

ton, \$325,000; the Western at London, \$200,000.

THE Pennsylvania State College has received from the children of the late J. Roberts Lowrie the gift of his herbarium. The collection comprises 2,750 mounted varieties representing 144 families and 707 genera.

WITH a portion of the funds at their disposal the trustees of the Captain Scott Memorial Fund have decided to establish a Polar Research Institute in connection with the new department of geography in the University of Cambridge.

THE exchange agreement, established before the war, between Buenos Aires medical schools and Paris schools, has been renewed. In August of this year Professors Marcel Labbé and G. Brumpt will go to Buenos Aires to give lecture courses. The Buenos Aires school will send to Paris either heads of clinics or laboratories to take postgraduate courses in Paris.

THE board of trustees of the Armour Institute of Technology has announced the appointment of Howard M. Raymond as acting president of that institution to fill temporarily the vacancy caused by the recent death of Dr. F. W. Gunsaulus.

FREDERICK H. SIBLEY, formerly professor of mechanical engineering at the University of Kansas, has been elected dean of the college of engineering at the University of Nevada. The college includes the four schools of civil, electrical and mechanical engineering and the Mackay School of Mines.

DR. OSKAR BANDISCH, formerly privat-docent in the University of Zurich, has accepted an appointment as research associate in biochemistry in Yale University. Dr. Bandisch received his training in organic chemistry at the Technische Hochschule in Zurich under Professor Baumberger, and has contributed much original work dealing with problems of plant assimilation and the influence of light on chemical reactions. His work at Yale will be entirely in the graduate school.

DR. SHEPHERD I. FRANZ and Dr. R. A. Cutting, respectively professor and associate pro-

fessor of physiology at the George Washington University Medical School, have resigned.

DISCUSSION AND CORRESPONDENCE ON THE USE OF THE TERMS "DENUDATION," "EROSION," "CORROSION" AND "CORRASION"

IN 1911 J. W. Gregory called attention to the looseness with which the above terms were used in geological and geographical literature,¹ and suggested certain restrictions in their meanings. Although the confusion in the use of these terms has been generally appreciated by geologists, Gregory's suggestions have met with little favor, and no effort seems to have been made to bring about a uniformity of usage. In fact, a review of various text-books which have appeared since the publication of Gregory's article indicates that the confusion is growing worse.

While the definitions suggested by Gregory are open to strong objection, yet the existing ambiguity in the use of such important geological terms can not fail to be bewildering to students and authorities alike, and calls for some remedial action. A few quotations taken at random from recent text-books will emphasize this fact.

1. According to Tarr and Martin² denudation consists of weathering plus erosion, and erosion is further defined as involving "removal, transportation and deposition of rock fragments," though on p. 115 erosion is spoken of as the combined work of corrasion and corrosion, no mention being made of deposition. These authors apparently define corrasion as the mechanical degradation of rock by river water, and corrosion as the chemical removal of *solid* rock (pp. 114, 115) though the definitions are not at all clear.

2. Pirsson³ limits erosion to "the formation of rock débris and its removal" and gives no definition of denudation. Corrasion he defines as the action of a stream in rasping

¹ *Geographical Journal*, Vol. 37, 1911, pp. 189-195.

² "College Physiography," 1914, p. 18.

³ Pirsson and Schuchert, "Textbook of Geology," 1915, p. 31.

away the country rock *beneath* and *beside* it, "thus cutting an ever-deepening trench" (p. 37).

3. Cleland⁴ refers to the confusion in the use of the terms corrasion, abrasion, corrosion, erosion and denudation in a footnote on pages 83 and 84, and then defines corrasion and abrasion as synonymous and meaning the detachment of rock particles as a result of wear; corrosion as the work done by solution; erosion as the sum of corrasion and corrosion, and denudation as a general term for the lowering of the land surface by any agency.

4. Grabau,⁵ following Walther, defines erosion as clastation plus ablation, or the breaking up of rock material and its removal. Denudation is the removal of weathered and loose mantle rock and is a subordinate part of the process of ablation, which includes in addition corrasion, quarrying and corrosion. The former is defined as a "filing process" which may be accomplished by wind, running water, ice, waves or organisms, while corrosion is chemical removal by air (=evaporation), water, heat or organisms.

5. De Martonne⁶ uses the term erosion in a broad sense but does not define it. Corrasion he limits to the wearing action of *wind*-driven particles, as typically illustrated in arid regions (pp. 660, 664).

6. Kayser⁷ describes erosion as the mechanical work of water, and denudation as the sum of erosion and weathering, which latter term includes both chemical and mechanical action. Corrasion he defines in the same way as de Martonne (p. 240), both authors here following Walther and von Richthofen.

