significant relationship was discovered between the occupation, education or health of parents and the intelligence of their children. There was also little correlation between the intelligence and the health, nutrition or cleanliness of the individual child. The intelligence of Jewish boys was somewhat better than that of the boys of the poorer Gentile schools, but inferior to that of the medium or superior Gentile schools. The Jewish girls were apparently less intelligent than the Gentile girls in all schools. One rather striking fact brought out by the investigation was that whereas, among the Gentiles, boys and girls of corresponding ages were of about the same degree of intelligence, among the Jews the girls were distinctly inferior in intelligence to the boys. How far this is a general racial characteristic is a question which requires further investigation.

There is no evidence in the memoir of any prejudice against the Jew. The authors state that their "chief fear in checking indiscriminate immigration is not that Britain may lose a supply of cheap labor, but that we may exclude a future Spinoza, a Mendelssohn, a Heine, or an Einstein. Yet in approaching the problem sympathetically and, as we hope, without bias, we can not see that unrestricted immigration has been an advantage to this country." What the verdict of the future will be no one can tell. A continuation of the memoir will appear in a subsequent issue.

Following a short illustrated article on hereditary epicanthus and ptosis, by C. H. Usher, there is an extensive, but unfinished memoir by Miss Ethel M. Elderton on "The Relative Value of the Factors which influence Infant Welfare." Miss Elderton has studied how infant mortality is affected by the age and health of parents, order of birth, cleanliness of the home, employment of the mother, occupation of the father, habits of the parents and food in the home. The influence of these various factors is expressed in terms of coefficients of correlation. Those interested in public health and sanitation will find much of interest in this memoir.

The last article is on the correlation of birthrates and deathrates with reference to Malthus's interpretation of their movements. The author, Mr. A. B. Hill, comes to the conclusion that "apart from the secular trend, there has been but slight connection in either country [England and Wales, and Sweden] between the deathrates and the birthrates closely following them, over the period of time for which the statistics are available."

A copy of a fine portrait of the Reverend T. R. Malthus forms a very appropriate frontispiece of the first number of the new *Annals*.

S. J. HOLMES

UNIVERSITY OF CALIFORNIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW METHODS TO MEASURE THE RATE OF FLOW PRODUCED BY THE GILLS OF OYSTER AND OTHER MOLLUSCS

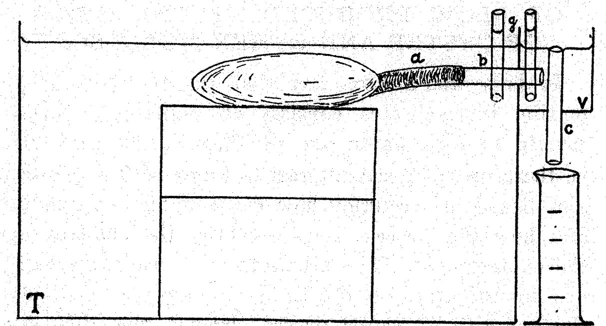
IT is a well-known fact that the food of many marine invertebrates consists of planktonic forms carried in with water passing through the gills. It is, therefore, of great interest to know with a reasonable degree of accuracy how much water is taken in and how the process is affected by the changes in the environment. The attempts were made by various investigators to determine by indirect methods the quantity of water passed through the gills, as, for example, determining the O_2 consumption and CO_2 formation, or by counting the number of plankton organisms in the stomach and in the outside water. So far as the oyster is concerned the figures vary from 300 to 8,000 cc per hour.

Better results can be obtained with the following two methods, which give the possibility to collect the water after it had passed the gills, and to measure the rate of flow and the pressure inside the gill cavity.

(1) The valves of the oyster are forced apart and a glass rod is placed between them to prevent their closing; a rubber tube (a), 6 to 7 mm in diameter, is inserted into the gill cavity and made fast by packing all the spaces around with cotton. The outgoing water passes through the tube; leakage, if any, can be easily noticed by adding a few drops of carmine suspension and watching the produced currents. The oyster is then placed into a tank (T) of about ten liter capacity; the tank is connected through a horizontal glass tube (b) of 6 mm diameter with a small vessel (V) about 50 cc capacity. A vertical tube (c) 8 mm in diameter goes through the bottom of a small vessel; its upper level is about 1 cm above the upper level of the horizontal tube b. The large tank is filled with water up to the level of the vertical tube c. When equilibrium is established the rubber tube a, inserted into the oyster, is connected to the horizontal tube b and the water from the gill cavity begins to flow into a small vessel; the overflowing water is collected in a graduate. To keep the levels constant fresh sea water is added into a large tank at the rate the water is propelled by the oyster.

