

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY. II
Preliminary report on experiments relating to continental deformation: R. T. CHAMBERLIN AND
J. T. RICHARDS.

The previous paper dealt with faulting, which may be regarded as a local, superficial phenomenon of continental masses; the present paper relates to the deformation of these greater masses. To attack this greater problem it seemed desirable to devise a mode of compressing blocks that have the shape of a continental sector of the earth with radial sides and superficial curvature. A machine for such sector crushing was built with movable steel jaws hinged below and corresponding in position to radii of the sphere. Into this a triangular wedge-like mass was molded with a surface curvature similar to that of a continent. By the use of a powerful jack, this representative of a continental sector could be squeezed by varying pressures reaching up to many hundreds of pounds per square inch. For experiments upon materials of uniform strength, pure paraffine was used; for experiments embodying the principle of increasing strength of materials with increasing depth below the surface in accordance with Dr. Adams's deductions from his experimental researches, there were molded, one above another in a series of zones of predetermined resistance, mixtures of plaster and paraffine in definite proportions. In all these experiments the prevalent type of faulting was that of a triangular wedge. This particular shape appears to be very significant, as has been suggested before. This wedge faulting naturally enough appeared first in the surficial portion of the sector; later after some relief had been realized above, and movement below had become less restrained, additional fracturing set in below. When paraffine alone was used, the numerous rough spots of the enclosing steel side-plates made trailing scratches on the soft material. These scratches served as autographic records of the different directions of internal movement of the material in reshaping itself into the separate wedges which came to divide the sector. As the scratches in many cases curved sharply, they indicated not only the various directions of movement of the separate portions of the sector, but also the *order of succession* of the individual movements that entered into the formation of each block. Further experimentation along these lines seems likely to throw some light upon the internal adjustments of

masses within the earth while undergoing diastrophism.

Origin of the stylolitic structure in Tennessee marble: C. H. GORDON.

The marble known commercially as the Tennessee marble comes from what is known as the Holston formation, which is of Ordovician age. The producing areas occur chiefly in the central portions of the East Tennessee Valley region with Knoxville as a center. The marbles are sub-crystalline to more or less completely crystalline in texture and vary in color from light pink and gray to differing shades of red, dark chocolate and cedar. At the present time the light pink and gray are the leading varieties. One of the striking features of these marbles is the presence of thin, dark-colored interlocking seams or sutures known technically as stylolites. In the main these extend approximately parallel with the bedding or grain of the stone but not infrequently they are more or less inclined to this and at times cut the rock in all directions. The theories proposed to account for stylolitic structure are briefly considered and the solution theory accepted as being the most satisfactory. The chief question involved is as to whether these represent actual parting planes as heretofore usually considered, or fractures. It is the conclusion of the writer that while many of the sutures, especially in the more impure portions of the formation are undoubtedly parting planes, those in the massive light-colored stone have been formed along fractures instead of bedding planes. From the high content of carbonate of lime (98½–99 per cent.), the rich profusion of organic remains, chiefly bryozoa and crinoids, the irregularity in development, and certain features indicative of disturbed conditions in sedimentation, it is suggested that accumulation of the deposits took place in clear but shallow waters on reefs or banks where colonies of the types represented established themselves and grew in rich profusion. If reefs were present they were bryozoa reefs and not coral reefs, as no undoubted corals have been observed in the formation.

Report on the discovery of ancient glaciation on Mauna Kea, Hawaii: WM. ALANSEN BRYAN.

Reporting the discovery in July, 1916, of an ancient mountain glacial field fifty square miles in extent on the summit of Mauna Kea (13,825 feet), the highest mountain in the Pacific Ocean, together with an account of a subsequent ascent of Mauna Kea, Hualalei, and Mauna Loa for the purpose of securing comparative data for the determination of the relative age of these three important subtropical mountain summits.

Conditions of deposition of marine salts and their bearing on the potash problem: A. W. GRABAU.

The three theories which have been developed to explain the widespread occurrence of salt deposits in the past are: (1) The bar theory of Oehsenius. (2) The cut-off theory and, (3) the desert salt theory of Walther. (1) According to the first a constant supply of sea water is derived from the neighboring sea or large salt-water body. It is illustrated by the Karabugas Gulf. Such deposits are characterized by basal gypsum beds, an abundance of organic remains in the intercalated mud layers and by normal marine deposits of the same age in the neighboring sea from which the salt water was supplied. Mother liquor salts can only be developed as the result of a final cutting off of the basin and complete evaporation. (2) Salts deposited in a basin filled with normal sea water and cut-off from the sea, will be characterized by a basal gypsum or anhydrite layer, by an absence of organic remains except at the base, by the concentration of the salts into the deeper lying portion of the basin and by a regularity of the resulting series of salts. Such salt deposits may be enriched by additions from connate sources, with the result that the sodium chloride will be in excess of the other salts. Mother liquor salts are normally deposited in such a drying basin. The Stassfurt salts are believed to have had this origin. (3) Marine salts enclosed as connate sea water and salts, may be concentrated in desert basins far from the sea. They are characterized in general by the absence of a basal gypsum or anhydrite bed, though these salts may occur sporadically. Irregularity of deposition, lens-like character of the individual beds, and an absence of marine organic remains are among the other criteria of such a deposit. Moreover contemporary marine deposits are not necessarily formed in the immediate neighborhood of the salt basins. Mother liquor salts are generally and perhaps normally absent from such deposits, this applying especially to the potash salts which will be adsorbed by the soil through which the drainage waters pass before reaching the evaporation basin, while those that do reach this basin are apt to be dissipated as shown by Walther. The Salina salts of North America are believed to have had such an origin.

The Ordovician terranes of central Vermont: CHARLES H. RICHARDSON.

