the London-clay are occasionally marked in the same way. The only traces of organisms found in washings from the Marl-band were one or two prisms of *Inoceramus*, not a single Foraminifer being seen.

In conclusion, I would remark, that my suggestion as to the origin of Marl-bands is not intended to apply to all those found in the Chalk, but only to such as exhibit the characters which I have detailed.

NOTICES OF MEMOIRS.

British Association for the Advancement of Science. Fifty-fourth Meeting, Montreal, 1884.

Section C.—Geology.

President: W. T. Blanford, F.R.S., Sec. G.S.

Vice-Presidents: Professor J. Geikie, LL.D., F.R.S.; Professor J. Hall; Professor T. Rupert Jones, F.R.S.; A. R. C. Selwyn, LL.D., F.R.S.

Secretaries: F. Adams, B.Ap.Sc.; Professor E. W. Claypole, B.A., B.Sc.; W. Topley *(Recorder)*; W. Whitaker, B.A.

Titles of Papers read on August 28th, 1884.

Address by the President (*W. T. Blanford, F.R.S. Sec. G.S.*).

E. Gilpin, A.M., F.R.S.C., Inspector of Mines, Nova Scotia.—Results of Past Experience in Gold Mining in Nova Scotia. (See p. 564.)

——— A Comparison of the Distinctive Features of the Nova Scotian Coal-field. (See p. 467.)

H. A. Budden.—On the Coals of Canada. (See p. 560.)

Rev. D. Honeyman, D.C.L., F.R.S.C.—On the Geology of Halifax Harbour, Nova Scotia.

J. H. Panton, M.A.—Gleanings from Outcrops of Silurian Strata in Red River Valley, Manitoba. (See p. 474.)

G. C. Brown, C.E.—The Apatite Deposits of the Province of Quebec.

Frank Adams, M.Ap.Sc.—On the Occurrence of the Norwegian "Apatitebringer" in Canada; with a few notes on the Microscopic characters of some Laurentian Amphibolites. (See p. 518.)

L. W. Bailey, M.A., F.R.S.C.—On the Acadian Basin in American Geology. (See p. 478.)

Prof. E. W. Claypole, B.A., B.Sc., F.G.S.—Geological Survey of Pennsylvania. Pennsylvania before and after the Elevation of the Appalachian Mountains. (See p. 466.)

W. H. Merritt.—On the Occurrence and Locations of the Economic Minerals of Canada. (See p. 521.)

(August 29, 1884.)

Prof. J. S. Newberry, M.D.—Phases of the Evolution of the North American Continent. (See p. 522.)

Prof. H. Carvill Lewis, M.A.—Marginal Kames. (See p. 565.)

Dr. H. W. Crosskey.—Report of the Committee on the Erratic Blocks of England, Wales, and Ireland.

Hugh Miller.—On Fluxion Structure in Till. (See p. 472.)

A. R. Selwyn, F.R.S., Director of the Geological Survey of Canada.—On a Theory of Ice-Action in the Formation of Lake Basins, and in the Distribution of Boulders in Northern Latitudes.

Ralph Richardson, F.R.S.E.—Points of Dissimilarity and Resemblance between Acadian and Scottish Glacial Beds. (See p. 517.)

W. F. Stanley.—Upon the Improbability of the Theory that former Glacial Periods in the Northern Hemisphere were due to the Eccentricity of the Earth's Orbit, and to the Winter Perihelion in the North. (See p. 518.)

Rev. E. Hill, M.A.—On Ice-Age Theories. (See p. 513.)

Prof. J. S. Newberry, M.D.—Recent Discoveries of New and Remarkable Fossil Fishes in Ohio and Indiana. (See p. 523.)

(September 1, 1884.)

Professor Hall, LL.D.—On the Fossil Reticulate Sponges constituting the Family *Dictyospongidæ*. (See p. 557.)

Professor Hall, LL.D.—On the Lamellibranchiate Fauna of the Upper Helderberg, Hamilton, Portage, Chemung and Catskill groups (equivalent to the Lower, Middle and Upper Devonian of Europe); with especial reference to the arrangement of the Monomyaria, and the development and distribution of the species of the genus *Leptodesma*. (See p. 559.)

Professor T. G. Bonney, D.Sc., F.R.S.—On the Archæan Rocks of Great Britain. (See *brief abstract*, p. 521.)

Dr. T. Sterry Hunt, F.R.S.—The Eozoic Rocks of North America. (Printed in full, see p. 506.)

Professor J. F. Blake, M.A.—First impressions of some Pre-Cambrian Rocks of Canada.

Professor J. D. Dana, LL.D.—On the Southward Ending of a great Synclinal in the Taconic Range. (See p. 473.)

