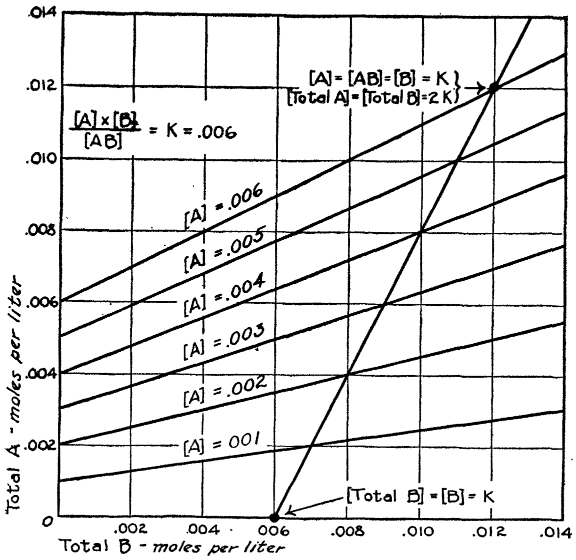

FIG. 1. Cartesian nomogram for law of mass action.

ing all points for [Total A] = n [A], and representing all points at which [B] = (n − 1)K, when n is a number chosen to give a line suitable for the purposes of graphic extrapolation, may be readily located. It follows from Equation 3 that when [A] = [B] = (n − 1)K, [Total A] = [Total B] = (n − 1)K + $(n-1)^2$K. A line is drawn through the points [Total B] = (n − 1)K, [Total A] = 0, and [Total A] = [Total B] = (n − 1)K + $(n-1)^2$K. The desired points for $[A] = \frac{[\text{Total A}]}{n}$ may be located upon it and connected, by straight lines, with the corresponding points for [A] = [Total A], [Total B] = 0.

The method as described is, of course, applicable only to mass-action equations in which all of the components appear in the first power. A similar, but somewhat more complex nomogram, in which all necessary curves are straight lines, has proved of value in the case of mixtures of two substances when two dissociation constants are involved.

FRANKLIN C. MCLEAN

UNIVERSITY OF CHICAGO

SEPARATION OF ONE COMPONENT OF POTATO RUGOSE MOSAIC BY pH DIFFERENCE

KOCH[1] showed that certain treatments inactivated one component of potato rugose mosaic without affecting another component ("mottle") which is probably identical with that called "latent mosaic" by Schultz *et al.*[2] In the writer's experiments juice from rugose mosaic potato plants was applied mechanically to tobacco plants after its adjustment to different pH values by means of dilution with citrate or phosphate buffer solutions. With the pH 3.6 or less, no infection occurred. At a range of 4.0 to 5.5, only the latent mosaic appeared. From 5.6 to 7.6 rugose mosaic resulted and at 9.7 only the latent mosaic was transmitted. It was also found that borate ions exhibited a marked toxic effect on the components, while citrate and phosphate ions showed little difference, if any, in their specific toxicity at concentrations less than 0.1 normal. The toxicity was found to vary with the time of contact between the infectious juice and the buffer solutions.

MONROE E. FREEMAN

COLLEGE OF AGRICULTURE
ORONO, MAINE

A SIMPLE METHOD FOR READING FILM-STRIPS

IN a recent communication in SCIENCE[1] Dr. Seidell called attention to the "Biblio Film Service" maintained by the library of the U. S. Department of Agriculture, Washington, and described a magnifier, to cost in the neighborhood of $10, for reading the film-strip. The writer recently obtained some of these film-strips and discovered that they could be read with ease under the low power of the ordinary binocular dissecting microscope. With such magnification about two thirds of the page may be brought into sharp focus, with the added advantage of being able to use both eyes in reading.

G. ROBERT COATNEY

STATE TEACHERS COLLEGE
PERU, NEBRASKA

SPECIAL CORRESPONDENCE

BIOLOGY OF SHELL-MOVEMENTS OF THE OYSTER

IN recent work by Nelson,[1] Galtsoff,[2] Marshall Webb[3] and Hopkins[4] on recording graphically and continuously the opening and closing movements of oysters during one or more days, interesting observa-

[1] T. C. Nelson, Report N. J. Exp. Sta., U. S. A., for 1920 (1921).

[2] P. S. Galtsoff, *Bull. Bur. Fish.*, U. S. A., Vol. 44, Doc. No. 1035, 1928.

[3] H. Marshall Webb, *Jour. du Conseil*, 5: 3, 1930, Copenhagen.

[4] A. E. Hopkins, *Bull. Bur. Fish.*, U. S. A., 47: 1, 1931.

[1] Karl Lee Koch, *Phytopath.*, 23: 319–342, 1933.

[2] E. S. Schultz, *et al.*, *Phytopath.*, 24: 116–132, 1934.

