If such a cycle would involve n numbers each of the possible $n!$ permutations of these numbers would be metacyclic according to the given definition. I know of no authority for the use of the common mathematical term "metacyclic" with this meaning and see no reason for using it thus. Under the term "Transitive group" it is stated that "if any set of n elements is replaced by any such set, it is *n-ply* transitive." If this were true it would follow that when a group of degree n is simply transitive it is also n-1 times transitive, which is obviously not necessarily true. In order that a group is *n-ply* transitive it is not sufficient that every set of n letters found therein is replaced by its substitutions by every other such set, but this replacement must occur also in every possible order. The fact that this distinction is frequently omitted elsewhere makes it the more desirable that it should be clearly given in a standard reference work.

Under the term "permutable" there appears the following sentence: "Leaving a finite group unchanged when it is operated upon by the group and the result is operated upon by the inverse of the original operation." It is difficult to see what is meant by operating on a group by the group. The term "permutable" is used in group theory with a wider meaning when it relates to groups than when it relates to operators. At any rate, the quoted sentence is practically meaningless but relates to an important mathematical property. Under the term "group of an equation" there appears the following statement: "A transitive substitution group, of the same degree as the irreducible equation, that does not change any function of the roots that is expressible rationally through the coefficients, but changes every other." The group of a reducible equation is intransitive and the definition of the term "group of an equation" should include this case. The definition of the preceding term, "group of a function," is also incomplete, since it applies also to every subgroup of this group.

In the biographical section which appears at the end of this dictionary the Hindu mathematician Aryabhata is said to be "the earliest known algebraist" and to have flourished in the fifth century, while Diophantus of Alexandria is called a "Greek algebraist" who flourished in the third century. It is obvious that it is impossible that both of these statements are correct. The well-known Norwegian mathematician Sophus Lie is here said to have died in 1870, when he was only twenty-eight years old. As a matter of fact most of his extensive works were published after this date, and he died in 1899 at the age of fifty-six years. One looks in vain in this section for the name of one of the most noted French mathematicians, E. Galois (1811–1832), whose fame has gradually increased since the time of his early death and has far outstripped that of many others whose names appear here.

G. A. MILLER

UNIVERSITY OF ILLINOIS

THE CHLORINE CONTENT OF THE LEDA CLAY

A SAMPLE of fossiliferous Leda clay (Pleistocene) collected in a road cut near Waterville, Maine, was recently analyzed by one of our students, U. U. Savolainen, of the Tufts College Chemical Department, for its chlorine content. The results, although provisional, indicate that further work along similar lines may prove of interest and of geologic value.

The sample analyzed was a light grey unweathered clay containing abundant, well-preserved shells of *Mytilus edulis*. Microscopic examination showed it to be made up largely of colloidal clay particles, although there was some rock flour associated with the finer material.

The specific gravity of the fresh clay, determined by the paraffin dip method, was found to be 1.88, while that of the dried clay was 1.47. From these figures the pore space was calculated to be about 41 per cent.

The chlorine content was found by leaching the finely divided clay with distilled water and titrating with silver nitrate solution, using potassium chromate as the indicator. The results obtained varied from .0000731 to .0000789 grams of chlorine per gram of clay. From this and the pore space the possible amount of chlorine in the water that was assumed to have originally occupied the pore space was determined. This was found to be between .174 and .194 grams of chlorine per 1,000 grams of water.

At the present time the average amount of chlorine in sea water is about 19 grams of chlorine in 1,000 grams of water. Since the ratio of the chlorine to the total amount of salts in sea water is nearly constant, the chlorine found in the clay seems to indicate that the original sea water enclosed by the clay was about 1/100th of the average salinity of the present-day oceans. This low figure may be explained in several ways.

First of all, there is the ever-present possibility of error in the determination of such minute amounts of chlorine.

Secondly, there may have been some leaching of the chlorine content after the deposition of the clay. But this seems quite unlikely as indicated by the well-preserved shells of Mytilus.

Thirdly, there arises the possibility of chemical union or physical affinity of the chlorine with the clay constituents. How far this can take place, it is impossible to say.

