obtained, is, according to our experience, due to the thioglycollate itself. An equally great, or even greater pressure, which continues for some hours at a decreasing rate, is obtained if the thioglycollate is added to pure sodium bicarbonate (*e. g.* 0.3 cc. of a 1.0 m. solution gives a pressure equal to 275 cmm. in 2 hours at 37°). The rate at which the pressure develops varies considerably with temperature. We have carried out experiments at 20°, 25°, 30°, and 37°. The results differ only quantitatively, being greater at the higher temperatures. This pressure is probably due to the fact that the thioglycollic acid contains one or more anhydrides which are slowly hydrolyzed during the experiment. This is in agreement with the finding that if an approximately 1.0 m. solution of our thioglycollic acid, which had been distilled 3 weeks previously, was refluxed for 2 hours, with volume control to see that no water was lost, it increased its titratable acidity by 14.3% as judged by titrating with NaOH using methyl red as indicator. This solution then developed much less pressure in a manometric experiment.

On the basis of the above findings we believe it is no longer justifiable to speak of a regeneration of this inactivated enzyme system by thioglycollate. We herewith withdraw the statement, and any conclusions based on the statement, that the inactivated glycolytic enzyme system of muscle can be regenerated by thioglycollate.

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Effect of Certain Agents on Cochlear Effect and Hearing.*

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There has been some question as to whether the Wever and Bray[1] phenomenon will prove to be an accurate tool for the study of hearing in animals. These authors showed that electrical currents could be picked up from the eighth nerve of the cat with a suitable amplifier. With telephone receiver or cathode ray oscillograph such cur-

* The work was made possible by grants from the Research Council of the American Otological Society and the Hayden-Coakley Fund.

[1] Wever, E. G., and Bray, C. W., *J. Exp. Psychol.*, 1930, **5**, 373.

rents are found to have fundamentally the same frequency as the sound producing them; that is, if the 256 tuning fork is sounded near the ear of a cat properly hooked up, the sound of the fork is transmitted by the cochlea of the animal and can be picked up by an amplifier in another room and can be converted into sound or a graphic sine wave of 256 double vibrations. A similar phenomenon is obtained if the primary electrode is placed on or near the round window—this is called "the cochlear effect".

Several studies[2, 3, 4] have reported results tending to show that the cochlear effect may not correlate with hearing, while others[5, 6] have recently reported evidence of such correlation. On the other hand, from the point of view of an attempt to explain the cochlear mechanism, there have been various experiments to eliminate portions of the auditory response by stimulation[5, 7, 8] and by drugs.[9]

Hallpike and Rawdon-Smith[10] have recently reported that a crystal of sodium chloride in the niche of the round window aboiishes the cochlear effect. In a series of experiments on the cause of nerve deafness, we have tried several other substances on the round window. We find that glycerin and solutions, as well as crystals of sodium chloride, calcium chloride and quinine dihydrochloride all produce abolition of the cochlear effect if left in the niche of the round window long enough. With low concentrations they produce a progressive diminution of the high tones and a smaller diminution of the low tones, both of which are proportional to the concentration of the solution used and the length of time they are in contact with the round window. With glycerin we have observed recovery in one animal after 5 days, but with electrolytes we have observed no recovery to date. We have been unable to produce significant diminution of the cochlear effect, within the limits of our apparatus, by the placing of crystals of glucose or dextrose on the round window; nor is there any appreciable effect with distilled water.

In the apparatus used by us, the primary electrode was a shielded

[2] Davis, H., Derbyshire, A. J., Lurie, M. H., and Saul, L. J., *Am. J. Physiol.*, 1934, **107**, 311.

[3] Guttmann, J., and Barrera, S. E., *Am. J. Physiol.*, 1934, **109**, 704.

[4] Culler, E., Finch, G., and Girden, E. S., *Science*, 1933, **78**, 269.

[5] Davis, H., Derbyshire, A. J., Kemp, E. H., Lurie, M. H., and Upton, M., *Science*, 1935, **81**, 101.

[6] Hallpike, C. S., and Rawdon-Smith, A. F., *J. Physiol.*, 1934, **83**, 243.

[7] Wever, E. G., Bray, C. W., and Horton, G. P., *Science*, 1934, **80**, 18-19.

[8] Finch, G., and Culler, E., *Science*, 1934, **80**, 41.

[9] Adrian, E. D., Bronk, D. W., and Phillips, G., *J. Physiol.*, 1931, **73**, 2P.

[10] Hallpike, C. S., and Rawdon-Smith, A. F., *J. Physiol.*, 1934, **81**, 395.

copper wire on which was a small cotton plug kept wet with normal saline, placed on or near the round window. The indifferent electrode was a zinc-plated test clip on the exposed neck muscles of the animal. The amplifier was a 3-stage, capacitance-resistance coupled one with high resistance input and a gain control in the second and third stages. Amplification was adjusted to bring the cochlear response to audible threshold with the use of head phones. The sounds used were an ordinary harmonica, a Galton whistle, and in some of the experiments, a shielded audiometer. In all cases, both ears were exposed through the bullae in the neck and tested alternately. The experimental chemical was washed out of the middle ear with normal saline and the cavities cleaned of blood clots and excess fluid before testing. The control ear was always similarly cleaned.

To check the correlation of cochlear effect with hearing, young dogs were conditioned to sounds from the audiometer according to a modified method of Culler.[4] They were then subjected to the operation. Salt was placed on the round window on one side until the electrical responses were diminished or absent. When they had sufficiently recovered from the anesthetic, they were again tested with the sounds to which they had previously been conditioned. They showed a marked rise in auditory threshold (especially for the high notes) in the ear in which the cochlear response had been diminished by the placing of salt upon the round window. These dogs were operated on both sides, showed no subsequent middle ear infection, and no essential diminution on the side in which no chemical was placed on the round window. The fact that the high notes (which are supposed to act upon that portion of the basilar membrane nearest the round window) are effected more quickly and more severely than the low notes adds to the evidence for a "place" theory of hearing. The parallel loss of the electrical response and loss of hearing of dogs, tested by conditioning to the audiometer, constitutes another step in the correlation of hearing and the cochlear effect.