H. J. Johnston-Lavis.—Notice of a Geological Map of Monte Somma and Vesuvius.

W. Topley.—Report upon the National Geological Surveys of Europe. (Printed in full, p. 447.)

W. Whitaker, B.A., F.G.S.—The Value of Detailed Geological Maps in relation to Water-Supply and other Practical Questions. (See p. 468.)

Prof. V. Ball, M.A., F.R.S.—On the Mode of Occurrence of Precious Stones and Metals in India. (See p. 516.)

Dr. C. Le Neve Foster, H. M. Inspector of Mines.—What is a Mineral Vein or Lode? (See p. 513.)

(September 2, 1884.)

G. K. Gilbert.—Plan for the Subject-Bibliography of North American Geology. (See p. 562.)

Prof. E. W. Claypole, B.A., B.Sc., F.G.S.—On some remains of Fish from the Upper Silurian Rocks of Pennsylvania. (See p. 519.)

Prof. O. C. Marsh.—American Jurassic Mammals.

Prof. T. R. Jones, F.R.S.—On the Geology of South Africa. (See p. 476.)

Principal Sir W. Dawson, C.M.G., LL.D., F.R.S.—On the more Ancient Land Floras of the Old and New Worlds. (See p. 469.)

J. S. Gardner.—On the Relative Ages of the American and English Cretaceous and Eocene Series. (Printed in extenso, p. 492.)

E. Wethered.—On the Structure of English and American Carboniferous Coals. (See p. 515.)

Prof. T. R. Jones, F.R.S.—Second Report on the Fossil Phyllopoda of the Palæozoic Rocks. (See page 348.)

A. H. Mackay, D.A., A.Sc.—A Preliminary Examination of the Siliceous Organic Remains in the Lacustrine Deposits of the Province of Nova Scotia. (See p. 561.)

C. E. De Rance.—Tenth Report of the Committee upon the Underground Waters in the Permeable Formations of England and Wales, and the Quantity and Character of the Water supplied to various Towns and Districts from those Formations. (See p. 475.)

G. R. Vine.—Fifth Report on Fossil Polyzoa.

J. W. Davis.—Report upon the Exploration of Raygill Fissure in Lothersdale, Yorkshire.

(September 3, 1884.)

G. F. Matthews, A.M., F.R.S.C.—The Geological Age of Acadian Fauna. (See p. 470.)

G. F. Matthews, A.M., F.R.S.C.—The Primitive Conocoryphean. (See p. 471.)

C. E. De Rance and W. Topley.—Report of the Committee upon the Rate of Erosion of the Sea Coasts of England and Wales, and the Influence of the Artificial Abstraction of Shingle and other Material in that Action. (See p. 566.)

Prof. J. Milne.—Fourth Report on the Earthquake Phenomena of Japan.

Prof. E. Hull, LL.D., F.R.S.—The Geology of Palestine.

P. Hallett, M.A.—Notes on Niagara Falls. (See p. 563.)

A Paper of Geological importance was read, on Sept. 1st, in Section B—Chemical Science—by *Sir H. E. Roscoe*, on the Diamondiferous Deposits of South Africa and the Ash of the Diamond.

Abstract of Papers Read in Section C, Geology.

1.—On the Fossil Reticulate Sponges constituting the Family Dictyospongidæ.

By Professor James Hall, LL.D.

OUR knowledge of these forms in America dates back to 1842, when Mr. Conrad described a peculiar fossil body under the name *Hyndoceras* (in the belief of its relation to *Orthoceras*). Subsequently in the same year another form by Vanuxem as a marine plant, and in 1862 Dawson as Algæ, and followed by Hall in 1863, who described several of the species under the name *Dictyophyton*; adopting Vanuxem's name *Uphantænia* for other forms.

In 1879 Mr. C. D. Walcott described a form referable to this group of fossils, from the Utica State, as *Cyathophycus*. In 1881 Mr. R.

P. Whitfield published observations on the structure of *Dictyophyton* and its affinities with certain sponges, accompanied by a note from Dr. J. W. Dawson, on the structure of a specimen of *Uphantœnia*, etc. (D. Walcott on the Nature of *Cyathophycus.*)

In the same year R. P. Whitfield (with note by Dr. J. W. Dawson) described two species of *Dictyophyton* and one of *Uphantœnia.* (Bulletin of the American Museum of Natural History.)

In 1882, James Hall upon *Dictyophyton, Phragmodictya,* and similar forms with *Uphantœnia.* (American Association for the Advancement of Science.)

