AN ANALYSIS OF EROSION.

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The chief purpose of this paper is to briefly present to the view of students and teachers a clear analysis of the common processes of land sculpture, and incidentally to give definition and precision to certain terms which are used with respect to the sculptural processes. The subject matter deals with certain elementary phases of dynamic geology particularly encompassing the road over which all students of geological science travel in the secondary and college courses.

The literature dealing with the subject matter of this paper is very voluminous, and no attempt will be made here to cite references which cover all phases of it. Much of the literature deals with the common processes which have been presented over and over again in textbooks and other publications until the original presentations are not always apparent or available. Such terms as *weathering, erosion, denudation, corrasion,* and *corrosion,* have long been used. In certain early works they are used incidentally in describing the commonly observed processes and results of land sculpture. These terms are not used by all authors alike, with the result that considerable confusion with respect to their uses may be noted in the numerous elementary textbooks in our schools today. This confusion in the use of these common terms is most felt by instructors in the elementary courses.

Attention has occasionally been called to the confusion in the use of a number of the common terms used in elementary geology. One of the more recent of these protests against the confusion of the terms in our common textbooks is that of Malcolm H. Bissell[1] of Bryn Mawr College. Bissell cities J. W. Gregory's protest of 1911 in the *Geographical Journal* in which Gregory called attention to the various inconsistencies in the use of these common terms and suggested certain restricted uses of the terms. Gregory's suggestions have not been followed, and perhaps it is well that they were not, for the definitions offered by him are open to strong objection. Bissell cities the various uses of the terms as given in the leading texts that had appeared since 1911, and gives an admirable summary. He makes certain suggestions as to the use of these terms, and makes a plea that some responsible organization, such as the Geological Society of America, take up the matter of the use of these terms and give them standardized meanings. His presentation of this subject was read with much interest, and in two subsequent numbers of *Science* the use of the terms was discussed with suggestions which deserve consideration.[2]

[1] On the Use of the Terms "Denudation", "Erosion", "Corrosion", and "Corrasion", Science, N. S., vol. LIII, 1921, pp. 412-414.

[2] F. H. Lahee and W. G. Foye, Science, N. S., vol. LIV, 1921, pp. 13 and 130-131.

"Proc. Ind. Acad. Sci., vol. 37, 1927 (1928)."

It is not the intention of the writer of this paper to attempt to dictate what meanings shall be attached to the common terms of weathering, erosion, denudation, corrasion, corrosion, etc., so much as it is to present a clear analysis of the processes of erosion. Incidentally specific meanings are given these terms.

WEATHERING AND EROSION.

The terms weathering and erosion are very old terms—as old as the science of geology. They are much used terms. They are inclusive names for two sets of destructive processes which act upon the land material at and near the surface. Weathering is the group name for all the destructive processes which more or less statically act upon the materials of the land, while erosion is the destructive action of the moving or mobile agencies which act upon the lands. Together these two sets of processes bring about land waste or denudation, resulting in land reduction and restriction. Incidentally in land reduction or denudation, sculptural features, such as make up many of the landscape features of the lands, are produced. The features sculpturally produced are not permanent, but themselves undergo change and finally pass into nothingness in the final stages of land reduction. I am inclined to use the term *denudation* as comprehending both weathering and erosion. It has frequently been used in this sense, though for the past hundred years or more it has also been used incidentally as equivalent to the term erosion alone.

Weathering is the group name for all processes which carry on disintegration and decomposition of rock or rock materials at and near the surface, usually leaving crumbled or broken-down products as a result of the action. Rock or rock materials are disintegrated or decomposed *in situ* independent of removal agencies. The chief weathering processes concerned, acting singly or in conjunction, are: alternate freezing and thawing, wetting and drying, heating and cooling (without water), destructive work of organisms (mechanically and chemically, alive or dead), direct solution, hydration and carbonation (indirect solution), oxidation, and hydration. These processes along with some others not so well known act statically upon rock materials, with the result that rock debris or residue is formed at or near the places where the processes acted.

Some authorities (as for instance, Dana) would include as a part of weathering the incidental concentration of iron oxide, silica, or other substances, which shows on certain weathered surfaces, or surfaces undergoing weathering, as outstanding hardened places which give a fretted or rough appearance. These surfaces are frequently referred to as "honey-comb weathering." Such reinforcement of parts of rock surfaces undergoing weathering is carried on by processes which may accompany the weathering of certain rock surfaces, but these need not be included under weathering. Weathering processes are destructive. Efflorescence may cause a scaling off of material from certain rock surfaces, and when it does act in this way it should then be included in the weathering processes.

