So just as for Δb negative (see our preceding paper) we have a realisable coexistence-curve liquid-solid, viz. with *positive* pressures above a *triple-point* S, for Δb positive only when Δb has a sufficiently high value (here $=0,5$). For Δb positive this triple-point lies at about $^1/_2\, T_c$, in accordance with what was found experimentally for many substances.

In how far these results are still subject to modification, when not — as was supposed up to now — *two* simple molecules associate to one complex molecule, but more than two, we shall have to discuss in a concluding paper. Moreover some remarks will be made about some papers by VON WEIMARN, who lately also concluded to the improbability of the TAMMANN melting-point curve on the ground of crystallographic-molecular considerations, and who then already stated the *probable* existence of a critical point solid-liquid, which existence, however, has only been raised beyond doubt by our theoretical considerations.

Physiology. — *"On the negative variation of the nervus acusticus caused by a sound."* By F. J. J. BUIJTENDIJK. (Communicated by Prof. H. ZWAARDEMAKER).

(Communicated in the meeting of November 26, 1910).

Up till now of the electric phenomena caused by the natural irritation of the organs, only those of the retina and of the nervus opticus have been investigated. [1]).

As I have been told, about 1904 a French investigator observed electric currents with a mirror galvanometer, when he connected this measuring apparatus with the nervus acusticus of a rabbit and a loud sound struck the ear of the experimental animal.

With the string-galvanometer of EINTHOVEN I succeeded in registrating the action-currents of the nervus acusticus suggested by a natural irritation. Under ether-narcosis of the experimental animal, electrodes of a specific form were placed by means of a trepanation opening into the hindmost skull-cavity of a cavia. These electrodes, a thin metallic tube, containing an isolated metallic pin were pushed on along the side-parietes of the cerebellum, usually after piercing the juncture of the flocculus with the rest of the cerebellum. In this way a trial was made to reach the nervus acusticus with the extremity

1) Vide a. o. EINTHOVEN and JOLLY. Quart. Journal of Experim. Physiol. Volume I. 1908 page 373.

of the metallic pin, projecting about $^1/_2$ cm out of the surrounding electrode. A comparison of the results of these experiments with the section of the animals used, proved that the strongest action currents were obtained when the electrode had reached the spot where the nervus acusticus enters into the medulla longata or the adjoining part of the medulla oblongata (tuberculum acusticum). The electrodes were now united with the string-galvanometer and a compensation apparatus (composed according to the method of WERTHEIM SALOMONSON[1]). Thereupon a percussion was fired with a pistolet, and the motion of the string simultaneously with a signal, stating the moment of the shot, was registered by photography. The oscillation that the string showed, appeared to correspond with a current of 4.5×10^{-8} to 9×10^{-9} ampère.

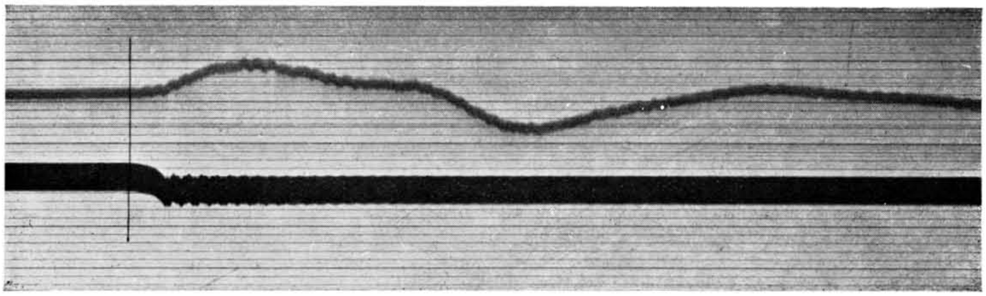
In the various experiments the latent period had a duration of 0.003—0.005 seconds.

The form of the obtained curve variegated in the various experiments; in the same experiment, however, the form remained pretty well constant. Without exception a deviation of the string had a two- or more-phasical character. Sometimes the phases passed imperceptibly into each other (vide fig. II), at other times, a more or less distinct pause was perceptible (vide fig. I). Moreover the string showed a very slight oscillation with a frequency of 1000—1500 per second. By the control-experiments this oscillating motion was proved not to be a physiological phenomenon. The object of these controlling experiments was to ascertain in how far the oscillations of the galvanometer were not caused by the action-current of the nervus acusticus. In the first place it appeared that, with opened current-chain, the string showed no oscillation when the shot resounded; the above-mentioned slight oscillation did appear with a latent period shorter than 0.001 second. Further it appeared that by putting various spots of the upper- or lower-brain out of circuit, the string showed no oscillation. Motions of the animal were entirely excluded by curarisation, the respiration-motions were also suspended. If one left the electrodes in situ, and waited, without altering anything in the experimental composition, till the animal had died and entirely cooled down, even the strongest report could no longer produce any oscillation in the string, the resistance in the chain however not having increased.

