or taxonomy. Though it is perhaps somewhat difficult for college freshmen at times, it impresses one as a well-written work by thoughtful, careful and competent zoologists. A new feature of this edition is a chapter on elementary chemistry and its biological applications. In twenty-one chapters the following topics are considered: biology, cells, protoplasm, chemistry, metazoans, mechanical support and movement, materials and energy, internal transport, disposal of wastes, unity and control, reproduction, breeding habits, development, genetics, classification, ecology, geographic distribution, fossils and evolution.

Animal Biology. By ROBERT H. WOLCOTT. xvii + 615 pp. McGraw-Hill Book Company, New York. 1933. $3.50. This book advocates the following principles: "(1) Life has a chemicophysical basis; (2) life phenomena are the outgrowth of organization; (3) the central fact in life is metabolism; (4) animals may be arranged in a progressive series with reference to organization; (5) the most complex animals are most effective and also the most efficient from a metabolic standpoint; (6) man, as the highest of animals, can learn by the study of animal life the principles of the most effective living; (7) he can also understand more fully his place in nature and more justly judge the actions of his fellows; this in turn may contribute to his intellectual and spiritual development; (8) every problem concerned with living is essentially a biological problem and capable of analysis and solution by the application of biological principles." The text is intended for the use of college students. Its writer was a teacher of long experience who has thoughtfully presented the general facts and principles of biology. The book contains fifty-five chapters grouped into five parts: (1) Fundamental Principles, (2) Protozoa, (3) Metazoa in General, (4) Metazoan Phyla and (5) General Considerations. It is well illustrated, a few of the figures being original. At the end is an excellent glossary, which not only defines scientific terms but also gives brief statements concerning authors mentioned in the text.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TIMING DEVICE FOR TAKING MOTION PICTURES[1]

THE study of any morphological state attains its full value only when a record is taken of the stages which precede and which follow it. An apparatus was built to operate a motion picture camera automatically so that single exposures are taken in adjustable intervals from one second to ten minutes. When a film so exposed is projected with the normal speed of 16 frames per second the recorded process will be accelerated in a corresponding ratio.

In the recent literature several automatic devices were described, most of which are too elaborate, filling the space of a laboratory room, and being correspondingly expensive, while others show in their construction signs of amateurish work. Therefore, it became necessary to design a simple apparatus which is within the financial scope of any laboratory and yet is constructed precisely and sturdily to withstand long wear. This apparatus was built to operate the camera in exactly equal intervals, adjustable to any interval required, over long periods of time, and synchronously to put into action a source of light for each individual exposure; for it is obvious that the living object would suffer unnecessarily from the powerful light if it were not excluded during the long intervals between two exposures.

[1] The construction of this apparatus was made possible by a grant from the Committee on Scientific Research, American Medical Association, to whom the senior author expresses his obligations.

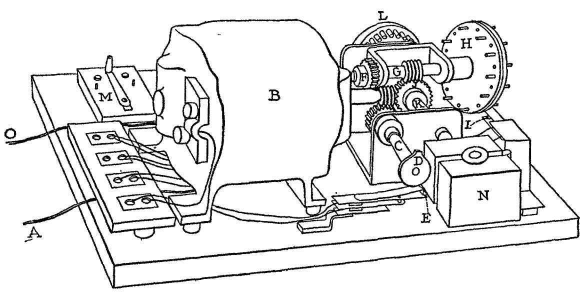

FIG. 1. The timing apparatus; *A*, power line; *B*, synchronous motor; *C*, first shaft; *D*, cam, operating *E*, the contact for the tripping magnet; *F*, worm and gear, connecting first shaft with second shaft (worm mounted on first shaft not represented in drawing); *G*, second shaft with peg disc *H*, (for intervals 1–20 seconds), operating contact *I*; *J*, worm and gear connecting second shaft with third shaft *K*; *L*, peg disk for intervals from 20–600 seconds; *M*, switch, short circuiting preparatory contact when operating in intervals below 20 seconds; *N*, condensors; *O*, three wire cable to plug board.

The equipment consists of a motor-driven impulse transmitter (timing apparatus), shown in Fig. 1, and B, B[1], in Fig. 2, and a tripping magnet (G, in Fig. 2) which by means of an adaptor ring is mounted on the motion picture camera. The timing apparatus transmits in regular intervals two current impulses. One operates the tripping magnet which—if energized—presses the release button of the camera for *one* picture. The other impulse lights the lamp (Fig. 2, K) for illuminating the object during the exposure.