Erosion (Latin, *erodere*, to gnaw away) is the name applied to the initial work of the important moving agencies which acquire, transport and deposit earth materials. Through the agencies of (1) wind, (2) running water, (3) glaciers, and (4) waves and currents, earth materials are actively withdrawn from surfaces. These agencies also transport and deposit earth materials. A considerable part of the work of glaciers and streams (rivers) is that of transportation and deposition without erosion on the part of these agents to acquire the material, as a considerable part of their loads may have been contributed to them. A large part of the chemical load of a stream is undoubtedly contributed, and, since this part of the load is unlikely to be deposited by the stream, streams then become mere transporting agents. But it is the erosive phase of these agencies that is to be considered here. The taking up of earth materials or the active acquisition of them by the surface mobile agencies constitutes erosion. Erosion is the initial work of the mobile agencies acting on the land surface. The final work of these mobile agencies is that of deposition, and deposition is exactly the opposite of erosion. Erosion is subtractional with respect to surfaces, while deposition is additional. Transportation is a connecting process between erosion on the one hand and deposition on the other.

Processes of Erosion.

My purpose here is to make clear the erosive processes of each of the great erosive agencies, i. e., to show how each of the great erosive agencies through individual processes withdraws, removes, or get possession of materials from surfaces upon which they act.

Processes of Wind Erosion. The wind acts widely over the lands of the earth. In many regions no results of wind erosion may be noted because of the obscuring effect of other more important agencies. In certain areas, notably in dry or arid regions, the wind is an important agency in giving form and expression to the landscape. Perhaps the most outstanding form is that of the dune, a form of deposition, yet one implying erosion. Forms of erosion resulting from wind action are not always spectacular, nor are they as such always due to wind action alone. Wind erosion processes are less important as form producers than they are modifiers of existing forms. The individual processes are *deflation, corrasion,* and *attrition.*

Deflation is the process whereby wind removes loose materials from surfaces. This process is effectively presented by Grabau in his monumental treatise, "Principles of Stratigraphy," where he states that it is by far the most important work of the wind. Loose soils are often carried away; sands are picked up or moved along; and fine particles and dust are taken from the dry surfaces of the lands. Removal of the fine materials from certain dry desert areas, leaving a surface paved with coarse materials and rock fragments, is a fairly common thing, and such stony desert areas are known as the *Hamada* type. Loose sands may be taken from restricted localities forming "blowouts," some of which become the sites of intermittent lakes. Certain rock surfaces ex-

posed to the winds are kept clean of any loosened material formed upon them. Surfaces of certain mesa tops and other restricted upland rock surfaces in arid regions are particularly susceptible to this action of the wind. Cliffs of friable sandstone may be wind swept and occasionally alcoves or caverns may be hollowed out. Winds sweep certain sandy shores, continually removing the sands thrown up by the waves. Here deflation acts with little result in form production, as the sandy shore remains about the same regardless of much sand withdrawal. The great dunes, however, inland from the shore offer monumental testimony of the sand deflation which has taken place along the shore. Dunes themselves migrate by deflation, the loose sands being swept over and about the dunes where by deposition the dunes are reconstructed in the leeward direction. The great dust storms of the larger arid regions have their initiation in deflation. In humid regions much dust is moved about taken from dry surfaces, usually spectacularly when windstorms precede a rain following a dry spell.

Corrasion is the wear on surfaces by materials in transit in a wind or water medium, or the "tooling" effect of materials coming in contact with surfaces while being transported by wind or water. Sand grains are swept along by the wind and in passing over surfaces or coming against them these sands effectively cut them, detaching small pieces which themselves are swept along or taken bodily into the air by upward rising eddies. The pieces cut or knocked loose are subject to deflation and are removed from the place where they were loosened or detached. Grabau in his "Principles of Stratigraphy" calls attention to wind corraded rock surfaces in which furrows have been sculptured out. These sand-carved furrows separated by more or less fluted ridges are called "yardangs" in central Asia. Hard pebbles are polished and smoothed by the sand blown against them, and some of them are much faceted, having facets which meet at a sharp angle. These wind-faceted pebbles are known under the group name of "windkanter." The pebbles with two facets meeting in a single edge are known as "einkanter," and those with three edges are known as "dreikanter." Upstanding rock masses are beaten and worn by the wind-blown sands, and those sides or faces against which the wind comes are often irregularly or weirdly carved, the product of combined deflation, corrasion and weathering. Perhaps alcoves or caverns referred to above are in part due to corrasion.

