mouse tissue. The respiration of the stored glycogen in the liver of the mouse proceeds in two linked phases, the first of which (anaerobic) is more sensitive to nicotine poisoning and accounts for the fact that *l*-nicotine inhibits the whole respiration more strongly than *d*-nicotine. The oxidation of exogeneous glucose and of lactate in the slices of starved liver are direct, and therefore more sensitive to *d*-nicotine. Glycolysis of the grey substance of the brain in mice is *l*-sensitive to nicotine and of the same order of magnitude as the endogeneous respiration in the liver, and it is therefore probable that lactic acid production is the limiting anaerobic link in the latter case.

An extensive comparative investigation has further shown that in green Algæ (*Rhitoclonium fontanum*) and Protozoa (*Palamecium candatum*, *P. Cursaria*, *Euglena viridis* and *Eudorina elegans*) oxidations are direct and *d*-sensitive to nicotine poisoning. At the same time, in the flatworm (*Polyulis nigra*) and in livers of adult pike (*Esox lucius*), frog (*Rana temporaria*), green linnet (*Chloris chloris*), and fowl (*Gallus domesticus*) oxidations are coupled with fermentations, and are more sensitive to the action of *l*-nicotine. It is also interesting that the liver of the chick (3 days old) appears to be primitive in the sense that its oxidation is *d*-sensitive to nicotine and therefore direct.

The precision of the results obtained in the analysis of oxidation and fermentation with the aid of optically isomeric nicotines may perhaps be due to the fact that both the pyridine and pyrrol groups of nicotine enter into the composition of enzymes catalysing carbohydrate breakdown[1] which are therefore in some way specifically destroyed by the nicotine.

A complete account of these investigations will be published shortly.

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Warburg *et al.*, *Biochem. Z.*, **282**, 157 (1935).

Interaction of Heavy Nuclear Particles

SOME time ago, it was suggested that the interaction between neutrons and protons goes on via particles of small mass—electrons (positrons) and neutrinos—somewhat in the same way as electromagnetic interaction (compare Coulomb's law) is transferred by photons[1]. After a recent discussion of the problem by Heisenberg[2], who pointed out the necessity for changing the r^{-5} law to one involving r^{-7} or r^{-9}, it seems desirable to perform the calculations for the magnitude of interaction in the most simple manner.

Indeed, the most essential point proves to be the fact of energy transfer *by a pair of particles*, and not by a single photon as in the usual electromagnetic case. For the magnitude of the interaction at the small distances which are of interest, even the statistics of the transferring particles is not important, or even the kind of partners implied (electron and neutrino, or two neutrinos). We have worked with simple scalar equations of wave type, or of the type of Schrödinger's second order relativistic equation. Starting with Fermi's assumption for the interaction between heavy particle and neutrino-electron field ($g\,\varphi_1\varphi_2$), or with a more general expression $\left(g\,\frac{\partial^n\varphi_1}{\partial t^n}\,\frac{\partial^m\varphi_2}{\partial t^m}\right)$ and applying the elegant method of Dirac's quantum electrodynamics, we get for the magnitude of interaction expressions proportional to $\frac{g^2}{r^5}\,I_1(r)$, or $\frac{g^2}{r^{2m+2n+5}}\,I_2(r)$. The integrals $I(r)$ are equal to 1 for $r \ll h/mc$ and vanish at great distances. Thus we get the remarkable result that the interaction depends chiefly on the presence of two particles, just as does the probability for β-decay[3]. If needed, one can introduce the relativistic equations for heavy particles and work with an interaction formula which is very similar to Breit's, but not identical with it.

So far as the order of magnitude is concerned, we can compare the interaction at the distance r_0, equal to the radius of a heavy particle, with the self-energy μc^2. For $r_0 \sim 10^{-13}$, which is assumed to be the most reasonable, the best choice is the energy expression, proportional to $\frac{g^2}{r^{11}}$ or $\frac{g^2}{r^{13}}$, which results from that form of the interaction between heavy and light particles and is that found to be the best for the purposes of β-decay theory[3].

We may note that until now no classical analogy for the field of two particles has been found, so that the above considerations rest on essentially non-trivial results of quantum electrodynamics.

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[1] Ig. Tamm; D. Iwanenko, NATURE, **133**, 981 (1934).
[2] W. Heisenberg, Zeeman's Festschrift, 1935.
[3] E. J. Konopinski and G. Uhlenbeck, *Phys. Rev.*, **48**, 7, 107 (1935).

Dependence of the Herschel Effect upon the Surrounding Gas Medium

THE Herschel effect—the weakening of the latent photographic image by means of light—is observed, as a rule, in the red and infra-red region of the spectrum. Recent investigations, however, show that under certain conditions the Herschel effect is observed in regions of the spectrum, where usually a normal photographic effect prevails. If, then, the Herschel effect is stimulated by the parallel reaction which accompanies the main photographic process, it is reasonable to suggest that the surrounding gas medium is involved in the reaction.

It was suggested to me by Prof. Narbut that an investigation of the influence of the gases oxygen, nitrogen, hydrogen and carbon dioxide and also of a vacuum upon the Herschel effect would repay investigation. Diapositive plates of the "Photo-Khim-Trust" works of Moscow and Kiev were used. The Herschel effect was obtained by red light (a photographic lamp of 25 candle-power).

Investigations were carried out with seven series of plates, with the following results:

(1) In oxygen, the Herschel effect is much more intensive.

(2) In nitrogen and carbon dioxide, the Herschel effect has almost disappeared.

(3) In hydrogen, the red light gives but a normal photographic effect—additional darkening of the plate. Hence the medium is apparently essential in

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