In the European literature, the first notice of which was observed by the writer, of any fossil resembling *Dictyophyton,* is in Murchison's Silurian System (1839), where *Cophinus dubius* is described and figured.

(In Morris' Catalogue this fossil is placed in the category of *incertæ sedes.*)

In 1845, M'Coy, in his 'Synopsis of British Palæozoic Fossils,' describes *Tetragonis Danbyi* (*Receptaculites Danbyi,* Salter in MS.).

In 1874 Mr. Salter, in his Catalogue of the Cambrian and Silurian Fossils in the Cambridge Museum (p. 176), places *Tetragonis Danbyi* under the Spongidæ. In 1880, Dr. Ferdinand Roemer has described the genera *Dictyophyton* and *Uphantœnia* (Lethea geog. Thiel, p. 126 and 128), placing them among the Algæ. At a later date the same author places *Tetragonis Murchisoni, T. Danbyi,* and *T. Eifelensis* among the Spongidæ.

In 1883 the same author ('Zeitschrift der Deutschen Geologischen Gesellschaft,' Bd. xxxv. p. 704) has discussed the relations of *Tetragonis Eifelensis,* with *Dictyophyton,* describing and illustrating *Dictyophyton Gerolsteinensis.*

This group presents a great variety of form in the mode of growth. The structure of the frond which characterizes every member of this family, may be described as a reticulation of tubular spicules forming rectangular meshes. In the simpler forms these meshes alternate in size and strength, owing to the regular alternation in the size of the bundles of spicules which determine the meshes. In the prismatic and nodose forms, certain bundles of spicules become very much developed and produce the characteristic form and ornamentation of the cup. The middle layer is uniformly reticulate; while the inner and superficial layers show an oblique and sometimes a radiate arrangement of spicules. In the highly-ornamented species the outside layer of spicules is often produced into tufts, spines, and intersecting fimbria or laminæ of greater or less prominence.

In the foreign literature accessible to the writer there are six species of this family described. In preparing a memoir on the subject he has been able to recognize, from personal examination, thirty-seven American forms, the oldest geologically being from the Utica State, and the latest form from the Keokuk limestone of the Carboniferous system. These thirty-seven species have been described under the following genera, viz.: *Cyathophycus Walcott, Dictyophyton, Ectenadictya, Lyrodictya,* and *Physospongia,* Hall; and *Uphantœnia,* Vanuxem.

2.—On the Lamellibranchiate Fauna of the Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups (equivalent to the Lower, Middle and Upper Devonian of Europe); with Especial Reference to the Arrangement of the Monomyaria and the Development and Distribution of the Species of the Genus Leptodesma.

By Professor James Hall, LL.D.

THE investigations of the fossil Lamellibranchiate shells has been carried on as a part of the work of the palæontology of the State of New York. Already ninety plates have been lithographed, and these with their explanations giving the names of the fossils have been distributed to the principal scientific societies of Europe and America. The full text of the descriptions of the species of the Monomyaria, 268 pages and plates i.–xxxiii. and lxxxi.–xcii., have been published complete. The remaining portions of the work were well advanced.

The Monomyaria are described under twenty-one genera and 284 species. The remaining portion of the work contains illustrations of about 215 species under thirty-three genera.

The author has found it necessary to make subdivisions among the forms usually referred to *Aviculopecten*, and it has seemed equally important to propose other generic names for forms which have heretofore been indiscriminately referred to *Avicula*, *Pterinea*, *Pteronites*, etc. While the essential internal characters have been regarded as of primary importance, such an arrangement has been made of the species that the student may determine their generic relations from the general form and exterior markings alone. Since, in all forms of the fossil Lamellibranchiata the interior surface usually remains attached to the matrix, a reliable means of identifying the genera by external characters becomes a consideration of primary importance.

Among the new genera proposed, *Leptodesma* presents some features in its development and distribution which may be of more than ordinary interest. The upper part of the Chemung group exhibits such physical features as might be expected from a gradually shallowing sea and the approach of estuarine conditions. Numerous circumscribed areas appear to have existed, and these, while often characterized by an abundant fauna, contain few species, and these forms are extremely limited in their geographical range. The species of the genus *Leptodesma* are often abundant and very characteristic of certain horizons within limited areas, but rarely have a general distribution through the strata, as some species of the Brachiopoda. They seem to have been developed in shallow lagoons, and the characteristic species of one of these areas rarely appear in another. At the same time the physical condition or other causes have operated to develope a remarkable variety in form, and as it does not seem possible to separate these forms generically, it becomes necessary to arrange them in distinct groups or sections.

