fe_2O_3$, and highly magnetic; sitapárite, $9Mn_2O_3.4Fe_2O_3.MnO_2.3CaO$, with a bronzy colour distinguishing it from braunite; and juddite, a manganese amphibole. Specimens of all these may now be seen in the British Museum collections.

In physical geology we note Mr. J. C. Brown's description of the mud-volcanoes of the Arakan coast, Burma (vol. xxxvii., 1909, p. 264), which are produced by the bursting up of petroleum vapours, and which occasionally build up temporary islands in the sea. Sir T. H. Holland and Mr. W. Christie furnish an important paper on the origin of the salt-deposits of Rajputana (vol. xxxviii., 1909, p. 154). They show, in the first place, that the rivers flowing into the basins in which the salt accumulates in dry seasons contain an unusual amount of sodium chloride; secondly, that this is not likely to be washed out of older salt-beds; and thirdly, by actual experiments at Pachbadra, that the amount of salt passing a front 300 km. broad and 100 m. high during the four hot-weather months is some 130,000 tons. Mr. T. D. La Touche suggested in 1902 that the salt in the great plains might be added to by wind-borne drift, but the present writers conclude that this is the essential method of supply. The Rann of Cutch becomes actually crusted over with salt in the dry season; magnesium and potassium salts, being more soluble, are left behind in the unevaporated water (p. 168), and the sodium chloride, probably with gypsum, is carried inland. Small Foraminifera have been blown inland from the Cutch coast for 500 miles. The rains follow on the hot months, and the salt is washed into temporary lakes before it can be blown back by the return monsoon. The application of this striking instance to the Triassic lake-basins, formed under desert conditions (p. 183), makes it of wide importance. Judging from the immense stretches of pebble-beds in the European Trias, and from the signs of extension and recession of the lakes, flood-waters arising under monsoon influences may have prevailed in a region that was dry during a large part of the year. Gypsum beds like those of our Trias are found deposited from the seasonal lakes of north-west India.

Stratigraphy is represented by Mr. G. E. Pilgrim's investigation of Tertiary fresh-water deposits in Baluchistan and Sind (vol. xxxvii., p. 139), in which he divides up beds previously grouped as Siwalik into an Oligocene series with Anthracotherium and the allied Brachyodus, an Upper Miocene series with Deinotherium and Tetrabelodon, and an unfossiliferous series, which is probably Upper Pliocene. Unconformities occur between these series. Mr. C. S. Middlemiss, writing on the Gondwanas of Kashmir (vol. xxxvii., p. 286), suggests a re-arrangement of beds previously studied. He has found a new Lower Carboniferous horizon in the Lidar valley (p. 319), lower than the Panjal volcanic series. Above the Panjal series on the Golabgarh Pass he traces a section where Lower Gondwana plants (Gangamopteris, Glossopteris, &c.) lie beneath marine beds with a Middle Carboniferous fauna. This establishes (p. 296) the position of the Lower Gondwana beds in peninsular India, including the Talchir glacial series. No signs of glacial conditions, however, were observed in their representatives in the north. Mr. E. W. Vredenburg, in a paper on a hippurite-limestone in Seistan (vol. xxxviii., p. 189), points out that Seistan occupies a tectonic depression, the floor of which has been covered by the lacustrine Pliocene Gobi formation, the

equivalent of the Siwaliks of India. This has been covered by later alluvium, but appears, highly inclined, on the margin of the basin, and earth-movements have probably continued into Pleistocene times.

Following on Mr. Yabe's recent review of the genus Fusulina, particularly in its Asiatic bearings, which was noticed in a previous article in NATURE, Mr. H. H. Hayden adds a critical and microscopic investigation in a paper on Fusulinidæ from Afghanistan (vol. xxxviii., p. 230). He shows good reason for the view that Fusulina is perforate, but urges that the appearance of its shell, and its minutely granular character under the microscope, should place it among the porcellanea. It does not appear, however, that the fossil porcellanea selected for comparison are in their original condition, seeing how quickly a granular calcitic structure arises in shells that were once composed of aragonite. Mr. Hayden regards the shell of a modern Biloculina as also similar, and as composed of calcite (p. 233). In the face of other determinations it will be well to suspend judgment before Fusulina becomes placed in a unique position.

In Palæontologia Indica, also published by the Indian Geological Survey, Dr. A. S. Woodward (vol. iii., Memoir 3) has described fish-remains from the Lameta beds of the Central Provinces, which fix the age of these beds between Danian times and the close of the Eocene period.