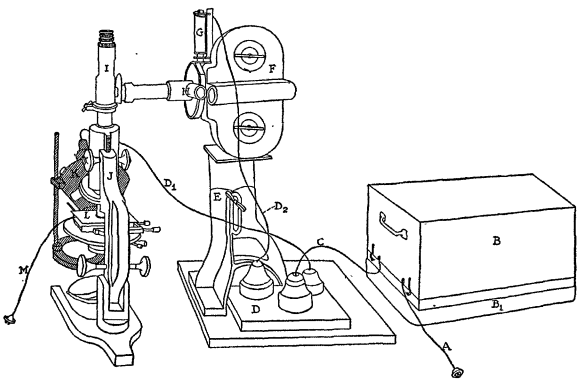

FIG. 2. General arrangement of the apparatus. *A*, power line; *B*, transmitter or timing apparatus; B_1, rubber mat; *C*, connecting line to the plug board; *D*, plug board; D_1, cable to microscope illuminator; D_2, cable to tripping magnet; *E*, base of the camera support; *F*, motion picture camera; *G*, tripping magnet; *H*, lateral, prismatic view finder (Goerz); *I*, "microphot" (Zeiss), bending the light by 90° from the vertical direction of the microscope horizontally into the camera; *J*, microscope; *K*, microscope illuminator; *L*, heating chamber; *M*, cord for heat chamber.

Since the incandescent lamp requires some time (from 1/20 to 1/5 sec.) to come up to brilliancy, the lamp must be lit a definite and constant time ahead of the tripping impulse. The transmitter is driven by a motor (Fig. 1, B) of constant speed. It has three shafts connected in sequence by gears in order to produce a stepping down of the number of revolutions per minute. On the first shaft (Fig. 1, C, highest speed) a cam (Fig. 1, D) is mounted which operates the contact (Fig. 1, E) for the tripping magnet. The second and third shafts (Fig. 1, G and K) bear a disk with a large number of equally spaced holes (Fig. 1, H and L). In these holes pegs are inserted which operate the contact in the lamp circuit. These pegs can be displaced by hand so that the contact can not be pressed when the disk is in rotation. Thus, the intervals between the impulses can be varied from 1 to 20 seconds (*i.e.*, 1, 2, 4, 5, 10, 20 seconds) depending on the number of pegs which press the contact during one revolution (Fig. 1, H). The length of one impulse is adjusted permanently in the machine (to approx. 0.6 sec.) by the location of the point of contact. For intervals longer than 20 seconds the second disk and contact (Fig. 1, L)—called the preparatory contact—is provided. This contact is in series with the lamp contact. While taking pictures in intervals shorter than 20 seconds, the preparatory contact is short-circuited by a switch (Fig. 1, M). If this switch is opened, the lamp contact can only close the lamp circuit when the preparatory contact is closed. In this way the intervals can be changed in steps from 20 to 600 seconds (*i.e.*, 20, 40, 60, 100, 200, 400, 600 seconds) by merely reducing the number of pegs in the second disk.

The different ratios of acceleration during *projection*, resulting from the different ratios of retarded *taking* of the pictures are computed in Table 1. It

TABLE 1

Interval between two pictures	Ratio of acceleration when projected with the physiologically adequate speed of 16 frames per second	A process of 12 hours duration is projected in:	Number of pictures in one hour
1 sec.	1: 16	45 min.	3600
2 sec.	1: 32	22 min. 30 sec.	1800
4 sec.	1: 64	11 min. 15 sec.	900
5 sec.	1: 80	9 min.	720
10 sec.	1: 160	4 min. 30 sec.	360
20 sec.	1: 320	2 min. 15 sec.	180
40 sec.	1: 640	1 min. 7, 5 sec.	90
1 min.	1: 960	45 sec.	60
1 min. 40 sec.	1: 1600	27 sec.	36
2 min.	1: 1920	22, 5 sec.	30
3 min. 20 sec.	1: 3200	13, 5 sec.	18
10 min.	1: 9600	4, 5 sec.	6

also contains the projection time of an actual event taking normally 12 hours and recorded with different ratios of acceleration.

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NOTE ON KEEPING LIVE FROGS FOR EXPERIMENTAL PURPOSES

SINCE the common experience of having frogs die in tanks, particularly in warm weather, is very disconcerting, it was thought worth while to insert in SCIENCE a note on our experience in storing these animals in a little electric refrigerator.

We have been able to keep a gross of frogs, in a hardware cloth box which fits in the bottom of our T. V. A. refrigerator, for a month with only three or four fatalities. They are dormant in the box (10° C.), giving only an occasional muffled croak as the machinery starts. When warmed, however, to room temperature, they become normally active with startling suddenness. Certain shipments, badly infected with "red leg," lasted surprisingly well in the refrigerator.

The only care we have given the animals has been to pick them over every day and to wet them with tap water.

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