chronous motors can not be used, feel a very acute need for an inexpensive, transportable time clock to activate more than one time signal. A device fulfilling these specifications has been in use in this laboratory for the past year and has been found reliable and accurate. The apparatus has a further advantage in that it is inexpensive, costing, exclusive of the mechanic's time, less than $15.00.

It is essentially a rotating switch driven by means of a direct current electric phonograph motor. These direct current motors may be obtained regulated by a governor to run at a normal speed of 78 revolutions per minute. This speed, however, may be increased or decreased by as much as twenty revolutions per minute in either direction. Hence it is possible to regulate the motor to obtain one revolution per second. For our ordinary laboratory work we use two models and find them adequate for most physiological class work. The first, so regulated as to produce one revolution per second, drives a rotating spring contact directly. The second has the shaft speed reduced by means of a worm and gear to one revolution per minute. In both cases the rotor makes a contact every 90°. Thus, in the direct drive, signals are given at 1, 0.5 and 0.25 second. The second model gives signals at one minute or 30 seconds or 15 seconds. It is used primarily for either slow muscular contractions, *i.e.*, uterine, or for respiratory or metabolic determinations. The details of the rotating switch and its electrical connections are given in Fig. 1.

The rotor is fastened directly to the shaft, which is also grounded to the battery. The circuit is closed when the rotor strikes one of the four induction switch

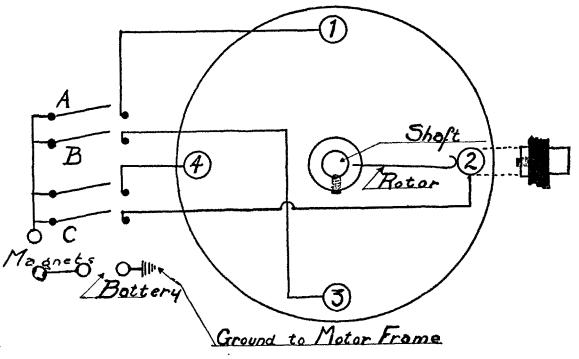

FIG. 1

points (1–2–3–4). These points are inserted 90° apart in a vulcanite disk.

Thus, closing switch A or B, one contact per revolution is made, closing the double pole switch (C) gives two equidistant contacts, closing all switches causes four contacts or a minimum time interval. It has been found advisable when a heavy electrical load is placed upon the contacts to use a two microfarad condenser in order to reduce the spark and so preserve the smoothness of the contacts. The entire unit is most compact. Even with the relatively large reducing gear it may be enclosed in a small box and easily transported from laboratory to laboratory. Since the motor is very quiet we have found it advisable to connect a small lamp in the motor circuit as an indicator to prevent battery wastage.

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SPECIAL ARTICLES

MUTATION RATE FROM OLD DATURA SEEDS

THE cytological aberrations in root-tips of *Crepis* plants from aged seeds, found by Navashin,[1] seemed to point to an influence on mutation rate by conditions that might be obtained in nature. Last year we reported high rates of pollen abortion mutations from seeds of *Datura stramonium* that were aged by storing up to ten years in the laboratory.[2] The same material has since shown that aging seeds induces also a high rate of visible recessive mutations.[3] Later, through the cooperation of H. B. Derr, county agent at Fairfax, Va., we obtained seeds that, apparently, had been buried for 22 years in the soil beneath a house.

These seeds, so far as we are aware, are the only material of the kind which has been subjected to genetic study. In view of the suggestions from earlier work that mutations induced by aging seeds may play a rôle in evolution in nature, it seems desirable to give the evidence upon which we base our belief that these seeds had remained undisturbed for at least 22 years. The house under which the seeds were found was built about 1909, and was bought by Mr. Derr in 1911. The kitchen was added in 1912. In 1924 a cellar was dug beneath part of the house in order to install a furnace. The excavated soil, piled outside, yielded a large crop of vigorous jimson weeds. Ten years later, in the spring of 1934, Mr. Derr took some soil from under the house and again obtained a number of jimson weeds. In June, 1934, one of us visited Mr. Derr's

[1] M. Navashin, *Nature*, 131: 436, 1933.