If an experiment was made when the animal was dead but had not yet entirely cooled down, an oscillation was still to be obtained though considerably inferior to the one resulting from the living

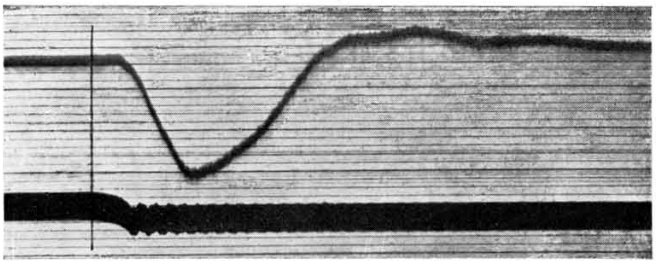
[1]) WERTHEIM SALOMONSON. Zeitschr. f. Biol. Techn. 1909 Volume I, page 366.

F. J. J. BUYTENDIJK. "On the negative variation of the nervus acusticus caused by a sound."



on the line of the abscesses 1 mm is equal to $\frac{1}{1250}$ second, on the ordinate 1 mm is equal to 6,1 $\times$ 10^{-9} ampère.

Fig. I.



on the abscis 1 mm is equal to $\frac{1}{1250}$ second, on the ordinate 1 mm is eq al to 6,1 $\times$ 10^{-9} ampère.

Fig. II.

Fig. I and Fig. II: Electric phenomenon in the nervus acusticus of the cavia caused by a reporting sound animal. Moreover the latent period had considerably increased and amounted to about 0.015 second. A comparison of the curves with those of the electric phenomena of the eye can, in my opinion, not be made, as the string of the galvanometer in my experiments had a very slight tension, and the curves consequently would require much rectification, in order to indicate the oscillations of the current that occur in reality.

For the latent period EINTHOVEN and JOLLY (l.c.) found for the frog's eye as the smallest value 0.01 second, moreover they report that for the stronger irritations the latent period is considerably shorter than for the feebler.

Perhaps there is some connection between the very short latent period, found in my experiments, and the exceedingly strong irritation which the impulsive sound of the report is for the experimental animal. Received by the microphone the report seemed to give an amplitude of oscillation of the string when brought into circuit with the secondary chain, forty times greater than a very strong flute-tone (a^3—a^4).

I could however when blowing this flute and likewise with the sound of a clock, observe an oscillation of the string, when it was connected with the nervus acusticus of the experimental animal. The oscillation was very slight 1—2 mm. and appeared to remain constant during the flute-tone.

With the cavia it was utterly impossible for me to reach the nervus acusticus operatively. With the rabbit I could reach the nervus acusticus through the roof of the hindmost skull-cavity, by cutting away part of the cerebellum. By cauterization the violent hemorrhage had to be stopped. With a blunt hook the medulla was a little removed, and a platinum electrode was placed at a distance of ± $^1/_2$ cm. into the medulla oblongata. Now I could likewise register by photography an oscillation, though not so strong as at the stabbing experiments with the cavia, it was of about equal strength as the oscillation that the string shows, when the stabbing electrodes are applied to the rabbit.

There is still a third method for observing electric phenomena of the nervus of a cavia or a rabbit. Of two unpolarisable electrodes, one was placed in the porus acusticus internus, the other on an indifferent spot of the hindmost skull-cavity.

This was done under strong ether narcosis, the skull having been widely opened, and the whole mass of brain removed. In the dying animal very distinct electric currents were still observed in the nervus acusticus when the report struck the ear. As has already been remarked these oscillations were remarkably smaller and had greater latency.

I have likewise tried to conduct the active current of the nervus acusticus of the frog. The nervus acusticus of this experimental animal can easily be reached without injuring the normal circulation or the brain. I have however not succeeded in observing an oscillation of the string-galvanometer. This may be partly attributed to the insufficient sensibility of the instrument, on the other hand the sensibility of the frog for sounds is exceedingly trifling. A frog poisoned with strychnine which showed symptoms of spasms when being blown, did still react with muscular spasms at a shot in the immediate vicinity, but did not do so when the shot was fired at some distance. Of the different tones it was those of a low vibrating figure that caused the greater reaction upon such like frogs, the high tones often had no influence at all. From the experiments of YERKES [1]) about the vigorating influence of the tone on the effect of a mechanical irritation it appears that vibrations of 50—10000 per second, in some way or other, cause an irritation to the nervous system of the frog.

I can moreover communicate that like PIPER [2]) I could show an electric current in a pike with the string-galvanometer when with a glass-rod the otolith was moved The unpolarisable electrodes were placed in such a way that one of them touched the nervus acusticus at the parietes of the emptied skull cavity, the other stood at some indifferent point of this parietes. Care was taken that neither the electrode nor the object could move from their places. I could not observe any electric action caused by a sound of whatever nature that was conveyed by the air to the head of the pike.

Mathematics. — *"On quartic curves of deficiency zero with a rhamphoid cusp and a node."* By Prof. GEORGE MAJCEN of Agram. (Communicated by Prof. JAN DE VRIES).

1. We shall here consider the quartic curve, which has as equation

$$(mx_3^2 + nx_1x_2)^2 - x_2x_3^2(a^2x_2 - bx_3) = 0 \quad . \quad . \quad . \quad . \quad (k_4)$$

It is easy to prove, that the represented curve has a rhamphoid cusp in the vertex $A\,(1,0,0)$ of the triangle of reference, that the cuspidal tangent is the side $x_2 = 0$ of this triangle, and that the vertex $B\,(0,1,0)$ is a node of the curve. The side $x_1 = 0$ is chosen

[1]) YERKES Journ of Comp. neurol and Psychol XV, p. 279.

[2]) PIPER. Zentralblatt f. Physiol 1906 Bd. I, p. 293.