liver is really a tissue for which the above does not hold or whether the fixation had been insufficient I have been unable to settle.

Summarising we may state that for the mesentery, the outer stratified epithelium of the cornea and the epithelial cells of LIEBERKÜHN's crypts of newborn cats a period in the mitotic nuclear division is observed with a maximum in the evening, the night or the early morning hours, a minimum in the later morning hours and the early afternoon. The maximum number of karyokineses does not always occur at the same time, but never in daytime, the minimum is always at the middle of the day.

Further investigation will perhaps reveal that also other tissues, as well of the cat as of other animals, show the same phenomenon and this may be the reason why in general in growing tissues no or very few karyokineses have been observed, since the fixation of the tissues has commonly taken place at the middle of the day.

Leyden, February 1916. *Anatomical Cabinet Histological Department.*

Physiology. — "*The electrical phenomenon in cloudlike condensed odorous water vapours*" examined by Prof. Dr. H. ZWAARDEMAKER in collaboration with Messrs. H. R. KNOOPS and M. W. VAN DER BIJL.

(Communicated in the meeting of March 25, 1916).

That odorous substances are often present in the air in the form of water vapours with a cloudlike condensation and in that state stimulate our sense-organ was first suspected by J. GAULE [1]) in the year 1900. A frequent occurrence of this phenomenon seems to me to be improbable [2]), still, I felt called upon to look more closely at the sensory qualities of odorous water vapours with a cloudlike condensation, when a suitable apparatus to produce them should be at my disposition.

Such an apparatus was devised two years ago by Prof. G. GRADENIGO, who made use of a simple glass sprayer, of the adiabatic expansion of compressed air, supplied under an over-pressure of two atmospheres and of the splashing of the waterdrops against a glass wall [3]).

1) J. GAULE in P. HEYMANN's Hdb. der Laryncologie und Rhinologie. Bd. III p. 178 Wien 1900.

2) Cf. my "Physiologie des Geruchs", p. 22. Leipzig 1895.

3) The apparatus still used by us is the one Prof. GRADENIGO kindly made me a present of. A description of it will be found in Arch. int. de laryngologie, d'otologie et de rhinologie 1911.

Probably the following takes place: The rapid air-current draws up the water in which the substance to be examined has been dissolved. This water evaporates in the air which streams past and which has become ionized at the vertical nozzle, and saturates the air with water-vapour, provided, as in our case, an excess of water is present. Meanwhile the over-pressure of two atmospheres being reduced to zero, the air suddenly expands. A considerable fall of temperature ensues and a cloudlike condensation appears. The spray splashes against the glass wall and according to GRADENIGO and STEFANINI, what flies past it gives a cloud, which may be stored for a considerable period if the precaution has been taken to dissolve in the water a small percentage of common salt or of a mixture of salts. We were able to confirm GRADENIGO's and STEFANINI's experience to the full. Even the most various non-volatile substances, electrolyte or not, when dissolved in water, give a beautiful, dense cloud, which may be stored for hours in a Tyndall case.

If, however, instead of salt- or sugar-solutions we take aqueous solutions of odorous substances, which naturally are more or less volatile, the cloud is less steady and will disappear after some minutes. Even then we can note in the ultramicroscope fine water-drops close upon their formation, briskly performing BROWNian movements.

It appeared at once that the odour outlasts the cloud, in other words that an odorous substance, as might be expected, is noticeable not only and not invariably as a condensed vapour, but also in a purely gaseous state. A similar observation was made also by J. AITKEN in 1905, when he stated[1]) that odorous substances, in a space where ions are wanting, do not form clouds from over-saturated air.

However, another remarkable fact manifested itself. When a simple condensed water-vapour or a salt-containing cloud is driven against a metal plate, well-insulated, and connected to an electroscope, it will, under the experimental conditions, not be possible to render a charge visible. This is easy to understand, as according to STEFANINI electro-positive as well as electro-negative ions are present in the salt-nebula, apparently in equal numbers. When placed between two charged condenser discs, the vapour clarifies, though it remains, while the somewhat larger ions are drawn to the positive, the somewhat smaller to the negative disc.

If, on the contrary, we took an odour-containing condensed vapour,

[1]) J. AITKEN, Proc. Roy. Soc. of London. Vol. 25, p. 894. 1905.

and allowed it, though being unstable, to flow against a metallic disc even from some distance, we discovered a very strong charge, which, of course, under the experimental conditions (overpressure of two atmospheres), was invariably a positive charge. While the cloud diffuses after the flow is arrested, the charge is left behind on the electroscope. The surrounding air is evidently not more conductive than it would be without a vapour. Also the drops creeping down the disc appear to be charged, the charge being under the experimental conditions invariably positive.

