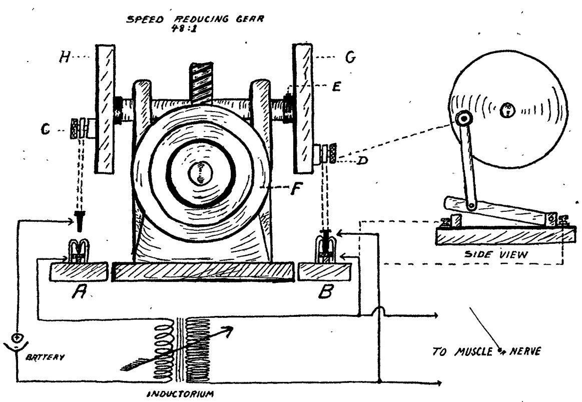
fatigue. In attempting this procedure by hand it was soon realized that the successful performance of the experiment necessitated considerable patience on the part of the operator, and such a degree of coordination of the hands, that not infrequently the investigator displayed signs of both muscular and nervous fatigue, while the isolated muscle was at its peak of activity. The desirability of some mechanical device for assisting in this phase of our experiment became apparent. A suitable apparatus for stimulating muscle and nerve preparations in the manner stated has been constructed from a speed-reducing gear, two single knife switches and an electric motor. Since the performance of this apparatus has been most satisfactory, both in the amount of time saved, and in its uniformity of action, its construction is presented here for any possible service it might render other investigators.

An essential part of the apparatus is a reducing gear with a speed ratio of 48:1. This is readily obtained from dealers in physical equipment at a nominal cost. An electric motor of fairly constant speed, usually 1750 r.p.m., is also required. The induction type A. C. motor is preferable. By the use of suitable pulleys the rotation speed of discs G and H (Diagram 1) is regulated to one revolution



per second. A and B are two single pole, single throw, knife switches, and are connected by metal strips of brass to eccentrically placed bearing surfaces C and D. The lengths of these bars are so adjusted, that when C and D are at their point of nearest approximation to switches A and B, the latter are fully closed. It is essential that one of these switches be completely insulated from the main body of the reducing gear. This is easily accomplished by means of a bushing of fiber or hard rubber contained in the disc at C or D, through which the brass bearing is inserted.

The knife switch A is connected in series with a battery, and the primary of an inductorium, in such a manner as to exclude the action of the vibrating interrupter. In other words, the primary is connected to produce single shocks. Switch B is a short-circuiting device, and is shunted across the secondary of the inductorium. The time relation of the opening and closing of switches A and B is regulated by the set screw E, which permits independent adjustment of the disc G with respect to H. For example, in stimulating by break induction shocks, set screw E is loosened, and by rotating disc G slightly forward, the position of D is advanced. The result is that B is opened, and is followed by the opening of A, and the production of a break induction shock.

This apparatus may be adapted to select the type of stimulus when employing either galvanic or faradic current, and leaves the operator's hands free to vary the intensity of stimulation.

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CRYSTALLIZATION OF CERTAIN SALTS USED FOR THE DISINTEGRATION OF SHALES

ONE of the most difficult problems confronting everybody working on microfaunas is the breaking of shales containing microfossils and cleaning the latter of matrix. In several cases the writer used to get very satisfactory results soaking shales in hot saturated solution of sodium hyposulphite ("hypo," the common fixing salt of photographic practice). Since hypo is several times less soluble in cold water than in hot, crystallization begins at once as soon as the solution has been sufficiently cooled, accompanied by disintegration of shale. When disintegration was found incomplete, it was only necessary to warm the specimen, bring into solution hypo which had crystallized from cold water, and cool it again. The process can be repeated as many times as would be necessary to achieve the complete disintegration of shale or to realize that this particular shale could not be broken in this way. It was possible to attain complete and rather quick disintegration of a shale which had resisted boiling, even with alkalies. To a certain extent this process may be compared with freezing and thawing, used successfully by micropaleontologists in similar cases.[1] The whole operation can be carried on conveniently in the s. c. Kjeldahl flask of pyrex glass with long neck and round bottom. As has been shown by experience, they stand well without cracking repeated, and even quick, warming and cooling.

1 G. D. Hanna and C. C. Church, "Freezing and Thawing to Disintegrate Shales," *Jour. of Paleontology*, ii, p. 131, 1928.