The author tersely gives the early geological history of central Vermont, from Algonkian time to the close of the Ordovician. He describes the Cambrian sedimentaries that flank the Ordovician

on the west and form the eastern foot hills of the Green Mountains. The paper describes the Irasburg conglomerate which marks the base of the Ordovician terranes in central Vermont and the line of an erosional unconformity between the Cambrian and the Ordovician already followed for more than 100 miles in Canada and Vermont. It shows that the boulders in the conglomerate are all pre-Ordovician and the matrix Ordovician. The author then gives the general distribution of the three belts, non-continuous, of the Memphremagog slates, their composition and economic possibilities. This is followed by a description of the three belts of the Waits River limestone which are continuous and have been followed southward from the international boundary for 100 miles. These formations include the numerous beds of Waits River and Washington marbles which are catalogued as marble reserves. A short discussion is included of the intrusives in both the Cambrian and Ordovician terranes with a citation of about 20 different types of igneous rocks that have already been identified in these formations. The author lays stress upon the paleontology of the area because central and eastern Vermont were regarded as devoid of all fossil content prior to his discovery of numerous beds of graptolites in both the Memphremagog slates and the Waits River limestones. These graptolites have already been discovered in every township south of the international boundary near the central north and south line in the state for a distance of approximately 100 miles. They are present in each of the three phases of the Memphremagog slates and in each of the three phases of the Waits River limestone. Their presence proves sedimentation began in central Vermont in early Ordovician time (Beekmantown) and closed with the lower Trenton. The graptolites have been identified by Dr. Rudolf Ruedemann, State Paleontologist, Albany, N. Y.

Postglacial continental uplift: HERMAN L. FAIRCHILD.

The influence of the Ontario dome on the development of the Tertiary drainage of western New York, Ontario and Michigan: AMADEUS W. GRABAU.

The author has previously outlined the series of domes and basins which had their maximum development in eastern North America during the Appalachian revolution, but which had initial developments preceding that. The Paleozoic strata from which the cuesta topography of New York and Ontario was carved were not coastal plain strata to the Canadian shield as often assumed,

but had their source in the Appalachian Old-land on the southeast. Most of the limestones probably extended across the Ontario dome region which now shows only crystallines. These were exposed after the doming by the peneplanation which the region suffered in post-Paleozoic time. Renewed slight doming of this region in early Tertiary times caused the development of a cuesta topography which has no relations to the original old-land, indeed the cuestas point away from that old-land. These cuestas are in reality renewed hog-backs of the type developed around the Black Hills dome but the strata dip away from the center of the dome at a very low angle. The radial arrangements of the old river valleys now in part occupied by the Finger Lakes of New York and the Tertiary consequent streams of Ontario and Michigan further illustrate the effect of this dome.

The change of content of gasoline vapor in natural gas with age of the wells: O. J. SIEPLEIN.

Natural gas which has been in contact with petroleum has taken up gasoline vapors from the petroleum. These can be condensed by pressure or by use of solvents. Gasoline vapor is probably one hundred times as valuable as the same volume of gas. As the well-pressure decreases, a larger quantity of gasoline is associated with the gas. An increase of 0.07 in specific gravity means an increase of one gallon of liquid gasoline from a thousand cubic feet of raw gas. Pumping of old oil wells as gas wells makes it possible to extract a large quantity of gasoline from that petroleum which is retained by the oil-sands and is not to be recovered by ordinary methods of producing petroleum.

A large high-pressure carbon dioxide well: L. G. HUNTLEY AND ROSWELL H. JOHNSON.

The so-called "air blasts," a peculiar geological phenomenon in the Kolar gold field, India: E. S. MOORE.

The Kolar Gold Field, situated near Bangalore, Mysore, in southern India, has long been the most important gold-producing area of India. In this field a quartz vein carrying high values in gold to great depths, cuts a band of hornblende schists of pre-Cambrian age and these are in turn intruded by large dikes of basic igneous rock. Surrounding the area of schists and intruding it is a great mass of granite-gneiss resembling the Laurentian rocks of this continent. The "air blasts," which have received their name from the miners because of the rush of air which often accompanies large related disturbances, are explosions occurring in the walls of the workings on account of potential

energy in the quartz, schist and dike rocks. This energy is permitted to act when mining operations relieve the pressure in certain directions. The source of this energy is believed to be found in the squeezing of the syncline of schist by the granite during compressional movements in the crust of the earth.

Pyrite in the coals of western Pennsylvania and its uses: HENRY LEIGHTON.

The enormous increase in the production of sulfuric acid since the war began, together with a curtailment of the importation of Spanish pyrite which, heretofore, was the source of 40 per cent. of the production, has brought about an earnest search for supplies in the United States. Among the sources of supply is the pyrite or marcasite occurring in coal beds as "sulphur balls." This material, during coal mining, is rarely saved, but if properly cleaned a good quality acid can be made from it. Among its good points is its freedom from injurious arsenic or phosphorus. By careful hand picking in the mine or on a picking table, much of this coarse material could be profitably saved under present conditions, while in washing coal for coke making, proper concentrating machinery could be installed for the recovery of a large amount of fine pyrite now wasted. An investigation of the pyrite resources of Pennsylvania is now being undertaken by the State Geologic Survey and indications are that much pyrite can be produced in the bituminous coal area, especially in the Pottsville and Allegheny series coals, around the north and northeastern margin of the bituminous field. Mercer, Jefferson, Clarion and Clearfield counties have in the past produced pyrite in small quantities and their production should be greatly increased.

Translations made accessible: LANCASTER D. BURLING.

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Factors determining the depth to salt water in wells: ROSWELL H. JOHNSON.

Problems in Green mountain geology: W. G. FOYE.

ROLLIN T. CHAMBERLIN,
Secretary