The pressure inside the gill cavity can be measured by plugging the tube c and watching on the water gauges (g) the rise of the level in a small vessel. In a few minutes a maximum difference is reached and no more water flows through the tube b. This indicates that there is no more difference in pressure inside the gill cavity and at the end of the tube b.

The difference may be maintained as long as the gill epithelium keeps on beating. Under optimum conditions the highest difference observed was 4 mm.



(2) To measure the rate of flow the same oyster is placed into a tray; the end of the rubber tube (a) is attached to a ⊥ tube, the upper end of which is connected to a funnel filled with a fine carmine suspension and the third end is connected with a glass tube of same diameter; the tube is 17 cm long and is graduated into cms. Releasing the clamp a very small amount of carmine suspension is added; it forms a distinct cone moving inside the graduated tube. The rate of movement of the apex of the cone is then measured. Since a distinct cone of carmine suspension is visible it may be assumed that in this case we have "stream line" or viscous flow to which the Poiseuille's formula

$$\mu = \frac{\pi g d^4 p}{128 L q} \qquad (1)$$

is applicable.

In this formula μ = viscosity in poises, g = acceleration of gravity, d = diameter and L = length of capillary tube, q = rate of flow in cc per second, p = difference in pressure between two ends of the tube. The maximum velocity is at the center of the tube; the average velocity of flow throughout the whole sectional area is then one half the maximum velocity. If the viscosity of water and dimensions of tube are known the pressure p may be calculated.

The experiments performed this summer on oysters show that the rate of flow is a function of temperature. It reaches its maximum at 25° C. and slows down with the decrease of temperature. Below 7.6° C. no current is produced, though the cilia are still beating. At 5° C. they come to a standstill. There is a considerable individual fluctuation in the rate of flow depending on the physiological conditions of the organism. A healthy adult oyster, three to four inches long, at temperature about 25° C. may take in water at a rate of 3,000 cc per hour. This is a maximum figure frequently observed during the experiments.

By using the "tank" method the discharged water can be easily collected and analyzed. Counting the microplankton in the tank water and in the discharged water I found that more than 99.5 per cent. of diatoms and dinoflagellates are caught by the gills. Water after having passed the gills contains almost nothing but mucus.

Taking in of water depends not only on ciliary motion of the gill epithelium, but also on opening and closing of the shell. To study this phenomenon the oyster is immobilized and one valve is connected to a recording apparatus with daily clock movement. Observations made during August and September, 1925, on more than twenty oysters show that at temperatures from 15° to 22° C. the daily period when the shells remain open averages twenty hours.

PAUL S. GALTSOFF
U. S. BUREAU OF FISHERIES

SPECIAL ARTICLES

DISPLACED SERIES IN THE SPECTRUM OF CHROMIUM[1]

RECENT analyses of the complex spectra of the elements of the first and second long periods have classified hundreds of lines as combinations between numerous groups of terms. In only a few cases, however, have sequences or series of homologous terms been established, which are characterized by different values of the total quantum number. The explanation for this is to be found in the new theory of spectral terms which had its inception in recent work by Russell and Saunders[2] and was later developed into a practical theory by Hund.[3] These new ideas account for the low terms of a spectrum from the various possible ways of adding the azimuthal quantum numbers of the several valence electrons of the atom. The probability of the occurrence of corresponding terms with higher total quantum numbers is much less, with the consequence that the resulting spectrum lines are faint and inconspicuous.

In Fe a sequence of ^5D terms has been indicated by Gieseler and Grotrian,[4] and in Cr and Mo sequences of ^7S and ^5S terms have been used by Kiess[5] and by Catalan[6] for calculating series limits and ionization potentials. It is a striking fact that the

[1] Published by permission of the director of the Bureau of Standards.

[2] H. N. Russell and F. A. Saunders, *Astrophys. Journ.*, *61*, 38, 1925.

[3] F. Hund, *Zs. f. Phys.*, *33*, 345, 1925.

[4] H. Gieseler and W. Grotrian, *Zs. f. Phys.*, *25*, 165, 1924.

[5] C. C. Kiess and H. K. Kiess, SCIENCE, *56*, 666, 1922; C. C. Kiess, *Sci. Papers, Bur. Standards*, *19*, 113, 1923.

[6] M. A. Catalan, *Anal. Soc. Esp. Fis. Quim.*, *21*, 84, 1923.