Wind erosion is carried on also by *attrition,* or mutual wear of materials undergoing transportation. Sand grains are rounded by continuous bumping or knocking against each other or on other surfaces. The pieces detached from them are dust particles and these are bodily taken away by deflation. The sands of the desert are moved and removed, masses are shifted and reshifted, dunes are built and rebuilt, and as a result of this much wind-shoveling of the sands they are not only rounded by the wear, but are worn to dust, and, as such, are little by little taken out of the area entirely. Desert regions are no doubt lowered in this manner. Attrition is contributive to deflation, as indeed is wind corrasion.

Processes of Running Water Erosion. The most profound and widespread factor in land degradation is running water. Through precipitation great amounts of water are received by the land and much of it runs off over surfaces, gathers into streams, and passes out of the region where it fell. In passing over surfaces running water takes with it much earth debris, and where it flows in streams it carves out valleys and other landscape features. The erosive phase of the work of running water is that of taking material from the surfaces over which it passes and otherwise actively getting possession of the materials of the land. There are at least four individual ways in which running water actively withdraws or gets possession of materials at the expense of the surfaces with which it comes in contact. These are: (1) hydraulic action or "fluviraption," (2) corrasion, (3) attrition, and (4) corrosive attack.

Hydraulic action is the operating force of flowing waters. It is the moving power of flowing water which tends to take or takes with it such objects as are in its path or which it may encompass. As such, flowing water is a very important erosive and transporting agency. Any direct cleaning or washing action on surfaces by flowing water is hydraulic action. Loose material may be swept away by it. Rains wash surfaces clean, and off-flow of unconcentrated waters takes away much material from land surfaces. The unconcentrated waters gather much material and enter streams with it. Streams following rains are turbid with the material taken from the general surface which forms the gathering grounds for streams. Streams or sheets of water sweep up much material from stream beds, valley bottoms, slopes, and other surfaces during floods and heavy rains. The lifting action of swiftly moving streams is effective in sheety rocks, such as shales. The water is hydraulically driven under the sheets or slabs and they are directly lifted or turned over and moved downstream. Swift waters often draw out and hoist up materials which are structurally loose, such as much jointed rocks and friable sandstones. This hydraulic effect is sometimes referred to as "plucking," but the writer prefers to use this term as a distinct phase or process of glacial erosion.

It is here suggested that the term fluviraption[3] be applied to this process of cleaning or washing surfaces, of seizing on to, lifting up, or moving along of loose material or material torn loose by the force of flowing water. Grabau[4] has used the expression fluvial ablation for the same process. This process of fluviraption as described above is the most important process of fluvial erosion. Most materials carried in suspension by streams have been gathered from their basin surfaces by this cleaning process. Materials carried at and near the bottom of streams by traction have been taken from previous resting places by this process. Any material loosened or detached through corrasion is seized and taken

[3] The term "fluviraption" is compounded from two Latin words, *fluvius*, moving, running or flowing water, and *rapere*, to tear away or to snatch up and carry away: hence *fluvi* and *raption* or *fluviraption*, the act of tearing away or snatching up and carrying away by flowing or running water. This term is interpreted to apply to the waters of both the land and the sea in their action upon surfaces. S. E. Stout, Professor of Latin, Indiana University, has approved the formation of this term as here used.

[4] Principles of Stratigraphy, 1913, p. 17.

away by the same process. Attrition products formed in running water likewise are taken into the possession of running water by this process. Pothole drilling, waterfall excavation and sapping, and lateral quarrying and undermining by streams are striking localized phases of stream erosion. When analyzed these methods of stream erosion are seen to be the combined action of the single processes fluviraption and corrasion. It may be noted that fluviraption plays the same rôle in running water erosion that deflation does in wind erosion.

Corrasion has been defined above as the mechanical wearing of (rock) surfaces by rock waste in transit in a water or wind medium. Corrasion as thus defined has a rather limited meaning as an erosive process. As used in a number of texts the term is expanded to include any mechanical wear which rocks undergo in erosion, and as such includes attrition. Also it is used frequently in the sense of scour on surfaces, including in it the process defined above as fluviraption. Furthermore it is used to include the abrasion of rock which takes place in glacial erosion. I prefer to hold to the more restricted meaning of the term, as it then is applied to a specific process in erosion. If used in the inclusive sense which some authors ascribe to it, then it becomes equivalent in meaning to the term erosion and is useless.