7. Park⁸ defines denudation as "the wearing away, wasting, or breaking up of the land surface, whereby the general level of the

land is lowered." Erosion, according to this author, is embraced within the term denudation and is somewhat vaguely defined as referring to "the more active and obvious wear and tear carried on by the sea, by streams, rivers and glaciers" (p. 15). Corrosion is "eating away of rock due to chemical solution, hence . . . is frequently used to denote chemical denudation" (p. 16). On page 34 the same writer refers to corrasion as "a variant of corrosion used by some writers to denote the vertical excavation performed by a stream," but recommends the use of erosion in its place.

The above quotations are only a few out of many and include only books published in the last ten years, yet they show an amazing divergence of views. This will be better illustrated by the following summary:

Out of a total of 7 authors quoted,

Denudation is defined by 5:

- as weathering plus removal, transportation and deposition of rock fragments; (1)
- as a general term for the lowering of the land surface by any agency; (2)
- as the removal of loose mantle rock (1)
- as weathering plus the mechanical work of water (1).

Erosion is defined by 6:

- as removal, transportation and deposition of rock fragments (1)
- as the formation and removal of rock debris (2)
- as the mechanical work of water (1)
- as rock wear plus solution (1)
- as the more active and obvious wear and tear performed by streams, rivers and glaciers and by the sea (1)

Corrasion is defined by 6:

- as mechanical degradation by rivers (2)
- as the detachment of rock particles by wear of any agent (2)
- as the wear caused by wind-driven particles (2)

One author rejects the term altogether, holding it equivalent to erosion.

Corrosion is defined by 4:

⁴ "Geology, Physical and Historical," 1916.

⁵ "Principles of Stratigraphy," 1913, pp. 17, 18.

⁶ "Traité de Géographie Physique," Second Edition, 1913.

⁷ "Allgemeine Geologie," third edition, 1909, Vol. I., p. 260.

⁸ "Textbook of Geology," 1914.

- as work done by solution (3)
as chemical removal by all agents (1)

Comment on these examples is scarcely necessary, but it might be added that this list does not by any means exhaust the definitions that might be quoted, as reference to Gregory's article will show.

The definitions suggested by Gregory are as follows:

- denudation = the wearing down of the land by any agency whatever.
erosion = the widespread lowering of the land by wind, rain and weather, and by rivers and glaciers acting *laterally*.
corrosion = the excavation by rivers and glaciers of their beds.
corrasion dismiss as a synonym for corrosion.

These definitions are unsatisfactory in many respects. To separate the lateral and vertical degrading action of rivers and include only the former under the term erosion is not only unnecessary, but highly artificial. Indeed, a satisfactory definition of erosion will be an exceedingly difficult matter to accomplish, for the reason that the word has come to be used in two different senses: one broad sense in which it signifies the general process of the wasting of the land surface and is thus equivalent to denudation, as exemplified in the definition of Davis,⁹ and a much narrower sense common in geological literature in such phrases as "ice erosion," "wind erosion," etc. The only solution of this difficulty would appear to be to use "denudation" for the general process and restrict "erosion" to the narrower meaning of gnawing or cutting away.

A general term for the action of rivers and glaciers on their banks and beds seems desirable, and for this purpose the word corrasion is much preferable to corrosion, since the latter has a distinctly chemical implication. There seems to be, on the other hand, no good reason for using separate terms for the lateral and vertical wearing action of streams and glaciers, since the adjectives

⁹ Davis and Snyder, "Physical Geography," p. 105.

lateral and vertical prefixed to corrasion would amply distinguish the two processes.

There would also appear to be room for the term corrasion as used by Grabau to denote the chemical removal of material by any or all agents, solution being a part of this general process, and confined to the action of water.

However these various terms be used eventually, the need of rescue from the hopeless confusion and ambiguity of the present is undeniable. The Geological Society of America found it advisable to standardize the nomenclature of faults; should it not also be the duty of that organization, or, better yet, of an International Congress of Geologists, to take official notice of the ambiguous meanings of the words denudation, erosion, corrasion and corrosion, and establish precise and authoritative definitions of these much-abused terms?

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EUCLID OF ALEXANDRIA AND THE BUST OF EUCLID OF MEGARA

DURING the middle ages and later, it was the ill fortune of Euclid, the mathematician, to have been confounded with Euclid of Megara who lived about a century earlier and was not a mathematician. As if this confusion were not sufficient to tantalize mathematicians in general, another mistake came to be made, involving the same two Euclids. This time a bust found on a Greek coin, which according to numismatic authorities is really aimed to represent Euclid of Megara, came to be published broadcast as the picture of the mathematician of Alexandria. This happened in England where William Whiston, who was Sir Isaac Newton's successor in the Lucasian professorship of mathematics at Cambridge, brought out a school edition of Euclid containing as a frontispiece this bust, said to have been taken from a bronze coin once in the possession of Queen Christina of Sweden.¹ Unfortunately this same picture

¹ For the history of Queen Christina's Coin Collection, consult an article by Hugo Gaebler in the

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Science **53** (1374), 412-414.
DOI: 10.1126/science.53.1374.412

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