

On the 30th day, the control group were 10 gm. below their original weight whereas the mucin group had gained 7 gm. and the pigs receiving glucuronic acid had gained 36 gm. There were no external symptoms of scurvy. One animal was killed from each group. Autopsy showed slight hemorrhagic areas around the joints. The cortices of the adrenals reduced silver nitrate. Orange juice was removed from the diet with the exception of one pig of the glucuronic acid group. On the 31st day, the weight of the control group reached its original level, but they started to lose weight rapidly. The mucin group started to lose weight slowly on the 32nd day, and the pigs receiving glucuronic acid started to lose weight rapidly on the 34th. Again, mucin and glucuronic acid delayed the onset of scurvy on a Vitamin C deficient diet.

We conclude from our experiments that Vitamin C is not glucuronic acid since it does not protect guinea pigs on a scorbutic diet from developing scurvy nor alter the severity of the condition of scurvy. Our data indicate that the addition of glucuronic acid to the diet we fed was beneficial to the guinea pig, since it postponed the period of loss of weight in the onset of scurvy and facilitated weight recovery when orange juice was added to the diet. Since there are no data in the glucuronic acid content of foods, we do not know how much may be present in the food.

Since the guinea pigs which were fed glucuronic acid gained weight faster than the control group, we consider this as evidence indicating that the guinea pig either cannot synthesize glucuronic acid or that the synthesis proceeds slowly. Also we have observed that the adrenals of a guinea pig which has died as a result of scurvy do not reduce silver nitrate solution.

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Electrical Currents Associated with Sound Reception by the Ear.

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The remarkable phenomenon of the reproduction of voice sounds and musical tones entering the cat's ear, by amplification of electrical currents from the eighth nerve and neighboring structures,

observed by Wever and Bray,¹ has been confirmed by Davis and Saul,² Adrian,³ Hughson and Crowe⁴ and by Witting.^{5*} If the view held by the discoverers of this phenomenon is substantiated, that these currents represent true action currents related to hearing, it will necessitate a marked revision of our present views in regard to the refractory period and frequency of impulse transmission in sensory nerves, or else the assumption of an elaborate coordinating mechanism.

We have found the same phenomenon in the dog under sodium barbital or nembutal anesthesia. Using a 6 stage amplifier, sufficient volume is obtained to make clear records on a phonographic recorder. Words, sentences and single frequencies between 100 and more than 5000 per second are clearly reproduced. Our results, in part confirming, in part supplementing, and in part contrary to previous observations may be summarized as follows:

1. In common with previous workers we find that the phenomenon may be adduced by leads not only from the eighth nerve but also over a rather large contiguous region and in the neighborhood of the cochlea. With one electrode on the cut surface of muscle several centimeters away from the nerve, we have obtained positive results of varying degree of intensity with the other electrode (a) on the eighth nerve, (b) on the tenth nerve, (c) near the round window within the bulla (Adrian), (d) on the neighboring cerebellar cortex, (e) on the bony tentorium, (f) on the neighboring cerebral cortex, (g) within the external auditory meatus, and finally (h) on the occipital bone. Leads (c) and (g) may be obtained without opening the skull and give satisfactory volume and clarity of reproduction. Negative results were obtained with the electrode on the parietal bone. While the volume of sound obtained at a given amplification is as a rule greater when the eighth nerve is in the circuit, clarity of reproduction of the speaking voice is usually greater when

¹ Wever, E. G., and Bray, C. W., *Science*, 1930, **71**, 215; *Psych. Rev.*, 1930, **37**, 365; *Proc. Nat. Acad. Science*, 1930, **16**, (5), 344.

² Davis, H., and Saul, L. J., *Proc. Am. Physiol. Soc.*, 1932, 28; *Science*, 1931, **74**, 205.

³ Adrian, E. A., *J. Physiol.*, 1931, **71**, 28.

⁴ Hughson, W., and Crowe, S. J., *J. Am. Med. Assn.*, 1931, **91**, 2027.

⁵ Witting, E. G., *Laryngoscope*, 1932, **42**, 497.

* Kruzer and Dorge⁶ fail to elicit the phenomena and ascribe the result to fortuitous circumstances connected with the apparatus. This explanation seems to be eliminated by the precautions used by Wever and Bray and subsequent workers to exclude the possibility of extraneous sources of current.

⁶ Kruzer, G., and Darge, H., *Science*, 1932, **75**, 105.

the connection is made with neighboring structures. It is suggested that this may be due to interference in the former case brought about by action currents of lower frequency arising from the cochlea and conducted through the auditory nerve.

2. Placing pure chloroform in the open wound so that the eighth and tenth nerve lie in a pool of this substance does not decrease the volume obtained from the eighth nerve but tends to clarify reproduction. The same is true of 4% cocaine. Wever and Bray and Adrian have been unable to abolish the phenomenon by similar nerve depressants applied to the nerve, although Davis and Saul found evidence of depression with novocaine along the central auditory pathways. Pure chloroform applied locally to the sciatic nerve in the frog abolishes sensory action currents in 2 minutes or less.

3. The phenomenon does not always disappear shortly after cessation of the vascular circulation.^{1, 2} In animals dying from hemorrhage, fairly clear reproduction may be obtained for more than an hour after cessation of the heart beat, and intelligible phonographic records made as late as three-quarters of an hour after cardiac death. There is a rapid decrease in intensity within the first 5 minutes, and then a very slow decrease until final disappearance. In animals killed by the intravenous injection of a rapidly acting poison (chloroform, magnesium chloride), the phenomenon may disappear completely within 3 to 8 minutes.

4. While we have not as yet measured the magnitude of the potential changes associated with this phenomenon, there is clear evidence that this is much smaller than that associated with known sensory action currents.

5. In contrast with the rather wide area over which these currents may be obtained, it is impossible with our apparatus to detect action currents from other sensory nerves, unless one or both of the leads makes direct contact with the nerve.

6. If these currents arise from microphonic action of the cochlea, as suggested by Adrian, the apparatus is not a simple resistance microphone, since a condenser in the input circuit to the amplifier, reducing the small constant grid current to zero, is without effect. We have some evidence that the underlying process may be of the nature of streaming potential.

The origin of these currents, and their relation if any to hearing, requires further investigation.