Corrasion, as used in the narrow sense of its meaning, is not of great importance as a process of running water erosion. There is little corrasion on soil surfaces or the great gathering grounds of stream waters. It is largely confined to the beds of streams, but incidentally it acts on the banks or sides of stream channels. It is of little importance in stream beds which are in a graded condition or those which are composed of loose material. The principal process acting on such stream beds is fluviraption.

Corrasion is the "tooling" action of the materials in transit on or against surfaces which they strike. The "tooling" silt, sand or pebbles may have barely an instant of contact with the rock surfaces, acting in a striking or bumping manner, or the larger materials may more or less slowly rub or grind the surfaces over which they are moved, detaching particles which are immediately caught up by the transporting medium, victims of fluviraption. It is to be noted that corrasion as an effective process in erosion must have fluviraption or deflation act with it as a follow-up process. As noted above corrasion in conjunction with fluviraption is effective in detaching materials in pothole drilling, waterfall excavation and sapping, etc. Detachment of rock particles takes place through corrasion almost wholly when the rocks are firm and massive in character, for then fluviraption is of little avail as a single process. Scoured and smoothed rock surfaces in the rock-bound stream beds of certain youthful valleys are evidences of corrasive erosion.

Attrition is a process which is incidentally erosional in character. It is closely allied with corrasion and may not well be distinguished from it. The coarser materials undergoing transportation, or subject to transportation, at or near the bottom of a stream by the traction method, are comminuted by attrition. The fine particles detached from these materials are then subject to the suspension method of transportation.

Stones become rounded, as cobbles and pebbles, and sands lose their sharpness and also become rounded. Further wear reduces them and renders them more susceptible to transportation. It may be noted that the rounding of sand grains in water takes place much more slowly than rounding through attrition of sands under the action of the wind. In water the sand grains are somewhat protected by the film of moisture adhearing to them, especially when the sand grains are smaller than seven-tenths of a millimeter in diameter. Also the water medium is more dense and the sand grains strike each other much less violently.

The term *corrosion* as used by most authors is a blanket term covering any and all chemical actions which alter or break down rocks at and near the surface. Running water passing over rock surfaces carries on more or less corrosive attack, chiefly through solution. Ordinarily solution and other corrosion processes are grouped under weathering, but, since running water is an actively moving agent, such work as it does in extracting material from surfaces may be classed as erosive in character. In its flowing action it sweeps away all products formed, allowing no residue or broken down products to accumulate, thus somewhat in contrast to the corrosion processes which act statically in the weathering processes. Here weathering and erosion are more or less arbitrarily separated. Corrosive attack by running water is probably of little quantitative importance.

Glacial Erosion Processes. Glaciers are masses of accumulated snow and ice which move out of a snowfield area into an adjoining area where they waste away. Glaciers in moving over surfaces or in coming in contact with them actively take material away, acting as an important erosive agency in the restricted areas of their occurrence. Glaciers are moving solids, hence their movement is very different from that of wind or water. They do not flow in the ordinary sense. While they actively acquire material at the expense of surfaces, transport it and deposit it, they do not do their work in the same ways as wind and running water, though the individual processes are somewhat comparable. It may be recognized that glaciers actively acquire material through the operation of four individual processes: viz., *exaration*, *plucking*, *abrasion*, and *gouging*.

Exaration is a term applied by Walther and Grabau[5] to the action of glaciers in removing loose material from surfaces over which they move. The glacial ice gathers around or encompasses the loose material, holds it within its solid clasp, and moves away with it. In the region of snow and ice accumulation this process may keep all loose material cleaned from the surfaces over which this part of the glacier moves, but in the region of ice ablation the thinned and waning ice may not take up the loose material over which its lower portion is thrust; on the contrary, it may deposit some of the basal or other material which it has brought to or toward its terminus. Exaration as a process is comparable to deflation and fluviraption, wind and running water processes respectively.