[2] J. L. Cartledge and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 20: 103–110, 1934.

[3] A. F. Blakeslee and A. G. Avery, Abstract, *Amer. Nat.*, 68: 166, 1934.

house and with him dug out four bags of soil at a depth of about two to eight inches from unexcavated parts of the cellar. From these soil samples more than 500 Datura plants, together with 168 plants of other genera, chiefly *Acalypha* and *Chenopodium*, were grown at Cold Spring Harbor. There seems to have been no possibility of seeds being carried into this location after the building of the house and its kitchen. The foundation walls (brick for the house and concrete for the kitchen) extend below the ground surface and also about two feet above this level to the floor of the house. A small, externally shielded ventilator was well above the ground line; the outside cellar door was covered, and the closed windows were under the porch. The soil was a hard, dry clay.

Controls were grown from seed of wild plants on Mr. Derr's farm, harvested in 1933, and from the standard inbred Line 1 which furnished test and control seed for our aged seed experiments. Because of a change in the sampling method a higher proportion of the pollen abortion mutations that actually occurred may have been found in the 1934 experiments than was found in 1933. In 1934 a flower from each of the two main forks of each plant was examined, while in the 1933 season the two flowers were taken at random and were, no doubt, in many cases from the same main branch. Since most of the mutations involve sectors of half or less than half of a plant, more may be expected to be found by the method of sampling both main forks. The results from these 22-year-old seeds and their controls are shown in Table I.

TABLE I

POLLEN ABORTION MUTATIONS (TWO-FLOWER SAMPLES)

From seeds—	Plants	Mutations	Percentage
RECORDS OF 1934			
Buried 22 years	427	8	1.8
1-year-old, control	47	0	0.0
1-year-old, Line 1 control	261	3	1.1
RECORDS OF 1933			
Aged 5 to 10 years in lab. (Line 1)	405	32	7.9
1-year-old, Line 1 control	331	2	0.6

One of the eight mutations found seemed to involve the whole plant; the others occurred in sectors of the plants. Five had the appearance of chromosomal mutations and three of the gene mutation type.

Heat treatment of barley[4] and *Crepis*[5] seeds is reported to have given effects like those of aging seeds. Line 1 plants from seeds that were treated at the Boyce Thompson Institute, through the cooperation of Dr. Wm. Crocker and Miss L. V. Barton, are now being grown for mutation rate studies. Preliminary tests have shown that mutations may be induced in *Datura* seeds by heat treatment and that the moisture content of the seeds subjected to heat is of great importance in this connection.

Plants from the buried seeds under discussion are not strictly comparable with our standard Line 1 used as a control, although there is no evidence that the two races would be expected to differ in mutability. The rate of pollen abortion mutations found in the 22-year-old seed plants is scarcely higher than that in the controls, and is much lower than that found in 1933 for seeds aged five to ten years in the laboratory. Taken as they stand, these results indicate that seeds buried in the soil under these more or less natural conditions were unaffected by whatever influences there may be to induce mutations, and that age alone does not greatly, if at all, increase the mutation rate.

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[4] F. Peto, *Can. Jour. Res.*, 29: 349–362, 1933.
[5] M. Navashin and P. Shkvarnikov, *Nature*, 132: 482, 1933.

THE RELATION OF WATER AND ELECTROLYTES TO METABOLISM

A CONSIDERATION of the views held regarding the regulation of water by the living organism reveals an interesting fact. Most workers in this field have stressed the physico-chemical aspects of the problem and have adopted what is essentially a non-vitalistic concept of water balance. Thus Fischer[1] regarded acidosis as being the primary factor in water retention. Schade[2] has emphasized alkalosis. Gamble[3] and his co-workers considered that the total amount of water was determined by the total electrolytes present in the organisms. Starling[4] pointed out the importance of the colloid osmotic pressure of the blood. Davis and Dragstedt[5] have shown how acidosis diminished the ability of the body to retain water. All this evidence points to a mechanistic concept of water regulation. In order to examine further the truth of this purely physico-chemical explanation of

[6] Aided by a research grant from the Penrose Fund of the American Philosophical Society.
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[4] E. H. Starling, "Fluids of the Body," pp. 186, 1909.
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