These sections have been made with reference to the most prominent characteristic of the forms. Of those already known and

described, nineteen species are conspicuously marked by a posterior spiniform extension of the hinge-line, and form the section Spirifera. In another group, where the spiniform extension is not conspicuous, the umbo is remarkably prominent, and ten species are arranged under the section *Umbonata*. In other forms, the anterior extremity becomes nasute or rostrate, and seventeen species are placed under the section *Rostrata*. Other forms are nearly flat and spreading, with little or no extension of the hinge beyond the body of the shell, and these forms are placed in the section *Patulata*. Other forms have the hinge-line shorter than the width of the shell, the anterior end rounded or truncate, and having the general form of *Arca*. Of these, six species are placed under the section *Arcoidea*. Still, a few other forms have the aspect of *Mytilus*, and two species are placed under the section *Mytiloidea*. Here we have a group of shells among which we find no means of generic separation; and yet within its limits the species are developed in the direction of several other genera, so far as regards form and other external characters. The studies of this genus have been made from collections of many hundreds of specimens with the result stated. An examination of a more limited number of examples could easily have led to the reference of some forms to the genus *Mytilus*, some to *Arca*, and others to new and distinct genera.

The forms of this genus, as at present limited, certainly exhibit evidences of a most remarkable development in form and external characters; and are well worthy the study of the specialist in this department of Palæontology.

3.—On the Coals of Canada.

By H. A. Budden.

COAL is widely distributed over the Dominion; from the extreme eastern point on the Atlantic, in the Island of Cape Breton, it occurs, and through a portion of Nova Scotia and New Brunswick; from thence a wide blank exists, until about the ninety-seventh parallel is reached; from it to the base of the Rocky Mountains extensive fields are being developed; it is also met with at various points in British Columbia, but Vancouver Island, on the Pacific, contains the most valuable deposits.

Central Canada, although deprived of coal, is contiguous to the immense fields of Pennsylvania, Ohio, &c., and through the medium of the great lakes and the railways, is readily served at moderate cost.

The principal fields are five in number. Those in Nova Scotia are carefully described by Sir William Dawson, in his 'Acadian Geology,' but among others, Sir Charles Lyell, Sir William Logan, Brown, Hartley, Robb and gentlemen in the service of the Geological Survey of Canada, have given much attention to the subject. The North-West fields have been surveyed partially by the Geological Survey, Dr. George Dawson doing the principal work. Vancouver Island and British Columbia are indebted to the late Mr. Richardson and Dr. George Dawson for the results from their surveys; their reports are to be found in the records of the Geological Survey.

Cape Breton.—The coal-field is Carboniferous, the measures consist of an accumulation of strata, comprising shale, sandstone and fire-clay, with numerous valuable seams of bituminous coal. The principal field is about thirty-one miles long, bounded on the north by the ocean, on the south by the Millstone Grit, the outcrop of the seams are found on the shores of the deep bay. The measures lie at an easy angle, dipping under the sea.

Pictou County has the next important field, and is widely known on account of the immense thickness of the seams, they are more irregular in their dip than those of Cape Breton, with an angle from 10° to 30°. The total area is about thirty-five square miles, but owing to the extent of faults, a large portion of the coal is cast off, the whole field forms an irregular basin, let down on all sides, among rocks of older age.

Cumberland County.—This important field has only recently been developed on a large scale, the productive measures extend from the Joggins, on the shore of the Bay of Fundy, for more than twenty miles easterly, towards the base of the Cobequid Hills. On the shore of the Bay of Fundy, the exposure is of immense thickness, estimated at 14,000 feet, extending from the Marine Limestones of the Lower Carboniferous to the top of the Coal formation. Its extent has not yet been arrived at.

North-West. — The ninety-seventh meridian separates pretty exactly the coal-bearing formations of America into two classes. To the east, Carboniferous; in the west, the coal and lignites are found at various horizons in the Secondary and Tertiary rocks; their development has only commenced; but when it is considered that outcrops of valuable seams are found eastward of the Rocky Mountains, from the United States boundary, for hundreds of miles to the north, no anxiety need be felt as to their extent.

British Columbia.—Very little exploration has been made in the mainland, the coals of Vancouver Island being easily accessible and of excellent quality. The best-known fields are those of Comox and Nanaimo, on the eastern shore of the Island. The measures dip mostly under the sea; they are variable, however, and require the diamond drill to be used extensively; the coals are bituminous and are considered the best on the American Pacific Coast. Two companies, the Wellington and Vancouver, work extensive mines.

4.—A Preliminary Examination of the Siliceous Organic Remains in the Lacustrine Deposits of the Province of Nova Scotia, Canada.

By Alexander Howard Mackay, B.A., B.Sc.

