crease O_2 uptake over the hair-free control. To accomplish this, at least 100·0 mg of enamel were required. Thus, in these experiments involving keratin degradation, trace elements increased O_2 consumption to a greater extent than is attributable to stimulation of autorespiration alone.

These observations agree with other experiments (to be published) in which oral proteolytic microflora catabolized pulverized Ca^{45}-rat bone, as a result of which the pH rose from around 7·0 up to 8·0 and appreciable amounts of Ca^{45} passed into solution. The most likely mechanism whereby bone and enamel minerals dissolved under the conditions in these experiments is by the release of chelating agents as degradation products of organic matrix constituents.

Conclusions.—These studies indicate that enamel minerals stimulate keratinolysis, and keratinolysis contributes to dissolution of enamel apatite. Consequently, the simultaneous disintegration of organic and inorganic components of enamel during formation of dental caries appears more likely than an independent attack on either phase alone. In terms of comparative biochemistry, the proteolysis-chelation theory views tooth decay as due to essentially the same mechanism responsible for pathological bone resorption, normal deciduous tooth root resorption, dental cavities in marine mammals, lobster and mollusc diseases where the calcareous shells demineralize, and solubilization of rock phosphate (i.e. apatite) fertilizer in neutral and alkaline soils[6]. In these systems, acid is not the sole or major factor causing solubilization or decalcification, but chelation seems to be the common denominator. Organic chelators of microbial origin which dissolve calcium phosphates, even under neutral and alkaline conditions, may be useful biological reagents with which to attack such problems as the nature of the bonding between the organic and inorganic components of calcified body structures, changes with age, and the influence of fluoride.

A. Schatz, K. E. Karlson, and J. J. Martin

Research Laboratory, National Agricultural College, Doylestown, Bucks County, Pennsylvania, March 3, 1956.

Zusammenfassung

Nach der Proteolyse-Chelationstheorie der Zahnkaries werden organische und anorganische Bestandteile des Zahnschmelzes mehr oder weniger gleichzeitig abgebaut. Die Ergebnisse dieser Untersuchungen zeigen, dass 1. mineralische Bestandteile des Schmelzes die mikrobiologische Zersetzung des Keratins fördern und dass 2. die enzymatische Zersetzung des Keratins Stoffe entwickelt, welche die Apatitauflösung mittels Chelation fördern.

[6] A. Schatz and J. J. Martin, N. Y. St. dent. J. *21*, 367 (1955). – A. Schatz, K. E. Karlson, and J. J. Martin, N. Y. St. dent. J. *21*, 438 (1955). – A. Schatz, J. J. Martin, K. E. Karlson, and V. Schatz, N. Y. St. dent. J. *22*, 161 (1956). – A. Schatz, N. D. Cheronis, V. Schatz, and G. S. Trelawny, Proc. Penn. Acad. Sci. *28*, 44 (1954). – J. J. Martin, H. D. Isenberg, V. Schatz, G. S. Trelawny, and A. Schatz, Euclides *14*, 311 (1954). – A. Schatz, Umschau *24*, 746 (1955).

The Biometry of the Cirripede, *Chthamalus stellatus* (Poli)

Data have recently been given by Tenerelli[1] on the sizes of *Chthamalus stellatus stellatus* (Poli) and *C. stellatus depressus* (Poli) together with a discussion of the status of the 2 forms. These results are of considerable interest and would seem to warrant a more detailed statistical treatment.

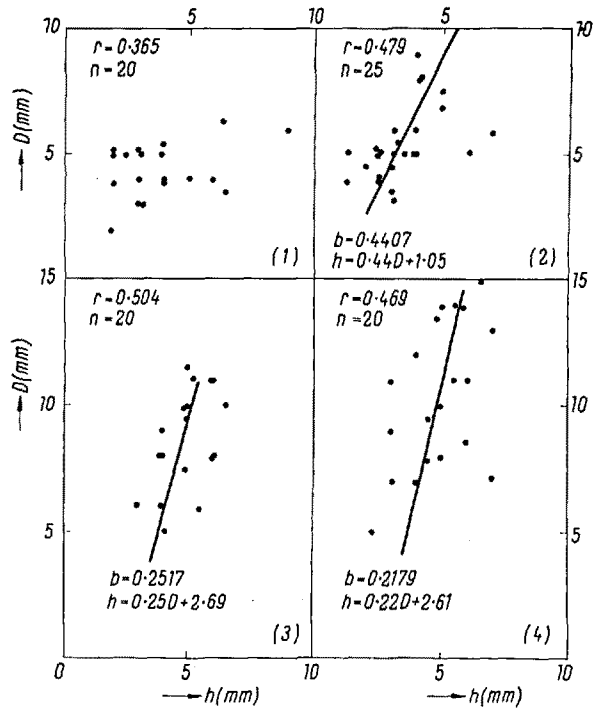

Fig. 1.–Plot of diameter (D) against height (h) for *Chthamalus stellatus stellatus* (Poli). Data from Tenerelli: (1) Zona inferiore di bassa marea. (2) Zona intercotidale, vicino alla linea superiore di alta marea. (3) 40–60 cm sulla linea di alta marea. (4) 150–180 cm sulla linea superiore di alta marea. Correlation coefficients and regression lines are also shown.

Measurements are given of the height and basal diameter of individuals of both varieties collected at several levels of the intertidal zone. Tenerelli points out that the form *depressus* reaches greater dimensions than *stellatus* but he does not distinguish between the different year classes. He further shows that the ratio of the height to the diameter is different in the 2 forms. It is more instructional to consider the relation between the heights of the individuals in respect to the diameter, at the different levels and in particular to determine whether this relation varies with the level in either of the forms; any such variation could indicate the effect of environment on the growth form of the animals.