Finally, there is the high probability of the original sea water being diluted by fresh water from rivers or melting ice. That this is quite likely is indicated by the presence in the clay of *Mytilus edulis,* which can withstand freshening of the water in which it lives. This species is frequently found living at the present time in large numbers far up estuaries that empty into the ocean along the coast of Maine.

ARTHUR S. KNOX

TUFTS COLLEGE

SOME OBSERVATIONS ON SLUMPING AND GULLY FORMATION

SOIL erosion and its prevention is an important problem to those interested in the conservation of our natural resources. In order to adequately solve the problem of soil erosion much information, obtained under various conditions, must be collected. Therefore, these observations are recorded as a contribution to the sum total of information already accumulated on this subject.

On the afternoon of Friday, October 9, 1936, in Muskingum County and neighboring portions of Ohio there occurred a severe rain-storm of the proportions of a cloudburst, which continued for perhaps one-half hour. After the torrent was over the rain continued to fall intermittently during the night. In the space of about 12 hours 4¼ inches of rain fell into a rain gauge just south of the village of New Concord, a large portion of which—perhaps as much as 3 inches—fell during the cloudburst.

On the campus of Muskingum College in New Concord there is a hill known as Flag Pole Hill which has been subject to severe slippage and gullying. The slipping was due to a clay layer about 11 feet above the Harlem coal and to another clay layer just below the coal. This hill had just been graded and manured in preparation for the planting of grass.

About one hour after the downpour the writer observed that a number of gullies had been formed by the run-off. When observations were first made a shallow gully with a funnel-shaped head 4½ feet across, narrowing to less than a foot, was observed. The head of the gully was just above the clay strata about 11 feet above the Harlem coal. In making the observations at this point the observer sank a foot or more into the mud. From time to time the water-soaked material above the head of the gully would slip into the gully and there mix with the water flowing in the gully. This material was of the consistency of a very viscous liquid, which could be seen to flow down the gully at the rate of a foot or less a minute. The advancing front of the sub-liquid mud measured at times an inch or two in height. Darkness terminated this observation, but early next morning the observations were continued.

During the night a slip 17 feet long had taken place on either side of the gully just described and at the level of the head of the gully. The slip had taken place when the soil and sub-soil above the clay had become saturated with water to the point that it could no longer hold together and slid down on the slippery clay strata. This slip extended 8 feet on one side and 9 feet on the other of the original gully. The material slipped down the hill for a distance of 3 feet and formed a terrace 2 feet high and 5 feet wide made up of soil and sub-soil which had slid down over the clay strata, which acted as a lubricant. Thus 170 cubic feet of material had moved 3 feet down the slope during and just after this one rain.

At the same level another smaller slip 26 feet in length had occurred but had moved down the hill only from 8 to 10 inches.

About 10 feet north of this large slip a large gully started about 13 feet below the top of the hill. From dimensions of a few inches it deepened and widened in the shaly sub-soil to 10 inches wide and 6 inches deep. On reaching the clay horizon it widened to as much as 22 inches and deepened to 8 inches or more. Several fall-like drops occurred in the bottom, as the water found more resistance in some layers than in others. At the level of the slip it widened to 4 feet, narrowing to about 30 inches in a distance of 5 feet, where it deepened to 18 inches. It has been calculated that this one gully alone has been formed by the moving of more than 60 cubic feet of material. This portion of the hillside can be classed as a "D" slope (more than 30 per cent.), from which most of the soil has been removed.

Other smaller gullies, 17 of which ranged upward to 7 inches in depth and 5 inches in width, were formed on this hillside during the few hours in which the water ran off during and immediately after the rain. These gullies were best developed in the clay below the outcrop of the Harlem coal. At one place where the hillside had been previously graded and was covered with a thick grass cover a slip 21 feet long had taken place on the clay just below the Harlem coal and slid 4 feet down the hill. The portion of the hillside in which this slip and the smaller gullies were developed can be classed as "C" slope (20 to 30 per cent.), from which most of the soil had been removed.

While the situation here described may not seem in itself important, yet when we consider that the erosion noted has taken place on a hillside having an area of less than one acre and during one rain the seriousness of the situation becomes evident.

ROBERT H. MITCHELL

MUSKINGUM COLLEGE