MANY of the lakes of Nova Scotia contain large deposits abounding in these remains, which consist of the siliceous skeletons of upwards of sixty species of Diatomaceæ, and of the siliceous spicules of at least seven species of fresh-water sponges. The deposits from different lakes are generally marked by a difference in the species present or in their relative proportion. In lakes which

are not agitated by large streams bearing earthy sediments during times of freshets, the deposits generally consist of a light slimy brownish mud sometimes of a depth beyond twenty feet, into which a pole can be easily driven by the hand. This mud, when treated so as to eliminate the carbonaceous vegetable matter, leaves a variable percentage of exquisitely sculptured diatom cells and various forms of sponge spicules. In some places this percentage is very high and the deposit correspondingly whiter and firmer, in some cases consisting nearly of the pure siliceous valves and spicules. The Diatomaceæ grow not only in the waters of these lakes, but in the streams flowing into them, so that these deposits are not all developed *in situ*. The sponges, on the other hand, affect the stiller waters of the lake. They attach themselves to and grow upon portions of submerged wood, stone or even sand, sometimes forming extensive incrustations several inches in thickness, some species extensively lobed and even branching. The sponge-flesh dying away each winter, innumerable microscopic spicula which formed its skeleton are thus scattered in the waters, so that in some localities the sponge spicules form a greater proportion of the deposits than the valves of the Diatomaceæ.

Some of these deposits may prove to be of industrial importance, the material being regarded as capable of use as polishing powder for various purposes, and in the manufacture of dynamite.

The lakes upon which these preliminary observations have been made include Ainslie, in Cape Breton; Lochaber, in Antigonish Co.; Mackay, Blackbrook, Garden of Eden, Grant, M'Lean, Calder, Forbes, Ben, and Toney Lakes in Pictou Co.; Mackintosh, Earltown, and Gulley Lakes, in Colchester Co.; the lakes which supply the city of Halifax with water, Grand Lake and Dartmouth Lakes in Halifax Co.; and Kempt Lake, in King's Co.

Lists of the species of Diatomaceæ and Spongidæ detected in the several deposits were given in the paper, which was accompanied by microscopical slides and specimens. The author has not yet concluded his researches.

5.—Plan for the Subject Bibliography of North American Geology.

By G. K. Gilbert.

THE United States Geological Survey is engaged on a Bibliography of North American Geology. The work when completed will give the title of each paper, with the title-page of the containing book, and the number of plates, the whole being arranged alphabetically by authors.

There is in contemplation also the simultaneous preparation of a number of more restricted bibliographies, each covering a division of geological literature. The plan includes abbreviated titles of papers, with reference to the pages on which the special subjects are treated, the entries in each bibliography being arranged alphabetically by authors.

The selection of topics for treatment in this manner involves the classification of geologic science, and Mr. Gilbert submitted a tentative classification, requesting the criticisms of geologists.

6.—Notes on Niagara.

By P. Hallett, M.A.

THESE notes may be expressed in abstract in the following proportion, and are submitted to the Section as questions for its consideration.

1. That, assuming the principle of the gradual formation of the cataract, the condition of existence of the present overhanging precipice is the superimposition of the hard Niagara limestone—corresponding to the Wenlock limestone—upon the friable Niagara shale, the latter being undermined, and the former overhanging; that the condition of existence of the rapids above the precipice is the succession of hard rocks simply, and that these differences of condition probably differentiate overhanging Falls from Rapids generally.

2. Hence, in case of the precipice receding to a point above the shale, the fall would disappear and become a rapid.

3. That the form of the water in the rapid in consequence of its increasing velocity is convergent to mid-channel; and hence the rapids, instead of being a source of danger to Goat Island and the small islands in their current, are actually a protection to them by determining the water from their banks.

4. That the water of the Fall undergoes a continuous disintegration from summit to base, and breaking up into smaller and smaller masses and spreading out as it descends. The "continuous roar" of Niagara is really a succession of impulses.

5. That this disintegration is a consequence of the collision between the falling water and the column of air beneath it; and that the compressed air in its descent is propelled inwards and outwards; inwards to form the well-known rush of winds behind the Fall, and driving the heading of excavation in the shale; outwards sending up the cloud mist that continuously hangs over the Falls.

6. That this collision between the air and falling water is really a conservative influence, distributing the direct force of the fall and partly transmitting it both directly and by reaction along the currents of the gorge.

7. That besides the force of the air propelled against the shale face of the precipice as a cause of its excavation, attention is also to be directed to the continuous drainage as evidenced by springs, etc., from the shale. Even along the gorge where there are no falls this appears to determine an undermining action or recession of the banks below, with overhanging rocks above.

