through direct erosion by sediment-laden waves. Interestingly enough, the dates which have remained legible for the longest time are those cut on the walls of caves or narrow inlets where the rock rarely becomes completely dry.

On the basis of carvings made in 1940, the depth of the average inscription was estimated to be one eighth inch. If six years are required to obliterate a carving (Fig. 1), a period of about 600 years would be necessary for surface weathering and erosion alone to cause the sandstone cliffs to retreat one foot. This figure probably represents a maximum rate for the sandstone, however, since obliteration takes place not only by retreat of the entire cliff front, but also by mere broadening of the letters into a wide hollow. A much higher rate of retreat exists for local cliffs of relatively unconsolidated terrace material near La Jolla. These are cut back by waves and rain wash so rapidly that only one or two 1940 carvings were found. An even lower rate for limestone (one foot in 6,000 years) was obtained by Goodchild[2] through the investigation of gravestones. The slowness of the retreat suggests that other processes such as undercutting by waves is primarily responsible for the cutting back of the cliffs at La Jolla. At the rate of retreat of one foot in 600 years, a cliff twenty feet high would contribute to the beach about 3.3 cubic feet of sand annually for each one hundred feet of its length. Although the method is subject to errors, it may be an approach for determining relative rates of surface weathering and erosion in other areas.

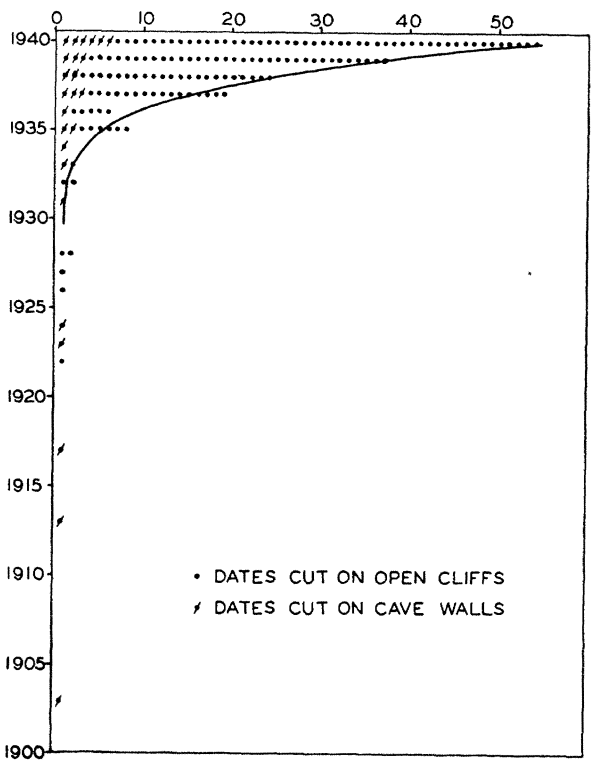

FIG. 1. Graph showing number of dated inscriptions found cut in sandstone sea cliffs near La Jolla, California.

K. O. EMERY

UNIVERSITY OF ILLINOIS AND
SCRIPPS INSTITUTION OF OCEANOGRAPHY

MAN'S BIOLOGICAL DESTINY

PROFESSOR ELIOT BLACKWELDER, speaking as retiring president of the Geological Society of America in an address published in SCIENCE for April 18, 1941, under the title "Science and Human Prospects," takes the view that man as a species is limited in power to improve native ability, except to such degree as may be accomplished by educational methods. However, no reason exists for so pessimistic a view because the human species is subject to biological laws that differ in no essential respect from the laws that govern animal and plant life. Surely, then, what has been accomplished with animals and plants can be repeated with man. Some of the work on animal and plant improvement was reviewed in the *American Naturalist*[1] not very long ago, and while this point was not discussed in that review, the work reviewed demonstrates that man holds his biological destiny in his own hands. And since the publication of the *American Naturalist* article, further gains have been made in the work at Mount Hope.

Purely voluntary action by a comparatively small number of people can develop a race of human beings whose brains would have most of the qualities which Professor Blackwelder wonders if man's successor on this planet may not possess, just as certainly as the abilities of animals have been improved. And the task will require such a small number of generations that it will doubtless seem like an instantaneous change to geologists. Nevertheless, a race of human beings whose poorest brains are superior to the best of to-day might have the same difficulties with human relationships as exist to-day because so many human relationships are governed by social inheritance rather than biological inheritance. As Professor Blackwelder puts it, ". . . and above all will his life and conduct be controlled by his intellect rather than by his feelings?"

