

TABLE I.  
Summary of 106 Experiments with Different Resuscitative Procedures.

	Oxygen			Nitrogen		
	Success	Failure	% Success	Success	Failure	% Success
Manual Artificial						
Respiration	6	5	55	1	6	15
Rhythmic Inflation	7	2	78	2	10	17
" Suction	4	1	80	1	4	20
Resuscitation (Rhythmic Inflation and Suction).	21	1	95	30	5	85

If asphyxia be allowed to reach the third phase (cessation of respiration, rapidly falling blood pressure), the animal ordinarily dies; but if asphyxial resuscitation be applied in this third phase at periods from one-half to  $2\frac{3}{4}$  minutes after cessation of respiration, permanent resuscitation of the heart and respiration can be accomplished quite regularly.

Asphyxial resuscitation, using inert gas, was produced by manual artificial respiration in 15% of the animals, produced by rhythmic positive insufflation in 17%, and produced by rhythmic suction in 20% of the animals. This phenomenon, however, was produced in 85% of the experiments where the combination of rhythmic insufflation and suction was used. (Table I.)

Resuscitation with an inert gas, like resuscitation with oxygen, is more effective the sooner it is applied after cessation of respiration. The phenomenon is abolished or markedly altered by carotid sinus denervation. It is abolished by double vagotomy.

Other physiological studies, including blood gas and alveolar gas analyses, are under way to determine what other factors may be involved in the mechanism of the phenomenon.

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#### Continuous and Reproducible Records of the Electrical Activity of the Human Retina.\*

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Two technical problems which have presented considerable difficulty in experimentation on human vision are (1) providing a sat-

\* Supported by a grant for the necessary apparatus by the National Research Council.

isfactory "artificial pupil" through which a beam of light may enter the eye unmodified by the contraction and dilation of the real pupil of the eye, and (2) providing a stable electrical connection with the cornea for the purpose of making continuous records of polarity and action potentials of the retina.

The first of the above problems is met in the present experiments by coating the central portion of a contact lens<sup>†</sup> with black enamel, leaving an opening of the desired aperture in the exact center of the lens (Fig. 1). This arrangement has the advantage that a diffuse field of light may be used for stimulating the eye. The subject merely sits at a convenient distance from the stimulus field and fixates normally upon a fixation point, without the discomfort of maintaining a rigid posture of the head. Since the artificial pupil moves with the eyeball, small head and eye movements will not interfere with the transmission of the stimulating light to the retina.

The second problem mentioned above, that of maintaining an electrical contact with the cornea, is met by the use of a corneal electrode mounted upon a contact lens as shown in Fig. 1. The electrode consists of a silver disc cemented into a hole in the contact lens. The surface of the disc is flush with the inside surface of the lens. A fine, flexible wire, supported by beeswax, is employed as a lead from the electrode. When the lens is inserted into the eye, the silver makes contact with the physiological saline solution between it and the cornea. A neutral electrode, consisting of a cup filled with

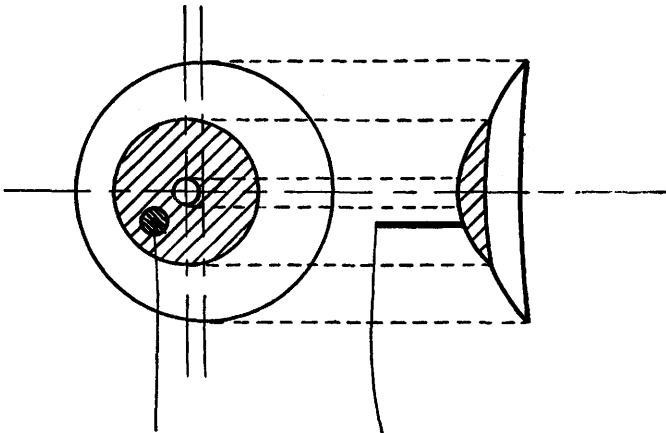


FIG. 1.

Front and side views of a contact lens adapted for use as an artificial pupil and as a mounting for a corneal electrode.

<sup>†</sup> The writer is indebted to Dr. R. J. Beitel of the American Optical Company for providing him with a contact lens.

saline, is applied to the skin of the subject over the cheekbone. The stability of these electrodes is such that records may be taken over a period of an hour or more with satisfactory reproducibility.

Fig. 2 presents a sample series of action potential records. These are tracings of photographic records made by a loop oscillograph actuated by amplified potentials from the electrodes described above. Records A to G show the response of the dark-adapted eye to brief (0.15 sec) flashes of "white" light whose relative intensity values are 100, 50, 25, 10, 5, 2.5, and 1, respectively. The short, vertical line below each record signals the moment of stimulation by light. With respect to wave form, the records of this series closely resemble certain of the single records which have been published by investigators who have used a moist thread electrode.<sup>1, 2, 3</sup> Record H is a calibration in the form of an applied potential of 0.25 millivolts lasting for one second.