[1] SCIENCE, February 15, 1935.

tions have been made indirectly on the biological activity of the adductor muscle components. This muscle consists, as is well known, of a large semi-translucent motor striated component and a smaller opaque so-called "catch" muscle. Graphs obtained by Galtsoff of the movements of the American oyster, *O. virginica,* are shown in Fig. 1, A. Somewhat similar figures (see

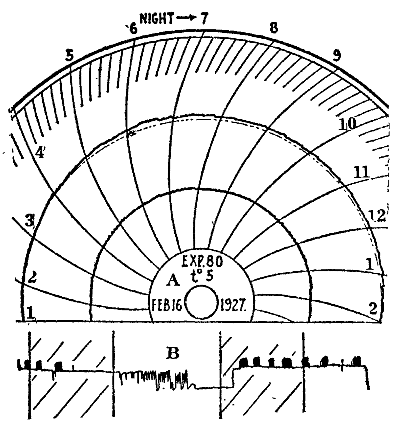

FIG. 1. A. Records by Galtsoff of shell-movements of *O. virginica;* B. Records by Marshall Webb of shell-movements of *O. edulis.*

Fig. 1, B) were obtained by Marshall Webb for the European oyster, *O. edulis.* Complete or almost complete closure is shown at infrequent intervals; this is the common natural movement when the animal closes the shell suddenly to extrude rejected food-material.[5] Nelson obtained his graphs from oysters actually immersed in the sea and interpreted the frequent partial closures as rejection of filtered sediment and inferred therefore that the oysters were feeding actively. Galtsoff obtained his graphs from oysters kept in glass-fronted tanks under temperatures when feeding does not occur and observed that rhythmic partial closure was not accompanied by rejection of unwanted filtrates or excreta. He suggests these partial rhythmical closures may be caused by various stimuli, *e.g.,* mechanical, changes in illumination, changes in pH, gas content, presence of certain chemicals. It seems unlikely, however, that stimuli of this kind can have operated in all the experiments. I have myself observed a quick partial closing which had the effect and no doubt the design of shaking ropes of mucus from the edge of the gill on to the mantle, but this again can hardly explain all the rhythmic partial closures obtained by Galtsoff. A more probable suggestion is that when partial closing does not occur from any other cause, it may be a relief contraction effected by the motor component to reduce fatigue in the catch component of the muscle. If partial closing occurs from whatever stimulus, fatigue is probably automatically relieved. The catch muscle is usually regarded as operating in the closed condition. Its major work is, however, that of maintaining the shell in a variable but fixed open condition, since oysters are open to some extent the greater part of their life. Biologically, therefore, the function of this muscle is mainly that of position fixing. There is the objection to this suggestion regarding fatigue that so far no evidence could be obtained by either Parnas[6] or Bethe[6] of work done by the position-fixing muscle, but it is perhaps more reasonable to doubt the evidence than the work done, for some minimum quantity of energy is required throughout the life of almost all bivalves to hold the shell against the maximum opening pull of the ever-operating hinge ligament, and it is probable that in no bivalve does the shell ever gape so widely in life as in death. Anaerobic respiration occurs in certain bivalves,[7] the European oyster[8] and without doubt also in the American oyster (see 9, Table 3), so that small variations in metabolism are intrinsically difficult to detect; nevertheless, further investigations on this subject by the ingenious experimental methods used especially by American workers may be expected to yield critical information.

J. H. ORTON

THE UNIVERSITY OF LIVERPOOL
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ON THE SITE OF ACTION OF ACETYLCHOLINE AND ITS SIGNIFICANCE

SINCE acetylcholine is closely identified with the cholinergic agent elaborated during autonomic nerve function, its properties assume particular importance and its site of action especial significance. It has been commonly assumed, though never completely demonstrated, that acetylcholine acts directly on the peripheral tissues innervated by parasympathetic nerves.

The current assumption concerning the direct action of acetylcholine has recently been questioned by Armstrong,[1] who has made the interesting observation that when the embryo fundulus heart is aneural its threshold for acetylcholine is higher than physiological limits. Moreover, when functional innervation of the heart does occur, the heart then responds to minute amounts of acetylcholine. From this it was concluded

[5] J. H. Orton, *Jour. Mar. Biol. Assoc.,* 9: 1, 1913, Plymouth.

[6] See Bayliss, "Principles of General Physiology," p. 538, 1927.

[7] J. B. Collip, *Jour. Biol. Chem.,* 49: 2, 297, 1921, and bibliography.

[8] J. H. Orton, *Fishery Investig.,* England, II, Vol. 6, 3, p. 65, 1924.

[9] P. S. Galtsoff and D. V. Whipple, *Bull. Bur. Fish.,* U. S. A., Doc. No. 1094, 1931.

[1] P. B. Armstrong, *Journal of Physiology,* 84: 20, 1935.