H. D. GOODALE

MOUNT HOPE FARM,
WILLIAMSTOWN, MASS.

FURTHER COMMENT ON PRESERVATION OF NATURAL AREAS

THE comment of Dr. Willard G. Van Name in SCIENCE for May 2, 1941, emphasizes further the need

[1] H. D. Goodale, *American Naturalist*, 72: 740, 243, May–June, 1938.

[2] J. G. Goodchild, *Geol. Mag.*, 12: 326, 1875; *Geol. Mag.*, 27: 463–466, 1890.

for planning in the preservation of natural plant and animal habitats. I can not share his rather sweeping criticism of the U. S. Forest Service, however. This agency has been committed to a policy of multiple use management for over thirty years—the greatest good to the greatest number in the long run. Its administrators have faithfully tried to follow this policy. It is only natural, then, that the large "roadless areas" and "primitive areas," often containing over a million acres in one block, should be scrutinized for other possible public uses before being set aside. The late Dr. Robert Marshall, the chief advocate of such a classification, was keenly alive to the needs of society as a whole, as well as being a trained plant physiologist. Naturally such large tracts could not be closed to productive use where local industries and communities would thereby suffer hardship. The U. S. Forest Service tries to stabilize communities by insuring a continuous supply of raw material.

Really valuable commercial timberland has, however, been reserved from all cutting and made permanent natural areas by the U. S. Forest Service in a large number of cases, such as the Port Orford cedar reserve and the Tionesta virgin forest in Pennsylvania, to which I took pains to refer in my note in SCIENCE of January 24, which Dr. Van Name does me the favor to quote. This latter area has been carefully zoned to insure adequate undisturbed environments for scientific study. One of the virgin forest areas on the White Mt. National Forest known as the "Bowl," containing 500 acres of magnificent virgin spruce, had so much commercial value that salvage operations were possible after it was destroyed by the hurricane; this many privately owned commercial forests did not have!

While both the U. S. Forest Service and the National Park Service have reserved a very imposing number of natural areas, I fully agree with Dr. Van Name that there are still others equally deserving of attention. In this connection one may even raise the question whether public ownership of this sort is always necessary or best. Some reserves owned by private universities or schools or scientific societies may be even safer from disturbance.

Finally I wish to correct any impression that may have been gained that I would recommend "that the first thing to do is to spend a number of years in an 'inventory' of desirable areas"—while immediate action is needed to save threatened fauna or flora. Certainly not. While unfortunately some surveys of this kind tend to drag on, there is no real reason why an inventory should not be completed in a few months at most if the cooperation of all naturalists were to be enlisted and the country divided into districts. Dr. S. Charles Kendeigh (Vivarium Building, Champaign, Ill.), chairman of the Ecological Society of America Committee for the Study of Plant and Animal Communities, has amassed a large volume already in the course of a survey of areas now reserved or in need of protection. This study could provide a basis for a comprehensive plan for the country to which federal agencies and state planning boards could make substantial and necessary contributions.

HENRY I. BALDWIN

N. H. FORESTRY AND
RECREATION DEPARTMENT,
HILLSBORO

SCIENTIFIC BOOKS

ORIENTATION

The Orientation of Animals, Kineses, Taxes and Compass Reactions. By GOTTFRIED FRAENKEL and DONALD L. GUNN. 352 pp. Oxford University Press. 1940.

THE first part of this volume is intended primarily as a text for undergraduates; the second (pages 136–352) primarily as a handbook for investigators. The aim of the authors is to classify responses already known rather than to elucidate the mechanism involved in the responses.

The classification proposed is a modification of that formulated by Kühn in 1919. The responses are divided into three main categories, designated kineses, taxes and transverse orientations and these are subdivided respectively into ortho- and klino-kinesis; klino-tropo- and telo-taxis; light compass reactions, dorsal and ventral light reactions and ventral earth reactions. Known responses are selected to illustrate the characteristics of each division in the classification, but there is no attempt to classify all the responses which have been described.

Nearly all the categories in the classification appeared long ago under different names, *e.g.*, kineses as changes in rate of response or undirected responses, taxes as directed responses or tropisms, klino-taxis as indirect orientation or orientation by "trial and error," "random movements" or "shock-reactions," tropo- and telo-taxis as direct orientation.

The authors maintain (p. 65) that in the new classification all anthropomorphic implications are eliminated, that the terms used are precisely defined and that it is consequently superior to former classifications which contain such anthropomorphic phrases as "trial and error" (Jennings), and "selection of random movements" (Holmes); and such ill-defined phrases as