flammatory cellular infiltration about foci of typhoid bacilli as seen in sections of tissue obtained postmortem. The postulation of a positive, selective leukocidal action of a soluble toxin *in vivo* is more compatible with the pathology of typhoid fever than is the accepted conception of a negative chemotactic or repellent influence of typhoid bacilli upon granulocytes.

9117

An Improved Optical System for Cathode-Ray Recording.

J. A. GANS. (Introduced by C. J. Wiggers.)

From the Department of Physiology, Western Reserve University Medical School, Cleveland, Ohio.

Recent years have brought the cathode-ray tube into considerable prominence as an instrument for registering and recording electrophysiological phenomena. With the recent advances in high-mu amplifier tubes, the most infinitesimal biological currents come within the scope of cathode-ray study. This has created a need for a reliable and highly efficient optical system for recording on photographic paper. A number of expedients have already been suggested and used, among them those of Gasser and Erlanger,[1] Rijlant,[2] and McCulloch and Wendt.[3]

The methods fall into 2 main divisions: (1) still photography or contact prints of single waves or periodically recurrent phenomena, obtained by photographing a standing wave or the persistent after-image of a single excursion with a still camera, or by holding photosensitive paper in direct contact with the tube screen while the fluorescent dot executes a single excursion across the screen; and (2) photography on paper moving in one axis, of excursions of the dot in a perpendicular axis, this being the method of necessity in the study of continually changing wave forms.

For quite some time the fluorescent screens incorporated in cathode-ray tubes had such low actinic rating and such long persistence of the after-image, that registration was limited to the first type of recording, namely, still photography. However, with the improvement of highly actinic and extremely low persistence screens

1 Gasser, H. S., and Erlanger, J., *Am. J. Physiol.*, 1922, **62**, 496.

2 Rijlant, P., *Gaz. Med. France*, 1934, **4**.

3 McCulloch, W. S., and Wendt, G. R., *Science*, 1936, **83**, 354.

such as the R.C.A. phosphor types 2 and 5, recording on moving bromide paper or film has become a general practice. The various methods in vogue employ a spherical lens to project an exact image of the dark screen and the bright moving dot upon the moving paper. When a round spot of light is so used in recording, the resulting record can in no way compare with the sharp, clean-cut record of hairline recording. However, if the dot can be converted essentially to a hairline, the records must obviously gain in definity and clarity. Such a system has been in use in this laboratory and has been found successful in producing better records. Figure 1 illus-

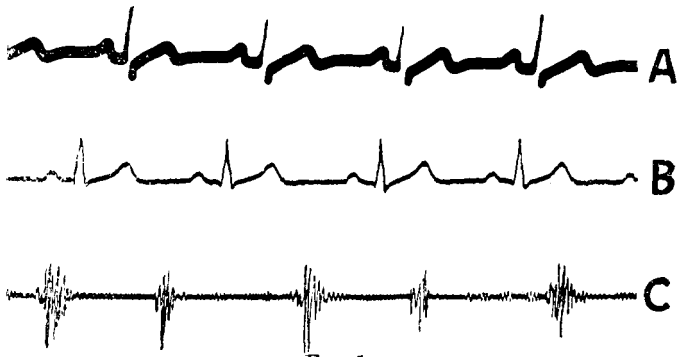

FIG. 1.

trates the effects. A is an electrocardiogram photographed by the round-spot method. B and C are respectively an electrocardiogram and a heart-sound record photographed by the hairline method herein described.

The method consists of substituting crossed cylindrical lenses for the spherical lense of other systems so placed that the image of the round dot becomes essentially a hairline ellipse. While it is difficult to describe such a 3-dimensional system verbally, Fig. 2 will probably convey the idea. The ordinary photokymograph (C) with

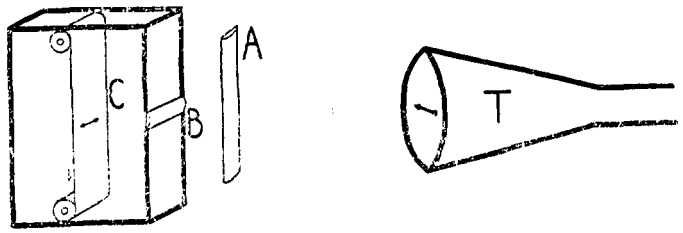

FIG. 2.

its cylindrical lens (B) is used. The cathode-ray tube (T) screen faces the camera, with the dot moving along the axis of lens B.

A second cylindrical lens (A) of slightly longer focal length than lens B is placed between the tube screen and the camera, with its axis crossing that of lens B at a right angle. The position of lens A is adjusted to focus the width of the tracing (analogous to the width of the slit in light-slit recording) and is not critical in adjustment. Lens B is not altered in any way and focusses the fineness of the hairline. Incidentally, the use of the camera with its cylindrical lens possesses the advantage of permitting various other phenomena to be simultaneously recorded by conventional rather than special methods. The number of other phenomena which may be so recorded is limited solely by the width of the photosensitive paper.

So simple is the arrangement and so lacking in critical adjustment that a test tube of the proper diameter filled with clear fluid can be used for lens A with satisfactory results, providing the excursion of the dot is not great enough to introduce spherical aberration.

9118

The Occurrence of Protoporphyrin in the Reticulocytes.

CECIL JAMES WATSON AND WILLIAM O. CLARKE. (Introduced by J. C. McKinley.)

From the Department of Medicine, University of Minnesota Hospitals, Minneapolis.

Van den Bergh and Hyman[1] described the regular occurrence of protoporphyrin in the erythrocytes. This was proven to be preexistent and not simply derived from hemoglobin during the process of extraction. Subsequently, protoporphyrin was noted in megaloblasts and erythroblasts of the embryonic bone marrow, and of pernicious anemia marrow, by Borst and Königsdörffer.[2] By means of perfusion experiments, Van den Bergh, Grotepass and Revers[3] demonstrated that the surviving liver is capable of converting proto- into coproporphyrin. This led them to suggest that the erythrocyte protoporphyrin might be parent to the coproporphyrin of the

[1] Van den Bergh, A. A. H., and Hyman, A. J., *Deutsch. Med. Wchnschr.*, 1928, **54**, 1492.

[2] Borst, M., and Königsdörffer, H., Untersuchungen über Porphyrie, S. Hirzel, Leipzig, 223, 1929.

[3] Van den Bergh, A. A. H., Grotepass, W., and Revers, F. E., *Klin. Wchnschr.*, 1932, **11**, 1534.