tures (1 specimen), 84 were cultures of sewage (6 specimens), and 22 were uninoculated blanks.

Regulation methods were used for the inoculation of a tryptone culture medium. Cultures were withdrawn from incubation in the first experiments at the end of 1, 2, 3, 4, 5, 6 and 24 hours and were tested for indole. Later experiments on cultures were performed after incubation at 37° C. after 2, 3, 4 and 24 hours.

Results: The inoculated specimens of *E. coli* yielded positive results in 7 out of 8 cases at the end of 3 and 4 hours incubation and in the 8th at the end of 24 hours incubation. However, 2 specimens were negative throughout. Four out of 8 were positive for indole at the end of 2 hours incubation. Mastafa[11] noted that a medium made by peptic digestion of entire hogs' stomachs could be used for the detection of indole at the end of 2 hours incubation. The Sonné, salmonella and aerogenes specimens were negative for indole production as expected. Except for trace results, the experiments with raw sewage, and treated sewage, obtained from a large city sewage treatment works, diluted 1:10, 1:100, 1:1000, 1:10,000, and 1:100,000 and undiluted, were negative or at best yielded a trace result for indole, at the end of 5 hours incubation, with the exception of two undiluted raw sewage specimens which yielded positives at the end of 5 hours incubation. However, every dilution of raw sewage yielded a strong positive at the end of 24 hours. Partially treated sewage yielded positives in dilutions up to 1:100 and settled sewage only when undiluted.

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SUMMARY

A simple and sensitive method for the detection of indole in cultures, urine, sewage, etc., is presented. The indole is extracted with chloroform and is then treated with a modified Ehrlich reagent. The possibility of use for the detection of water pollution is indicated.

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AN INSTRUMENT FOR THE RAPID MIXING OF FLUIDS IN SMALL TUBES[1,2]

IN the preparation of serial dilutions for purposes such as the titration of viruses and immune sera, the material in question is transferred to a tube containing diluent. Mixing is usually then effected by drawing the fluid to and fro in a pipette several times before transfer is made to another tube for the next dilution. When many dilutions are to be made, this process of mixing is not only time-consuming but physically wearing. In the contemplation of a large series of studies[3,4] on the titration of serum antibodies inhibiting the hemagglutinative action of the influenza virus,[5] a simple means was found for obviating much of the tedium and loss of time. This consists in the use of an electric massage vibrator[6] of the type shown in Fig. 1, which is a drawing taken from a photograph. The motor mechanism is mounted inside a closed metal chassis from which there projects a short rod. The rod is the vibrating part, and for it there are provided several rubber attachments. The best of these for the purpose is the bell-shaped one, illustrated in Fig. 1. The instrument is fixed to the table with an iron clamp, set going and the tube containing the materials to be mixed is held against the edge of the bell. As shown in Fig. 1, the mixing action is highly effective. Some trial is necessary, however, for finding the best point and the proper angle for application of the tube.

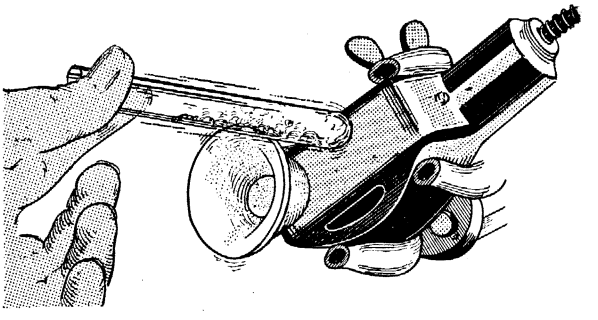

FIG. 1. A drawing of the vibrator and the mixing of fluid in the tube based on the tracing of a photograph.

Repeated tests have shown that mixing as good as that with a pipette can be obtained by holding the tube against the machine with the left hand during the period in which the right hand is selecting the

[11] Mastafa, *Compt. rend. soc. biol.*, 124: 450, 1937.

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[2] This work was aided by the Commission on Influenza and the Commission on Epidemiological Survey, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, United States Army. The work was aided also in part by a grant to Duke University from Lederle Laboratories, Inc., Pearl River, N. Y.

[3] I. W. McLean, Jr., D. Beard, A. R. Taylor, D. G. Sharp and J. W. Beard, *Jour. Immunol.*, in press.

[4] *Idem.* In preparation.

[5] G. K. Hirst, *Jour. Exp. Med.*, 75: 49–64, 1942.