8. That retrocession of the Falls, evident as it is, is not to be regarded as the operation of a mechanical force necessarily continuous, but as a movement to equilibrium. Hardly any retrocession has occurred in parts of the American Fall during the time that the Canadian has gone back some 500 yards. Retrocession would follow from any cause increasing the amount or force of the water, elevation of the land, increased rainfall, etc., and each retrocession would increase the discharging power of the river, thus tending to carry off the increased water supply. The relation

between the increased supply and the discharging power thus tends by retrocession then to equality and to balance.

9. All the features of Niagara being dependent on the force of the waters, every attempt to diminish this force by what is known as the utilization of the Falls would change these features, and if the utilization were carried to the extent sometimes proposed, these features would be destroyed. Abstract the *vis viva* from the water, and we have only a mass of inert matter.

10. And it may be questioned whether even the material argument in favour of utilization, great as it is, is so conclusively in favour of the utilizer as is often supposed. It is admitted that Niagara has played no mean part in the geographical evolution of this part of the continent; and, it may be noticed, does it not now play an equally important part in its preservation? In the Niagara descent is generated the impulse which commands the circulation both of the Upper and Lower Lakes, and hence to some extent the drainage, rainfall, and cultivation of their adjacent areas of country. The Niagara impulse, some four and a half million horse-power, moves the waters down from Erie and drives them through Ontario. If this impulse be wholly or even largely withdrawn in the manner proposed, what may be the effect on the circulation of this continental district? If this is not now a practical question, the propositions now in the air may soon make it one.

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7. Results of Past Experience in Gold Mining in Nova Scotia.

By Edwin Gilpin, Jun., A.M., F.G.S., F.R.S.C.

THE gold-fields of Nova Scotia stretch along the whole Atlantic coast of the province, and occupy an area of about 7000 square miles.

The auriferous measures may be divided into two series, an upper one consisting of black pyritous slates with occasional beds of quartzite and some auriferous veins and a lower one made up of alternating beds of slates and quartzites and compact sandstone, sometimes felspathic. The upper series is estimated to be 3000 feet thick, the lower 9000 feet.

Granite rocks stretch irregularly the whole length of the gold fields. The granite is evidently intrusive, and is older than the Carboniferous period.

The auriferous veins vary in thickness up to six feet; the usual size of those worked is only four to fifteen inches. The quartz is often crystalline and banded. The veins have the same strike as the inclosing rocks, and were at first considered to be *beds*, similar to those known to be auriferous in the Carolinas and elsewhere; but the fact of their containing portions of the inclosing slate, and of occasionally cutting obliquely across the bedding, proves that they are *true veins*.

The distribution of the gold in the veins may be termed capricious. While the veins for a long distance may be auriferous, there is generally one zone or several zones of quartz much richer than that

on each side. These zones or "pay streaks" do not appear to be the effect of any law that has yet been applied to our mines.

Judging from the available fossil evidence, which however is small, the gold-bearing beds appear to be of Cambrian age.

The quartz mills of Nova Scotia are similar to those in general use in Australia and California. The cost of mining varies from eighty cents in the open cast slate belts, carrying auriferous quartz, up to fifteen dollars a ton in small veins, three or four inches wide in very hard rock. The cost per ton of crushing with water power varies from sixty cents to one dollar, with steam power the cost is somewhat higher.

Attention is now being turned to low grade ores, that is to say, beds of auriferous slate with veins of quartz, yielding averages of four to eight pennyweights of gold to the ton.

During the year 1883 the miners averaged two dollars eighty-four cents a day from 25,954 tons of quartz, yielding ten pennyweights and twenty-one grains of gold per ton, and looking at the large extent of country containing proved auriferous strata, the author anticipates a permanent and profitable future for the gold mines of Nova Scotia.

8.—Marginal Kames.

By Professor H. Carvill Lewis, M.A.

DURING his exploration of the extreme southern edge of the ice-sheet in Pennsylvania, the author had an opportunity of studying certain short ridges of stratified drift, which appeared to represent in many cases a *backward drainage* of the melting edge of the glacier, and for which he proposed the name *marginal kames*.

After describing the general characters of kames, eskers, and osars, as studied in different parts of the world, the author reviewed the researches of American geologists upon this subject, and discussed the various theories as to the origin of these curious deposits. He then described in detail a number of marginal kames in Pennsylvania, indicating their relationship to the great terminal moraine (from which they are clearly to be distinguished), and to the lines of the present drainage. He showed that these kames are made of stratified sand and gravel, finest within and often coarse without, that they have a rude anticlinal structure, that boulders and till often lie on the top of them, that they contain no shells or other indications of having been shore-lines of any kind, and that while bearing no relation to the movement of the glacier, their courses coincide with the general drainage of the region in which they lie.

