by passing them through 30 per cent., 50 per cent., 80 per cent. and 95 per cent. alcohol, allowing 24 hours in each. After two changes of 95 per cent. alcohol the crania are left for three days in absolute alcohol, for three days in a mixture of alcohol and toluol, and, finally, in pure toluol until completely clear. Next, the crania are transferred into a melted mixture of one quarter paraffin and three quarters toluol, where they remain for 2 days. They are then transferred into a similar mixture consisting of one half paraffin and one half toluol; after another 2 days they are placed into a mixture of three quarters paraffin and one quarter toluol. Again after 2 days they are transferred into melted pure paraffin for 3 days. Finally they are placed into fresh paraffin for an additional 3 days or more. If large numbers of crania are treated, a third and even a fourth change of pure paraffin may be necessary.

This slow method of infiltration was found to be necessary, as comparatively large quantities of the preceding liquids are always carried along with the crania, thus leading to a comparatively rapid dilution of the more concentrated solutions; this in turn yields very unsatisfactory results, such as incompletely infiltrated specimens, shrivelled and distorted crania, etc.

When infiltration is completed the crania are removed from the paraffin and permitted to drip off all excess paraffin onto paper towels placed on the top of the steam radiator. This latter procedure needs careful supervision in order to assure freedom from paraffin of all foramina and at the same time prevent complete loss of the infiltrated paraffin. The finished crania are then placed on a layer of non-absorbent cotton in individual boxes.

The foregoing procedure has been applied with equal success to the crania of several species of sharks, namely *Squalus suckleyi* Gill, *Mustelus californicus* Gill, *Triakis semifasciatum* Girard and *Heptanchus maculatus* (Ayres). The only difference found was that the crania of the last-named species require approximately double the time intervals indicated above to insure complete infiltration.

The spinal column of sharks may be cleaned in the manner described for the crania, except that great care must be exercised in the hot-water treatment. If the spinal column is left but a few minutes too long, the interdorsal arches will fall out. No time can be specified, as it seems to depend, possibly, on the age of the shark. However, it was found that satisfactorily clean specimens are obtained even if not all adhering muscles can be blown off, since these fibers may be picked away readily with forceps after completed infiltration with paraffin, before cooling off of the specimen.

The same procedure is followed in infiltration of the spinal columns as indicated for the crania. The spinal column is broken into pieces about four inches long. After completed infiltration a lateral portion extending over three to four vertebrae is removed at one end of the piece of column, exposing a sagittal view of the vertebrae. At the other end of the piece of column a transverse section is made through the middle of a vertebra. These operations may be executed with a scalpel or razor blade. However, if large numbers of such pieces must be prepared, the work may be speeded up by using a power jigsaw. It was found that a very slow speed and a fine blade yield best results. The saw marks are easily removed by shaving off the exposed surface layer with a sharp scalpel. The student may be given a portion of spinal column from the trunk region and a portion from the tail region. If it appears desirable, sections through the cranium may be cut also on the jigsaw.

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A METHOD FOR MEASURING THE EFFECTS OF ACID BEVERAGES ON THE TEETH OF SMALL LABORATORY ANIMALS[1]

IN the course of studying the *in vivo* effects of various acid beverages (cola drinks, synthetic lemonade, etc.) on the molars of rats, it became necessary to devise a rapid, reliable method for evaluating the degree of destruction of the enamel. McClure[2] has used the weights of the molars, dried at 110° C., as an index of enamel destruction. We have found, however, that considerable differences (sometimes greater than 20 per cent.) may occur in the weights of comparable molars from rats of the same litter and sex. Accordingly, a simple but accurate scoring system has been worked out based on the appearance under the dissecting microscope (about ×15) of the lingual surfaces of the molars.[3] This procedure has been found to apply equally well to other small laboratory animals, such as the hamster.

After the animals have been killed the heads are autoclaved at 115° C. for 20 to 30 minutes to soften the flesh. The jaws are then easily removed and cleaned, after which the extent of acid damage to each molar is evaluated according to the following criteria:

No effect	0
High polish of lingual enamel	1
Slight etching of lingual enamel	2

[1] The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

[2] F. J. McClure, *Jour. Nutrition*, 26: 251–259, 1943.

