B. kandiensis + *B. typhosus* is not sufficient to come to the conclusion that we are dealing with erythrite, but if other characteristics of erythrite are present, it may help in the identification.

The formula:

$$\begin{cases} B.\ kandiensis + B.\ morgani \ldots\ldots G \\ B.\ typhosus + B.\ morgani \ldots\ldots 0 \end{cases}$$

may indicate several other carbon compounds apart from erythrite, principally adonitol, isodulcitol, inositol. To exclude adonitol the symbiosis *B. coli* + *B. morgani* may be used; if gas is not produced it is not adonitol; to exclude isodulcitol and inositol the simple fermentation with *B. paratyphosus* B may be used; if there is no production of gas the substance is neither inositol nor isodulcitol.

This is a preliminary report.

[1] Castellani, A., and Taylor, F. E., *J. Am. Med. Assn.*, 1926, lxxxvi, 523-527. Castellani, A., *J. of Trop. Med.*, 1926, lxxx, 217-226; *J. Am. Med. Assn.*, 1926, lxxxvii, 15-22; PROC. SOC. EXP. BIOL. AND MED., 1926, xxiii, 481; *Brit. Med. J.*, 1925, ii, 734; (1904) Meetings Ceylon Branch B. M. A. (yeast).

Fiallos, J. M., *J. Trop. Med.*, 1925, xxviii, 426-428.

[2] Shütze, H.—Communication by letter.

[3] Harde, H.—Communication by letter.

3440

The use of Ionized Gas Electric Lamps as Recorders in Measuring the Velocity of the Pulse Wave.*

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Bramwell[1] and his co-workers have devised an accurate method for measuring the velocity of the pulse wave, and have made valuable studies of the factors influencing it. They have shown that the two principal factors causing increased velocity are inelasticity of the arterial walls and a high diastolic blood pressure. That is, there is an organic and a functional cause for increased velocity. The greatest need for such a method is to differentiate between the two. It seems that this might be done by observing the effect on pulse wave velocity of reduction of diastolic pressure by means of drugs. No such study has been made, due to frequent accidents with the

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fragile instrument used. An instrument is needed which is rugged enough to be quite dependable and yet sensitive to the highest degree.

While working in the laboratory of Dr. E. P. Carter in 1924, I devised a method, as yet unpublished, for recording arterial and venous pulsations in which the string galvanometer was used as the recording instrument. A specially designed microphone, similar to that used in telephone transmitters, was placed directly over the artery so that the pulse wave caused increased pressure on the carbon granules and thus increased the current that might pass through. Fluctuations in the current caused by the pulse were recorded by photographing the oscillations of the galvanometer string, giving an accurate picture of the pulse wave. By the use of two galvanometers focused on the same strip of film, or a galvanometer with two strings, and with two microphones placed over arteries at different and measured distances from their bifurcation, it is possible to measure accurately the velocity of the pulse. Or, by using one galvanometer for recording the electrocardiogram and the other for recording the peripheral pulsation, and by measuring from the Q-R-S complex to the up-stroke of the pulse wave, the time elapsing from the contraction of the heart muscle until the pulse reaches the microphone is determined. By the use of the two-meter roentgenogram of the heart and aorta, it is possible to measure the length of the arteries traversed in the measured interval of time, and thus determine the velocity of the pulse. However, this method requires expensive galvanometers and unless great care is used too much current may be sent through the string, causing it to either break or become non-conducting.

With the development by engineers of the General Electric Company at their Edison Lamp Works, of electric lamps capable of becoming lighted and dark again within so short a period of time as one one-millionth of a second, a new recording instrument was made available to the cardiologist. Through the kindness of Dr. L. C. Porter, of General Electric, I have had the opportunity of using this type of lamp as a marker in measuring the velocity of the pulse. These lamps depend for their source of light upon the ionization by electric potential of such a gas as neon or helium, and not upon the heating of a filament. As compared with the string galvanometer, these lamps are recorders of great ruggedness and yet quicker in response. Below a voltage of 130 the lamp is entirely dark, but if the voltage is increased it becomes lighted. A current of low voltage is passed through the microphone which is placed directly over the artery. Each pulse wave causes a corresponding pulsation in the

electric current. By the use of vacuum tubes this pulsating current is so amplified that each pulsation causes a flash of a light. These flashes are recorded on the moving photographic film simultaneously with the electric cardiogram. It is not difficult to use two microphones and two lamps and record their flashes along with the electrocardiogram on the ordinary 6 cm. photographic ribbon. By the aid of the usual time marker, it is easy to determine the time interval between the contraction of the ventricle and the arrival of the pulse wave at either microphone.

It is believed that this instrument will make it possible to study accurately a large number of cases under varying conditions. It seems most likely that these lamps will be found useful as recorders in many types of cardiovascular instruments other than that just described.

A complete description of the apparatus and method, with evidence as to its limitations and possible usefulness, will be published shortly. This is a preliminary report.

[1] Bramwell, J. C., *Quarterly J. of Med.*, 1924, xvii, 225.

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Studies on Immunity to Measles.

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In 1925, Tunnicliff,[1] working with the diplococcus she had isolated from cases of measles, found that almost invariably a skin reaction was produced in persons who had not had measles, whereas in individuals who had had the disease, 96 per cent gave no reaction. Her antigen was a culture of organisms grown anaerobically in 1 per cent dextrose broth to which was added ascitic fluid, killed with 0.5 per cent phenol. Ferry and Fisher,[2] with an organism probably the same as Tunnicliff's, tested 35 individuals with negative measles history, and found 14 gave positive skin reactions. Thirty children who had had measles gave a negative reaction.

In the present studies, the 24-hour bouillon culture filtrate for organisms isolated by blood culture and prepared by Duval was used. Two-tenths of a cubic centimeter of a dilution of 1 to 10 was injected intracutaneously with the following results. In a home for