Plucking is the process by which glacial ice withdraws rock frag-

[5] Principles of Stratigraphy, 1913, pp. 17 and 263-264.

ments or blocks from surfaces by holding on to the upper surfaces or projecting parts. As a process it is particularly applicable to glacial erosion, though it is applied by some authors also to a phase of erosion by running water. It is an important process in the so-called "quarrying" action carried on by glaciers, particularly at the heads of valley glaciers. Surfaces from which rock fragments or blocks have been withdrawn by the plucking process of glacial erosion are very ragged and broken in appearance. Such surfaces because of their projecting rock masses are continuously favorable for further plucking. Plucked surfaces are especially noted in glaciated valleys about the cirque head and on the leeward or down-valley sides of roches moutonées. Plucking as a process is regarded as independent of exaration, though in action the former may be regarded as a specialized phase of the latter.

Abrasion is the wear carried on by glaciers which move firmly held rock over other rock surfaces. Rock material frozen fast and incorporated in the basal portion of the moving ice sheet hundreds of feet thick, cuts effectively the rock surfaces over which the glacier moves. Both the rock imbedded in the base of the glacier, and that of the surface over which the rock-shod glacier moves, suffer through this abrasion process. It is the action of a moving solid held firmly and under pressure against another solid, and the rubbing or grinding of the one over the other constitutes abrasion. Both rock surfaces are effectively worn. Under this action rock surfaces are smoothed, striated and much worn away, and the tools by which this is done are faceted on one or more sides and likewise smoothed and striated. No other erosive process gives rise to such surfaces. The action gives to the glacier the "rock flour" which is incorporated through exaration into the body of the glacier, and which becomes a characteristic part of the debris that glaciers deposit or which characterizes the silt burden carried by streams escaping from glaciers. Abrasion may be regarded in its action as comprehending such attrition as is carried on in glacial erosion. As an erosion process glacial abrasion is quite different from corrasion as carried on by wind and water. Its products,—smoothed and striated surfaces, faceted and striated boulders and pebbles, etc.—are quite unique. It is a distinct process, and should not be regarded as equivalent to and interchangable with corrasion, though it is a correlative phase of erosion.

Still another process by means of which surfaces may locally suffer in glacial sculpture is that of *gouging*. Glaciers are not readily mobile, and thus they are in contrast to air and water. They are solid, and as such they are likely in certain favorable places to be bodily pushed into soft rocks, such as clay shales, and actually plow up or shove forward masses of material which may be dragged or shoved along until overridden by the ice sheet. This is a sort of gouging process, and for want of a better term the writer has been describing it to students under the term "gouging" which is retained here. It is not likely that it is of any great importance in glacial sculpture.

Processes Involved in Wave and Current Erosion. Those waves and currents of lakes and oceans which come in contact with land at and

near shores are important agencies acting together to restrict and reduce the lands. The waves chiefly break up the rock masses against which they act and deliver the material to the currents which in their chief erosive function dispose of the wave eroded material. In many places along the coasts of the lands wave action is very spectacular in its attack on rocky shores. Currents, either associated with or independent of waves, without ostentation dispose of wave-given material. The actual processes involved in wave and current erosion are identical with those of running water on the land, but the manner of their exercise in most respects is quite different.

Certainly waves and currents carry on erosion by the process of fluviraption. Waves lave the rocks, cliffs and other features of the coasts often high above still water level. Forceful wave-sent waters are not only able to bring loose materials into the sea from the land, but, attacking in vulnerable places, are able to loosen and take possession of materials as well. The actual ways in which the washing attack (fluviraption) is carried on make wave erosion unique. Wave impact is a forceful broadside washing attack delivered by each wave that comes to the shore. In localities of spectacular wave action along the coasts the attack is undermining in character. Gravity favors material of the land being delivered to the sea. In wave attack water and air are driven with great force into cracks and crevices. These are the weakest places of the rocky land front which receives the attack. The hard-driven water and air in these places of weakness is followed by a release of the pressures between each successive wave. Any materials loosened are in time washed into the sea. Wave action also stirs up fine materials which had previously settled in shallow waters. Materials stirred up by the agitating waves go away with the masses of water which hold them in suspension, and ultimately these materials settle out of the water in places below wave-base or below the depth limits of wave action. Each storm with its complex of agitating waves and currents stirs up great amounts of fine material on the shallow platforms adjacent to the lands. A part of this material settles back upon the same platform, but much of it settles in deeper water. Removal of this fine material is one of the ways in which the platforms are lowered, allowing more efficient encroachment of the seas upon the lands. Fluviraption is also specifically carried on by currents, such as undertow, alongshore and tidal, in the removal of loose materials. Here the process behaves exactly as it does in running water erosion.