All the data, height against diameter, have been plotted in the Figures 1 and 2. With the exception of form *stellatus* at the lowest level (zona inferiore di bassa marea) and the form *depressus* at the highest level (180–260 cm sulla linea superiore di alta marea) there is a significant correlation between the 2 dimensions. In the former case the lack of correlation may be due to the

[1] V. Tenerelli, Atti Accad. Gioenia Sci. nat. Catania [6] *9*, 92 (1952–53).

effect of crowding by other organisms since there is little change in diameter with increasing height. In the latter case the opposite is true, there is little change in height as the diameter increases; with these large and presumably old barnacles at a very high and exposed level this would seem to be the result of abrasion. With these exceptions the appropriate regression lines of heights on diameter have been calculated and are also shown in the Figures.

It is a simple matter to test whether a set of samples can be considered to be drawn from a population having the same regression. The difference between the residual sums of squares of the combined regression line and those of the separate lines divided by the difference of the degrees of freedom is an independent estimate of the variance which may be compared with the residual variance from the separate regression lines.

Applying this test it is found that all the samples from the various levels of each form considered separately have a common regression line, i.e. for each form the relation between diameter and height is the same at all levels. However, when the common regression lines for the 2 forms (pooling all the individual results) are compared they are found to be significantly different.

A common regression line for all levels for either form suggests that the relation is little influenced by environment and together with the significant difference between the common regression strengthens TENERELLI's separation of the species into 2 distinct varieties.

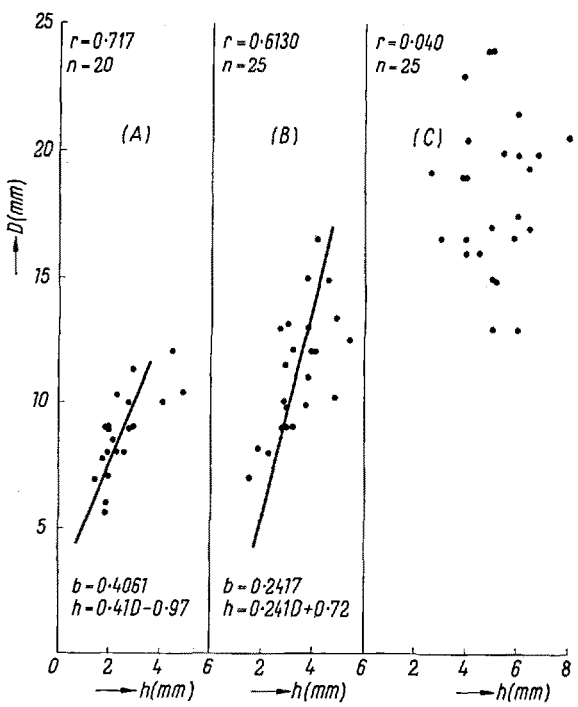

Fig. 2.–Plot of diameter (D) against height (h) for *Chthamalus stellatus depressus* (Poli). Data from TENERELLI: (A) Zona intercotidale, vicino alla linea superiore di alta marea. (B) 40–50 cm sulla linea superiore di alta marea. (C) 180–260 cm sulla linea superiore di alta marea. Correlation and regression lines are shown.

It is also of interest to note that, whilst the pooled regression lines are significantly different, this difference is one of position and not slope (Fig. 3); the rate of change of height with diameter is not significantly different. It appears from Figure 3 that the relation in the case of the form *depressus* is linear throughout life since production of the regression line gives values

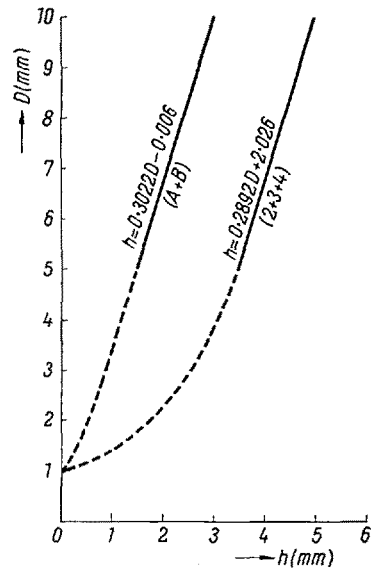

Fig. 3.–The common regression lines for the 2 forms *stellatus* (*2*, *3*, *4*) and *depressus* (*A*, *B*). Regression lines produced to show necessary change of slope in *stellatus*.

roughly equivalent to those expected in the newly settled animal; in the case of the form *stellatus* the same argument suggests that a change in the diameter-height relation takes place between settlement and a value of 5 mm for the diameter.

H. BARNES

The Marine Station, Millport, Scotland, November 7, 1955.

Résumé

Les données de TENERELLI sur les dimensions (hauteur et diamètre basal) de *Chthamalus stellatus stellatus* (Poli) et *C. stellatus depressus* (Poli) sont analysées ici par des méthodes statistiques. On peut constater une ligne de régression commune à tous les échantillons de chaque sous-espèce, pris à plusieurs niveaux. Les lignes de régression pour les deux sous-espèces en question offrent des différences significatives. Leur croissance diffère également.

The Exchange of Phosphorus in Shells of the Aquatic Snail *Physa acuta*

Many authors have been able to demonstrate by using radioactive isotopes the exchange of phosphorus and calcium in bones of higher animals. It therefore was of some interest to find out whether similar exchanges of important biogenic elements occur in the shells of some mollusca. Concerning generally the problem of basal metabolism of phosphorus in the aquatic snail *Physa acuta*[1] cultivated in our laboratory, we performed some experiments where finally a relatively intensive

[1] These studies were part of our research on the mode of action of molluscacidal substances on the snail's metabolism.