[3] J. S. Restarski, R. A. Gortner, Jr., and C. M. McCay, *Jour. Am. Dent. Asn.*, 32: 668–675, 1945.

Mild destruction of lingual enamel, with evidence of slight ridge formation at gingival margin 3
Moderate destruction of lingual enamel, with ridging more definite and some exposure of dentin 4
Severe destruction of lingual enamel, with marked ridge at gingival margin, and appreciable exposure of dentin 5
Almost complete destruction of lingual enamel with definite evidence of destruction on other surfaces, and marked exposure of dentin with some destruction 6

With very little study, one is able to readily distinguish between the different categories, so that this method of grading has given reproducible results in the hands of different observers.

After appraising the individual molars, one can determine the average tooth score for the animal or for the upper and lower jaws separately. When the effects of different acids are being compared, the latter system is frequently more revealing because certain acids seem to attack the upper and lower molars in different degrees—some affect the molars of both jaws fairly equally, while others produce far greater damage to the lowers than to the uppers.

Fig. 1 shows a series of tracings made from photomicrographs of ground sections of seven typical mandibular rat first molars depicting the various stages of enamel destruction described above. As the tooth score increases, the progressive loss of lingual enamel above the gum line is readily observed. In molars 5 and 6, mild to moderate destruction of dentin on the lingual and occlusal surfaces is apparent.

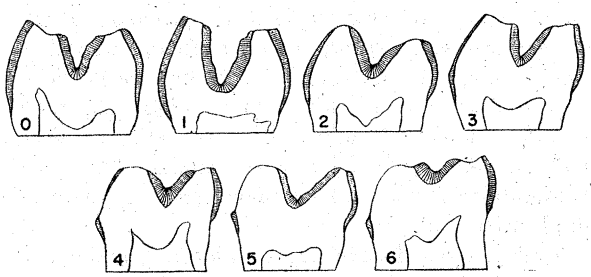

FIG. 1. Rat molars showing various stages of destruction by acid beverages.

To further substantiate the suitability of the visual grading system, the enamel content of several complete sets of molars from rats exhibiting varying degrees of gross enamel destruction was determined using the dentin-enamel separation procedure of Manly and Hodge.[4] The data in Table 1 show that as the average tooth score increases, the percentage of enamel in the teeth decreases.

TABLE 1

PERCENTAGE OF ENAMEL IN DRIED RAT MOLARS COMPARED WITH THE AVERAGE TOOTH SCORE DETERMINED BY THE VISUAL GRADING SYSTEM

No. of analyses	Average molar score	Percentage of enamel in molars	
		Range	Average
6	0	22.1–23.3	22.7
3	1.1–1.9	22.5–24.7	23.6
2	2.4–2.5	21.1–22.8	21.9
3	3.1–3.3	17.9–19.5	18.9
4	3.4–3.6	17.3–19.0	17.8

The application of this method to the study of tooth-decalcifying properties of specific beverages is being reported elsewhere.

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DISCUSSION

CONTINUITY AND DISCONTINUITY IN EVOLUTION

IN an earlier article[1] describing the concept of integrative levels, I indicated that its value lies in the full recognition of both continuity and discontinuity in evolution.

In stressing the need for special techniques, terminology and laws at the social level, I did not, as Gerard and Emerson[2] assert, "isolate completely everything human from the rest of nature," any more than a biologist denies chemical laws when he formulates biological concepts like natural selection. Man has much in common with other organisms. The closer an organism's sensory, integrative and reactive capacities are to man's the more we can learn from it about human behavior.[3]

Yet caution must be exercised in applying general biological laws to man's behavior. To understand man, attention must be centered on those qualities which make him unique. Man, alone of all organisms, possesses a culture which embodies his historical experience and which imposes basic patterns on his

[1] Alex B. Novikoff, SCIENCE, 101: 209–215, 1945.
[2] R. W. Gerard and Alfred E. Emerson, SCIENCE, 101: 582–585, 1945.
[3] Joseph Needham, *Science and Society*, 6, p. 375, 1942, has written, "social insects . . . differ so severely from the primates in their morphology that they have less to teach us than is often supposed."
[4] R. S. Manly and H. C. Hodge, *Jour. Dent. Res.*, 18: 133–141, 1939.