Corrasion is an important process carried on by waves and currents. One phase of it is the hurling of rocks, pebbles, etc., against cliffs. Such "artillery"[6] action is very spectacular but rather uncommon. The wave-cut platform outward from the sea-cliffed shore line is commonly bare rock or has on it only a thin veneer of material. This has been called the "abrasion platform" by Johnson,[7] chiefly because it is a field of intense wear. Waves and currents drive pebbles and sands over it, and these tools wear away the rock platform, but they themselves

[6] Johnson, D. W., Shore Processes and Shoreline Development, 1919, p. 68.

[7] Shore Processes and Shoreline Development, 1919, pp. 162 and 224-225.

suffer through attrition. Attrition and corrasion, individual processes of wear, are of great importance in wave and current erosion. The veneer of loose material is nearly always present on the platform, but this veneer is being constantly worn out through attrition, and the fine material and silt produced by the wear are taken by currents to the deeper and quieter waters where they settle out below wave-base. The veneer is constantly being replaced by wave eroded material which comes from the land. Corrosion may be dismissed as an auxiliary phase of marine attack doubtfully classed under erosion. It is incidental in wave and current erosion.

The combined processes of fluviraption, corrasion, and attrition, as carried on by waves and currents, act trenchantly on the lands where the sea comes in contact with them. The shore line where acted upon by these erosive processes retreats, and the platform seaward from the shore is deepened to the depth of wave-base and is greatly broadened as the shore line is eaten back. Truly the oceans consume the lands. Such is the view as regarded from the standpoint of wave and current erosion alone.

SUMMARY AND CONCLUSION.

In this paper an attempt is made to clearly present the erosive processes and to give the terms which to the writer appear suited to them. Attention is called to the confusion existing with respect to the meaning of a number of these commonly used sculptural terms, but little attempt is made here to cite the specific uses by various authors. Distinction is made between weathering and erosion, which are regarded as inclusive terms comprehending two sets of distinct processes which may act separately or in conjunction. Both sets together are comprised under the term denudation. This distinction is made on the basis of the uses of these terms by numerous authors who have described them or called attention to their results. It is a distinct departure from the organization (but not so much the use) of these terms as presented by Gilbert in Chapter V of his great classic, "Geology of the Henry Mountains."

The various individual processes of each of the great erosive agencies are described under the terms which appear to be well suited to them. Some eight individual processes in all are described as distinctive erosional processes; some are applied in the work of a single agency and some applied in two or more. Deflation is described as a process of removal of accumulated loose material from surfaces or removal of material at the time of loosening or availability by wind action. Its correlatives in the other erosive agencies are fluviraption and exaration; the first applied both to running water and to waves and currents, and the second to glaciers. Fluviraption is a term proposed in this paper for the name of the process in which the actively moving waters of either land or sea sweep away or seize onto and carry away loose materials or materials which may become loosened. Exaration is the term applied to the process of removal of loose material from surfaces by glaciers. Corrasion is used in the restricted sense of wear on rock sur-

faces carried on by materials in transit in a water or wind medium. It is of considerable importance in erosion by wind, and waves and currents, but of little importance as a single process in running water erosion. It has one correlative, that of abrasion in glacial erosion. Abrasion is a term applied to the process of the rubbing, cutting, or grinding action of one moving solid held firmly against another in glacial erosion. Attrition is the wear which tools in a water or wind medium undergo. It is regarded as an individual process taking place in erosion by wind, running water and waves and currents, very closely related to corrasion. Attrition is distinct from corrasion chiefly because material is not removed from stationary surfaces, but is a wearing out of the materials in transit or potentially in transit. It is an auxiliary process to deflation and fluviraption. Abrasion in glacial erosion comprehends it. Plucking and gouging are defined as special processes of removal in glacial erosion alone. Corrosion is a comprehensive term applied to chemical actions on rocks. It is a term of some significance in weathering, but has only a limited application as an erosive process as carried on by actively moving waters.

The processes described above are real. The terms applied to them are used specifically. Little that is new is brought out with respect to the processes or the terms applied to them. The writer has simply made an attempt to present a clarifying and organized view of the processes and the terms applied to them. It is not the hope of the writer to find his geological friends in full agreement with all the views set forth in this paper, but he does hope that they may see the need of a relatively specific meaning attached to the many common terms used in this paper.