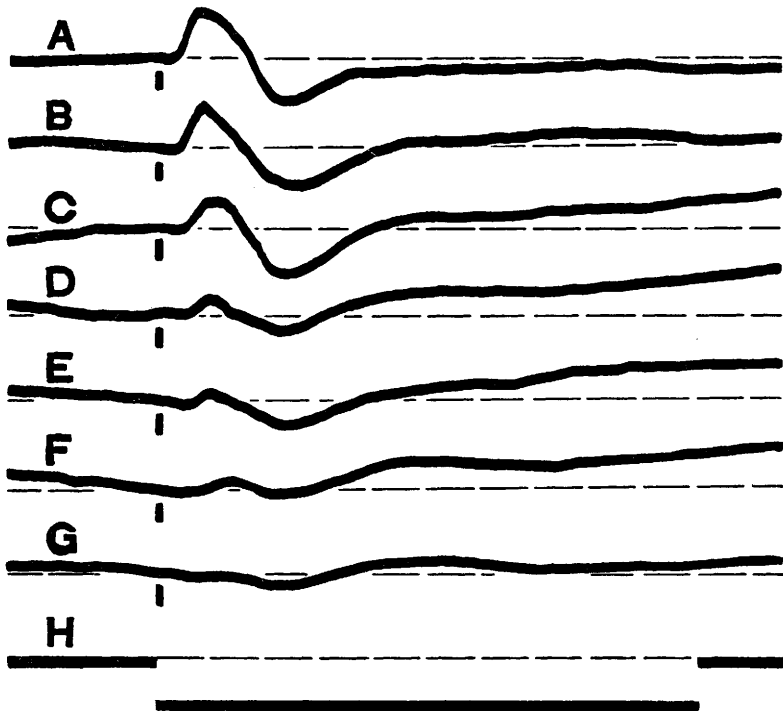


FIG. 2.

A series of electrical responses to brief flashes of light in the dark-adapted eye. (See text for details.)

<sup>1</sup> Hartline, H. K., *Am. J. Physiol.*, 1925, **73**, 600.

<sup>2</sup> Cooper, S., Creed, R. S., and Granit, R. J., *J. Physiol.*, 1933, **79**, 185.

<sup>3</sup> Gröppel, F., Haass, F., and Kohlrausch, A., *Z. f. Sinnesphysiol.*, 1938, **67**, 207.

By virtue of the present method, which allows for the taking of records over prolonged periods, the writer has recently been able to investigate the form of response obtained during various stages in the process of dark adaptation. Comparative responses of cone and rod receptors have also been studied. It is possible that measurements of the retinal action potential may turn out to be of clinical significance in distinguishing between defects of the retina and those of higher centers.

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### Cardiac Output in Coronary Occlusion Studied by the Wezler-Boeger Physical Method.\*

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The gas analytic methods of determining cardiac output, developed particularly by Grollman, cannot be applied in patients with acute conditions, for example, acute coronary occlusion. We have, therefore, used the physical method of Wezler-Boeger,<sup>1</sup> based upon the equation of the distensibility of the aorta estimated from the pulse wave velocity. The output is calculated from the pulse pressure, pulse wave velocity and aortic diameter. The functional length of the elastic reservoir of the aorta is determined from the natural frequency of the femoral pulse.

$$\text{Stroke Volume (V)} = 2Q \frac{a \times T}{s \times a^2} = \frac{Q}{2} \cdot \frac{\Delta P \times T}{s \times a} \text{cc.}$$

Q = Diameter of the aorta, in the outlined cases obtained from Suter's<sup>1</sup> anatomical tables.

$\Delta P$  = Pulse pressure in Dyn/cm<sup>2</sup>.

T = Natural frequency of the aorta, obtained from femoral pulse tracings.

s = Specific gravity of blood = 1.06.

a = Pulse wave velocity of the aorta, obtained from simultaneous carotid and femoral pulse tracings.

Comparative studies of the Grollman acetylene and the physical methods have been carried out in 70 determinations in 8 normal subjects.<sup>2</sup> Both methods checked within 10%, the absolute values running parallel.

\* Aided by a grant from the American Medical Association.

† Fellow of the Dazian Foundation for Medical Research.

<sup>1</sup> Wezler, K., and Boeger, A., *Erg. d. Physiol.*, 1939, 41.

<sup>2</sup> To be published.