It happens often that the cold hypo solution, even highly oversaturated, does not crystallize. In this case a small grain of hypo dropped into solution produces an immediate effect—recrystallization of salt.

Certainly any other salt, differently soluble in cold and hot water, may be used for this purpose with the same result as hypo. F. e. sodium sulfate or washing soda are very good. In the case of washing soda the same solution may be used at first for boiling shale within and then, when boiling alone would be found insufficient, for crystallization through cooling.

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SPECIAL ARTICLES

TOPOGRAPHIC SIMILARITIES BETWEEN MATERIALS REVEALED BY ULTRA-VIOLET LIGHT PHOTOMICROGRAPHY OF LIVING CELLS AND BY MICRO-INCINERATION[1]

LUCAS,[2] Wyckoff and Ter Louw,[3] Lucas and Stark,[4] and Wyckoff, Ebeling and Ter Louw[5] have recently published excellent ultra-violet photomicrographs of various living tissues. While examining these photographs, especially those of Wyckoff, Ebeling and Ter Louw, it occurred to me that there was a striking similarity between the shadow casting material (that which absorbed ultra-violet light of wave-length 2750 Å) and the mineral ash deposits in micro-incinerated cells of similar types. The idea is not altogether a new one, as Policard[6] had already pointed out that the calcium content of the nucleus might furnish an explanation of its capacity for absorbing ultra-violet rays as previously noted by Köhler.[7] The following observations were made in an attempt to ascertain the precise degree of similarity which exists. The method of microincineration employed was essentially that of Policard[8, 9] with some later modifications and improvements in methods of observation introduced by Scott[10, 11] and by Scott and Horning.[12]

(1) BACILLUS SUBTILIS

The ultra-violet photomicrographs of *B. subtilis* published by Wyckoff and Ter Louw serve as an excellent starting point, since the morphology of this organism is relatively simple. They show that the ultra-violet rays of wave-length 2750 Å are intensely absorbed by spores (Figs. 2, 4, 5 and 6). The authors indicate that the spores do not arise from a gradual merging together of preexisting cell bodies having similar physical properties. Indeed, at their first appearance they have already acquired their ultimate size and shape. Furthermore, the cytoplasm of spore-bearing cells is said to be of the same degree of opacity as the younger forms.

Smears of spore-bearing cultures of *B. subtilis* were dried in air and some colored with Giemsa's stain, while others were incinerated. The spore was found to be the locus of greatest mineral deposit. The residual ash was whitish grey tinged in places with a definite brownish red indicative of the presence of iron oxide. The mass of mineral was not doubly refractive when viewed with polarized light, hence, it was probably devoid of silica. The remainder of the cell was almost free of inorganic salts, with exception of its limiting membrane, which in most instances could be made out rather clearly. There were no definite concentrations of ash in the cytoplasm but only faint, finely divided deposits about the spore. Microchemical tests demonstrated that calcium was present in the ash.

From these findings it is apparent that the material which shows the greatest ultra-violet light absorption is exactly comparable to the mineral ash deposits in incinerated *B. subtilis*. Furthermore, a heavy deposition of salt in the spore lends weight to the frequently expressed opinion that spore formation is a concentration of cellular substance accompanying dehydration.

(2) RESTING NUCLEI OF TUMOR CELLS

Lucas gives photographs of cells of a mouse tumor which had previously been fixed and cut but not stained. In this particular instance the comparison of ultra-violet photographic results and those obtained by incineration is more exact, as tissues must of necessity be fixed in the course of preparation for the latter kind of study. In Lucas' Fig. 7 a number of "optical

[1] Aided by an appropriation from a grant made by the Rockefeller Foundation to Washington University for research in science.
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[3] R. Wyckoff and A. Ter Louw, *J. Exp. Med.*, 54: 449, 1931.
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[9] A. Policard, *Protoplasma*, 7: 464, 1929.
[10] Gordon H. Scott, *Compt rend. Acad. Sci.*, 190: 1,323, 1930.
[11] Gordon H. Scott, *Proc. Soc. Exp. Biol. and Med.*, 29: 349, 1932.
[12] Gordon H. Scott and E. S. Horning, *J. Morph.*, 53: 1932, in press.