It was argued that marginal kames are due to sub-glacial streams draining the edge of the ice-sheet. When the terminal moraine rested against an upward slope, this sub-glacial drainage was backward or into the ice. A study of the terminal moraine had led the author to the same conclusion, and a number of examples were given to show in certain places the absence of any drainage outwards from the glacier.

Finally, the sub-glacial drainage of the modern glaciers of Green-

land and of Alaska was alluded to, as also the aqueous nature of much of the till in the lowlands, all of which strengthened the conclusion arrived at concerning marginal kames, and concerning an extended sub-glacial drainage of the American ice-sheet.

The paper was illustrated by views of kames and moraines, most of them from photographs taken in the field.

9.—Report of the Committee[1] appointed for the purpose of Inquiring into the Rate of Erosion of the Sea-Coasts of England and Wales, and the Influence of the Artificial Abstraction of Shingle or other Material in that Action. Drawn up by C. E. De Rance and W. Topley.

THE importance of the subject referred to this Committee for investigation is universally admitted, and the urgent need for inquiry is apparent to all who have any acquaintance with the changes which are in progress around our coasts. The subject is a large one, and can only be successfully attacked by many observers, working with a common purpose and upon some uniform plan.

The Committee has been enlarged by the addition of some members who, by official position or special studies, are well able to assist in the work.

In order fully to appreciate the influence, direct or indirect, of human agency in modifying the coast-line, it is necessary to be well acquainted with the natural conditions which prevail in the places referred to. The main features as regards most of the east and south-east coasts of England are well known; but even here there are probably local peculiarities not recorded in published works. Of the west coasts much less is known. It has therefore been thought desirable to ask for information upon many elementary points which, at first sight, do not appear necessary for the inquiry with which this Committee is entrusted.

A shingle-beach is the natural protection of a coast; the erosion of a sea-cliff which has a bank of shingle in front of it is a very slow process. But if the shingle be removed, the erosion goes on rapidly. This removal may take place in various ways. Changes in the natural distribution of the shingle may take place, the reasons for which are not always at present understood; upon this point we hope to obtain much information. More often, however, the removal is directly due to artificial causes.

As a rule, the shingle travels along the shore in definite directions. If by any means the shingle is arrested at any one spot, the coast-line beyond that is left more or less bare of shingle. In the majority of cases such arresting of shingle is caused by building out "groynes," or by the construction of piers and harbour-mouths which act as large groynes. Ordinary groynes are built for the purpose of

[1] Consisting of Major-General Sir A. Clarke, R.E., C.B., Sir J. N. Douglass, Captain Sir F. J. O. Evans, R.N., K.C.B., F.R.S., Capt. J. Parsons, R.N., Professor J. Prestwich, F.R.S., Capt. W. J. L. Wharton, R.N., Messrs. E. Easton, R. B. Grantham, J. B. Redman, J. S. Valentine, L. F. Vernon-Harcourt, W. Whitaker, and J. W. Woodall, with C. E. De Rance and W. Topley as Secretaries.

stopping the travelling of the shingle at certain places, with the object of preventing the loss of land by coast-erosion at those places. They are often built with a reckless disregard of the consequences which must necessarily follow to the coast thus robbed of its natural supply of shingle. Sometimes, however, the groynes fail in the purpose for which they are intended—by collecting an insufficient amount of shingle, by collecting it in the wrong places, or from other causes. These, again, are points upon which much valuable information may be obtained.

Sometimes the decrease of shingle is due to a quantity being taken away from the beach for ballast, building, road-making, or other purposes.

Solid rocks, or numerous large boulders, occurring between tide-marks, are also important protectors of the coast-line. In some cases these have been removed, and the waves have thus obtained a greater power over the land.

To investigate these various points is the main object of the Committee.

A large amount of information is already in hand, much of which has been supplied by Mr. J. B. Redman, who for many years has devoted special attention to this subject. Mr. R. B. Grantham has also made important contributions respecting parts of the south-eastern coasts.

But this information necessarily consists largely of local details, and it has been thought better to defer the publication of this for another year. Meanwhile the information referring to special districts will be made more complete, and general deductions may be more safely made.

As far as possible the information obtained will be recorded upon the six-inch maps of the Ordnance Survey. These give with great accuracy the condition of the coast, and the position of every groyne, at the time when the survey was made.

Appended is a copy of the questions circulated. The Committee will be glad of assistance, from those whose local knowledge enables them to answer the questions, respecting any part of the coast-line of England and Wales.

Copies of the forms for answering the questions can be had on application to the Secretaries.