The Mysore Geological Department (Bulletin No. 4) has assisted the gravity observations of the Survey of India by the determination of the densities of a large number of specimens of hornblende schists obtained from mine-shafts nearly 3000 feet in depth. The unaltered rock, where it is below the zone of saturation by water, has a density of 3·00. The effect on the superficial zone of alternate wetting and drying in a tropical atmosphere is shown by its being regarded as "weathered" down to 100 feet, the density in the first 10 feet being 1·65, inclusive of air-spaces, and rising to 2·66 at 30 feet and 2·90 at 100 feet. The determinations give what are styled "apparent specific gravities" in soil-analysis, and the method of collection of the loose material in its field-condition in a measured box might have proved simpler than that actually adopted (p. 9). In vol. viii. of the Department's Records (for July, 1906, to June, 1907, received in November, 1909), Mr. B. Jayaram makes the now customary complaint (p. 84) that his oldest rocks in Mysore are hornblende-schists, into which gneiss, and subsequently pegmatite, have intruded. He presumes below this "an hypothetical archæan basement rock, say gneiss," but this is probably suggested out of deference to the text-books. His notes on rocks and minerals express a large amount of original observation, and he claims a secondary origin for his pyroxene-hornblende granulites (p. 99), without realising that he is thereby bringing them into line with those of Saxony, the nature of which was so long misunderstood. According to Dr. Smeeth, the State geologist (p. 15), there is a good deal to be yet learned about the origin of the Mysore laterites; but Mr. H. K. Slater's report on the Sorab Taluk (p. 31) has suggestive remarks on the relation of laterite to lithomarge, and of lithomarge to an original highly felspathic granulite, elsewhere referred to as a banded felsite or rhyolite. He believes that the same granulite (p. 49) passes, by impregnation with silica and iron oxide, into a brecciated chalcedony-hæmatite rock, which has been described, somewhat misleadingly, as a quartzite. This paper needs some press-correction.

The Reports of the Mineral Survey of Ceylon for 1907 and 1908 include the last work of Mr. James Parsons, whose tragic loss is recorded in that for 1908. Considerable attention is given to thorianite, and the monazite of Ceylon has yielded 10 per cent. of thoria. "Reconstructed" rubies, as well as beautifully cut gems of a glass rich in lead and thallium, are now being sold in Ceylon markets. Western science has much to answer for in the east. The useful relations between the Survey and the Imperial Institute in London are clearly seen in these reports, and the same feature is apparent in the Geologists' Annual Report of the Federated Malay States for 1908, in which tin-deposits are naturally of foremost interest.

G. A. J. C.

EDUCATION ABROAD AND IN ENGLAND.[1]

IN education, as in other matters, each nation must solve its own problems for itself. Every system of education should be the expression of national characteristics and adapted to national idiosyncrasies. Still, lessons which we can ill afford to neglect may be learnt from the study of developments in other countries, and in some respects it is much easier to ascertain what is being done abroad than at home. Thanks to the admirable series of special reports inaugurated by Prof. Sadler, we can make ourselves more or less familiar with the details of foreign education. With regard to England, we are not so fortunately situated; the Board of Education gives little or no information as to new and successful experiments, and its reports have mainly a statistical value. This lack of information as to the progress within recent years renders a comparison between English and foreign systems difficult and misleading.

Attention is commonly concentrated upon Germany and the United States. This is natural, having regard to their extraordinary industrial development during the past generation and the extent to which it may be attributable to their systems of education. With regard to Germany, it would be remarkable if a nation forced to repair the ravages of war by intellectual effort—you remember Humboldt's famous expression in 1807, "Der Staat mus durch geistige kräfte ersetzen was er an physischen verloren hat"—had not in the course of a century become pre-eminent in one or more departments; but when you test the value of the system you will find, I think, that the general balance is in our favour. The facilities for technical and scientific instruction are as great here as there, but where the German has the advantage is in the better quality of the pupils who attend those colleges and schools. This is entirely due to the excellence of their secondary education, and until we can make the Board of Education and the public realise that prolonged and sound general education is the essential antecedent to successful technical and scientific training, the quality of the material supplied to our technical and scientific institutions will remain inferior. By their regulations, the Board of Education seem hardly to appreciate the supreme importance of this. A course of four years compares most unfavourably with the courses at the Gymnasia and Realschulen, and it is a fatal mistake to allow that course to be shortened in any circumstances, or to permit individual pupils or special classes to follow a curriculum varying from the curriculum approved for the rest of the school. To remedy the glaring defects in our system of secondary education, and to place our pupils upon terms of equality with those in Germany, it is imperative to fix a higher standard and strictly to adhere to it.

Of the United States as a whole it is difficult to speak. Each State has its own system, and the only common characteristic is the lavish expenditure upon buildings and equipment. No one is more conscious than the American himself that the results are far from satisfactory.

In spite of this, however, valuable lessons may be learnt from America. We are indebted to them for the promotion of international congresses, which will be of universal benefit if they only succeed in the standardising of university education, which at present leads to endless misapprehension and confusion. We might, too, with advantage imitate their custom of holding frequent local inquiries with a view to the re-adjustment of existing methods so as to satisfy modern requirements. At the same time, they have done much to solve the problem of the connection between instruction and apprenticeship, the workshop and the school. The fundamental principle there is based upon the rational assumption that the proper and only way for a young man to learn the practical side of his profession, together with business details, is by working as a regular employee, and that the only place where he can learn properly the scientific and the cultural subjects is at a school under trained teachers. We need also a bureau of education as well organised and endowed as that at Washington to act as an imperial centre for information and advice.

[1] From a paper read at the North of England Education Conference, Leeds, on January 8, by John C. Medd.