[6] Allover A.C. Vibrator, Allover Mfg. Co., Racine, Wis.

new pipette for the next transfer. In a routine experiment a single operator prepared 823 individual dilutions in a total elapsed time of 114 minutes, an average of 7.2 per minute.

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A NEW COLORIMETRIC REAGENT FOR TITANIUM

IN a report on their investigation of disodium-1,2-dihydroxybenzene-3,5-disulfonate $[C_6H_2(OH)_2(SO_3Na)_2 \cdot H_2O]$ as a reagent for the colorimetric determination of iron, Yoe and Jones[1] observed that it gives an intense yellow solution with Ti^{+4}. Their preliminary observation indicated the sensitivity to be about 1 part of titanium in 200 million parts of solution when comparisons are made in 50 ml, tall-form Nessler cylinders. This observation has been substantiated.

The color intensity of the titanium complex is independent of acidity over the range pH 4.3–10, the color does not change in intensity or tint over periods of several months, and it obeys Beer's law over the useful range of concentration.

The number of interfering ions is small. Aluminum, calcium and tungsten reduce the intensity of the color; this can be largely overcome by adding an excess of reagent. Iron, vanadium and uranium develop colors with the reagent, but only the first is commonly encountered. The purest available reagents used for opening up samples contain sufficient iron to give an off-tint color to the titanium complex. The iron interference may be eliminated by buffering the solution at pH 4.7 with acetic acid and sodium acetate in a 1:1 molar ratio and adding 50 mg of sodium hydrosulfite per 100 ml of solution. Under these conditions the iron is reduced to the ferrous state and gives no color with the reagent, and hydrosulfite solutions show no turbidity for 20 minutes.

If titanium and iron are both to be determined, this may be done with the same solution. Add the reagent (about 0.1 g), adjust to pH 4.7, measure the absorbency (-log of transmittency) at 560 mμ (the maximum for the iron complex at pH 4.7), then reduce with sodium hydrosulfite and measure the absorbency at 410 mμ. The amount of iron and titanium may be determined from previously prepared graphs.

A more extensive report on the use of this reagent for the colorimetric determination of titanium will be published elsewhere in the near future.

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DISCUSSION

THE PHYSICAL CHEMISTRY OF COLOR VISION

THE manifold and long-continued research work of Selig Hecht and his collaborators on the nature of vision and visual response to light has culminated or converged, in one aspect, that of color vision, in a rather radical transformation of the trichromatic theory initiated by Thomas Young, developed by Clerk-Maxwell and Helmholtz, disputed by Hering and exploited practically in various processes of color photography. This transformation is proposed by Dr. Hecht most concisely, for present reference, in his paper on "The Development of Thomas Young's Theory of Color Vision" and very important confirmatory and extensory investigations are given in a more recent paper by J. Mandelbaum and E. U. Mintz.[1]

The basic nature of the transformation is evident on comparing the accepted trichromatic "excitation" (or sensitivity) curves of Koenig, Abney, Wright and others[2] and those introduced by Hecht. These, instead of differing widely throughout the spectrum, are close together, and have maxima in the yellow-green part of the spectrum near the region of maximal photopic visibility; the shape of the curves varies but little one from another, and from the photopic-visibility curve.

As pointed out by Mandelbaum and Mintz, "The virtue of Hecht's formulation is that for the first time much of the data relevant to color vision is included."

Hecht has stated the difficulties of the physico-technical theory[3] for the physiological (and chemico-physical) picture as follows: referring to the accepted values of the excitation curves adopted by the American Optical Society and the visibility curve (of Gibson and Tyndall) he says: "These are all unimpeachable facts. But they make it extremely difficult to formulate a physiological picture of what they mean, especially in the matter of treating the excitation curves or the *Grundempfindungen* as the real physiological primaries which must accomplish what Thomas Young's notion expects them to." In face of the difficulties, Hecht has proposed, as he himself, I think too modestly, has said, a set of "Variations on a Theme by Thomas Young." It is, incidentally, a part of the intention of this note to suggest that there has been so radical a transformation of the theme as to

[1] *Ind. Eng. Chem., Anal. Ed.*, 16: 111, 1944.
[1] *Am. Jour. Ophthal.*, 24: 1241, 1941.
[2] *Jour. Ophthal. Soc. America*, 20: 231, 1931.
[3] Thus to designate the current theory.