Appendix—Copy of Questions.

1. What part of the English or Welsh Coast do you know well? **2.** What is the nature of that coast? (*a*) If cliffy, of what are the cliffs composed? (*b*) What are the heights of the cliff above H.W.M.? greatest; average; least. **3.** What is the direction of the coast-line? **4.** What is the prevailing wind? **5.** What wind is the most important—(*a*) In raising high waves? (*b*) In piling up shingle? (*c*) In the travelling of shingle? **6.** What is the set of the tidal currents? **7.** What is the range of tide? Vertical in feet; width in yards between high and low water. At Spring tide, at Neap tide? **8.** Does the area covered by the tide consist of bare rock, shingle, sand, or mud? **9.** If of shingle, state—(*a*) Its mean and greatest breadth. (*b*) Its distribution with respect to tide-mark. (*c*) The direction in which it travels. (*d*) The greatest size of the pebbles. (*e*) Whether the shingle forms one continuous slope, or whether there is a "spring full" and "neap full." If the latter, state their heights above the respective tide-marks. **10.** Is the shingle accumulating or diminishing, and at what rate? **11.** If diminishing, is this due partly or entirely to artificial abstraction? (*See* No. 13.) **12.** If groynes are employed to

arrest the travel of the shingle, state—(*a*) Their direction with respect to the shore-line at that point. (*b*) Their length. (*c*) Their distance apart. (*d*) Their height—(1) When built. (2) To leeward above the shingle. (3) To windward above the shingle.—(*e*) The material of which they are built. (*f*) The influence which they exert. **13.** If shingle, sand, or rock is being artificially removed, state—(*a*) From what part of the foreshore (with respect to the tidal range) the material is mainly taken. (*b*) For what purpose. (*c*) By whom—Private individuals, local authorities, public companies. (*d*) Whether half-tide reefs had, before such removal, acted as natural breakwaters. **14.** Is the coast being worn back by the sea? If so, state—(*a*) At what special points or districts. (*b*) The nature and height of the cliffs at those places. (*c*) At what rate the erosion now takes place. (*d*) What data there may be for determining the rate from early maps or other documents. (*e*) Is such loss confined to areas bare of shingle? **15.** Is the bareness of shingle at any of these places due to artificial causes? (*a*) By abstraction of shingle. (*b*) By the erection of groynes, and the arresting of shingle elsewhere. **16.** Apart from the increase of land by increase of shingle, is any land being gained from the sea? If so, state—(*a*) From what cause, as embanking salt-marsh or tidal foreshore. (*b*) The area so regained, and from what date. **17.** Are there "dunes" of blown sand in your district? If so, state—(*a*) The name by which they are locally known. (*b*) Their mean and greatest height. (*c*) Their relation to river mouths and to areas of shingle. (*d*) If they are now increasing. (*e*) If they blow over the land; or are prevented from so doing by "bent grass" or other vegetation, or by water channels. **18.** Mention any reports, papers, maps, or newspaper articles that have appeared upon this question bearing upon your district (copies will be thankfully received by the Secretaries). **19.** Remarks bearing on the subject that may not seem covered by the foregoing questions.

N.B.—Answers to the foregoing questions will in most cases be rendered more precise and valuable by sketches illustrating the points referred to.

REVIEWS.

MANUAL OF GEOLOGY, THEORETICAL AND PRACTICAL. By JOHN PHILLIPS, LL.D., F.R.S. In Two Parts. Part I. PHYSICAL GEOLOGY AND PALÆONTOLOGY, by H. G. SEELEY, F.R.S. With Tables and Illustrations. 8vo. pp. xiv. and 546. (London: Charles Griffin & Co., 1885.)

THE publishers of the present Manual have evidently acted upon the conviction that the name of the veteran geologist, John Phillips, is as a strong tower, and still retains a charm for geologists.

And such indeed is doubtless the case amongst those scientific men who have a lively personal recollection of his speeches and discourses, but it can hardly weigh much with the generation of younger geologists, for whom the name will only sound as a faint echo from the past, awakening no vivid memories of pleasant days.

There can be no doubt as to the popularity which Prof. Phillips enjoyed, whether in connection with the Yorkshire Philosophical Society, the British Association, or the University of Oxford. His genial kindly manner to all, his happy and ready address, and the ease and fluency with which he spoke in public, all tended to make him a firm favourite among his contemporaries.

In these days of hurry, and eager competition for recognition, when the footprints of the pioneer of yesterday are speedily obliterated by the new man of to-day, there is a noble and kindly sentiment suggested in the retention of Phillips's name on the title of the present Manual. But as the last edition of Phillips's work