The literature contains previous reports of vapours disposed to condense in the shape of drops round the positive ions as their nuclei [1]). We know now that in the cases here referred to, which were few and far between, the experimenter used substances of some olfactory quality. This induced us to examine all odorous substances at our disposition with a view to their electrical effect.

First of all we examined the odorous solids at hand, as I felt inclined to generally identify the phenomenon observed by us with the so called odoroscopic phenomenon [2]). Then our researches were extended to odorous liquids in aqueous solution. Seemingly insoluble substances were mixed with water in a separator; the fluid was subsequently filtered and the filtrate sprayed under an overpressure of two atmospheres into an inconstant vapour [3]).

Electrification was detected with: acetaldehyd, acetone, ether, ethyl-alcohol, ethylbisulfid, ethylbromid, ethylbutyrate, ethylmelonic acid, allylsulfid, ammoniac, amylacetate, amylalcohol, amylbutyrate,

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[1]) Cf. H. KAMERLINGH ONNES and W. H KEESOM, Enc. d. meth. Wissenschaft V. 10, p. 910, note 937. which brings up the literature to 1912.

[2]) The odoroscopic phenomenon has been discovered by VENTURI was named after him, studied again by PRÉVOST and extensively investigated by LIÉGEOIS. (Arch. de physiol. 1868 t. I p. 35). VAN DER MENSBRUGGHE (mém couronnées par l'acad. royale de Belgique t. 34 1870) correlated it with a lowering of the surface tension. MARCELIN (Ann. de phys. t. IX, p. 14 1914) found that by covering the evaporation and consequently the movement was stopped. A satisfactory method to obtain a perfectly pure, fat-free water surface has been suggested by RÖNTGEN. For the theory see Lord RAYLEIGH Sc. papers. Vol. 3, p.p. 347 and 383

[3]) The phenomenon of electrification affords a very sensitive reagent to find out whether any part of an odorous substance dissolves or not; in this respect it is comparable to the olfactory sense. Therefore, the vessels must be kept perfectly clean and control tests with pure water must continually be inserted The amount of electricity conveyed by the vapour to the electroscope is astonishingly great, much greater than the electricity generated by the splashing of water (LENARD). A full discussion of electrification through transformation of liquid surfaces into gases was brought forward by A. BECKER in Jahrb. der Radioactiv. u Electron. Bd. II, p. 42. 1912.

anethol, anilin, anisaldehyd, apiol, acetic acid, benzaldehyd, borneolbromin, bromoform, isobutylalcohol, carvone, chinolin, chloroform, cinnamylaldehyd, citral, citronellol, cumol, decylaldehyd, duodecylaldehyd, eucalyptol, eugenol, formaldehyd, guaiacol, heliotropin, ionone, iron, iodin, linalool, menthol, mercaptan, methylanthranilate, methyl butyrate, methylsalicylate, formic acid, myrtol, naphtalin, nonylaldehyd, paraldehyd, paraffin-ether, propylamin, pulegon, pyridin, safrol, skatol, styron, thymol, trimethylamin, undecylaldehyd, valerianic acid, vanillin, xylol.

As yet we did not come across any exception among the true odorous solids.

All odorous vapours charge a metal or glass wall positively, when it is placed in their way. With the true odorous solids ethylmelonic acid, benzaldehyd, citral, eugenol, geraniol, heliotropin, ionon, camphor, menthol, trinitrobutyltoluol, (artificial moschus) this effect can be produced even in extremely weak dilutions. With other substances the charge is less strong, sometimes weak. With ammoniac it was so weak that we almost supposed we had to do with an exception. However, even with this substance a positive charge is not altogether wanting. Aqua cholarata does not electrify appreciably. No more does ozone-containing water.

Of course, the question arises where the other charge is located. It may be rendered visible by replacing the disc by a wire gauze. This shade will be charged positively, while in the cases examined, the negative drops fly through it and are caught up on a disc drawn up behind the shade. The positive drops streaming down the shade emit a stronger scent than the negative ones collected on the disc.

It seems to me that what we have observed so far may be explained as follows:

Suppose that somewhat larger drops form round the positive ions than round the negative, then the smaller negative drops will, in the case of odorous watervapours, evaporate sooner and thus leave the negative nuclei denuded. [1])

These negative nuclei will slip through the meshes of the wire

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1) Also when we take odorous paraffin a spraying occurs, though not through condensation. The dense cloud then forming is again electro-positive, and continues for some time. The cloud smells of the substance dissolved in the paraffin, of tallow if the paraffin be pure. In this case the odour can volatilise from the drop, but the drop itself cannot evaporate.

An odorous substance dissolved in glycerin does not give a charge, unless the solvent is diluted with three times its volume of water.

gauze, whereas the large positive nuclei, loaded with waterdrops, dash against the disc and creep down along it. Also in GRADENIGO's and STEFANINI's experiments with salt-clouds the larger drops splash against the glasswall and the smaller escape to the inhalatorium.

With their salt-clouds, contrary to our odour-containing vapours, however, the positive charge cannot be rendered visible on an intercepting disc, though both positive and negative charges can, also with salt-clouds be demonstrated when another method is employed viz. through special contrivances.

In what we have said above we assumed that the odour-containing water condenses round the negative as well as round the positive ions, also, however, that the former disappear sooner, because the drops evaporate more rapidly. It goes without saying that we may also assume the vapour to condense, under the experimental conditions, only round the positive ions. (See the above references to the literature).

The excess of charge in odorous cloudlike condensed vapours is in every sense the counterpart of the odoroscopic phenomenon (camphor movement on perfectly pure water), as it requires for its arousal:

1st. volatility of the substance;

2nd. an effect of reducing the surface tension of the water.

The phenomenon of electrification is, however, more general, as it applies to odorous liquids as well as to odorous solids, that are soluble in water, whereas the odoroscopic phenomenon holds only for the latter.

Special attention should be given to the fact that a 2 % alcohol-solution, when sprayed, gives a distinct charge, which gradually diminishes with 5 %, 10 % and 25 % solutions, the latter giving only a trace, while a 50 % solution gives no charge at all. A similar ratio with slight differences in the percentages is found in the case of acetone, pyridin and a number of other substances examined on this point.

Even surprisingly small quantities of true odorous substances suffice to generate electricity as e.g. $25{,}10^{-6}$ grms of geraniol taken up in 25 c.c. of a 2 % salicylas natricus solution (giving no charge of itself), is sufficient to produce a distinct charge. A similar result is obtained with a quantity of trinitrobutyltoluol (artificial moschus) of the same order. Such liquids have (as determined after TRAUBE) a lower surface tension than water. If we bear in mind that the 25 cc. of liquid were diffused in a large volume of air, it is easy to realize how vivid the electrical reaction is. Still it is far distanced by the sensory reaction of smell (of trinitrobutyltoluol e.g. 1.10^{-16} mgrms is distinguishable in one litre of air). In the present experiments we purposely used a rather sensitive electroscope. Our first care was insulation and the avoiding of sources of errors. It is, therefore, not out of the bounds of probabilities that for judiciously selected and very sensitive instruments the electrification-phenomenon and the sense organ will appear to vie with each other in giving the reaction. Apart from experimental conditions, the small quantity of the substance, manifesting itself by virtue of electrification is, as I think, dependent on molecular weight, on volatility and on a lowering effect upon the surface tension. They are the very factors constituting the physical conditions that must be fulfilled by a substance to act biologically as an odorous substance.

Anatomy. — "*On the determination of the position of the macula-planes and the planes of the semicircular canals in the cranium*". By Dr. H. M. de Burlet and J. J. J. Koster. (Communicated by Prof. H. Zwaardemaker).

(Communicated in the meeting of April 28, 1916).

§ 1. In order to be able to give an exact determination of the position of the macula-planes and the planes of the semicircular canals in the cranium, a first requirement is to connect the situation of these planes with fixed data taken from the cranium, which can easily be found again in each specimen. Absolute value cannot be assigned to the most exact determination, because the data taken from the cranium are always liable to variation; such a determination must therefore always be taken as an individual one.

By comparison of found sizes with different individuals of one and the same species, an impression may be obtained about the variation and an average position can be approximated.

The following refers to the rabbit, on whose cranium-basis we have fixed a line by two points, which points can easily be traced in each rabbit-cranium. The situation of these points moreover being so, as to enable us to demonstrate them accurately in series-sections. Pl. 1 shows the rabbit's cranium-basis seen from above. An imaginary line *a b*, connects the Incisura intercondyloidea (*a*) with a little spina (*b*), which regularly appears at the proximal end of the basi-occipitale. This line, which is the starting-point of our determinations, is almost conform with the line of intersection of the