Synthesis of Thiocamphor and other Cyclic Thioketones

THIOCAMPHOR has been synthesised in good yield in my laboratory by Mr. D. C. Sen, by the simultaneous action of dry sulphuretted hydrogen and dry hydrochloric acid gas, at 0°, on a solution of camphor in absolute alcohol. The substance is crystallised from aqueous alcohol or from benzene and it melts at 145°. It is a red crystalline substance having the aroma of camphor combined with a slight foetid smell. Attempts have been made to synthesise the compound by the action of ammonium sulphide or hydrosulphide on camphor, or on the pernitroso derivative of camphor quinone and from bornyl magnesium chloride and sulphur¹. But in these cases the yield appears to have been low, due to the accompanying by-products, and the purity of the substance also seems to be doubtful, as the melting points described are different in different cases.

The physical and chemical properties of the substance have been studied and important derivatives are being prepared. Thiocyclohexanone (non-polymerised) has been synthesised by the same method along with its tripolymerised derivative. Fromm² also studied the same reaction but isolated the tripolymerised derivative only. The method is being extended for the synthesis of cyclic thioketones containing different ring systems. The results of these investigations will be published in due course in the *Journal of the Indian Chemical Society*.

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¹ *Ber.*, **39**, 3503. *Ber.*, **36**, 863. *Gazzetta*, **39**, 11, 196.

² *Ber.*, **60**, 2090; 1927.

Series of Cæsium Atoms in an Electric Field

WE have investigated the absorption spectrum of cæsium vapour in an electric field by a method similar to that used by C. J. Bakker in Prof. Zeeman's laboratory¹ and by E. Amaldi and E. Segrè² in studying potassium and sodium. The background was given by a high purity carbon arc. A Hilger large quartz spectrograph E_1 was used. A spar

FIG. 1. Absorption spectra of cæsium near the limit of the principal series 6S-mP: above, without electric field; below, in an electric field of 900 volts/cm.

crystal was placed in the light beam before the slit of the spectrograph, so that polarisations parallel to the electric field (ω -component) and perpendicular to it (σ -component) could be photographed simultaneously and separately.

Fig. 1 shows the absorption spectrum of cæsium near the limit of the principal series 6S-mP without an electric field (upper spectrum) and with a field of about 900 volts/cm. (lower spectrum). The first doublet on the left is the 6S-11P, $\lambda = 3398.14$ and

3400.00 Å. Without the electric field, one may follow the series 6S-mP up to its thirty-first term; while in the electric field the intensity of the lines diminishes progressively and the series breaks down. The lines of the principal series are split owing to the occurrence of forbidden lines corresponding to 6S-mD transitions. For high terms the electric perturbation increases to such a degree that P and D terms become indistinguishable, and the splitting becomes an almost symmetrical one on both sides of the unperturbed P terms. In the region between the permitted lines of the series 6S-mP, there appear some combination lines belonging to the 6S-mS series.

The forbidden lines of the 6S-mD and 6S-mS series begin to be detectable at a certain value of m (m is 14 for the 6S-mD series and 17 for the 6S-mS series in the ω component in the electric field of 900 volts/cm.). Their intensities increase with m , until they are stronger than the neighbouring permitted ones; then they become weaker and fade away.

The effect of the electric field is greater on the ω components than on the σ ones.

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¹ *Proc. Roy. Acad. Sci. Amst.*, **35**, 589; 1933.

² *NATURE*, **132**, 444, Sept. 16, 1933.

Interaction of Neutrons and Protons

HEISENBERG's well-known assumption, ascribing the neutron-proton interaction to the exchange of the electric charge, seems to be irreconcilable with Fermi's theory of β -radioactivity¹. On the other hand, a natural generalisation of Fermi's theory may perhaps account for the interaction of heavy particles.

According to Fermi², a heavy particle (a neutron or a proton) may emit (and absorb) a pair of light particles—an electron or a positron and a neutrino. It seems natural to assume that a heavy particle may also emit (and absorb) a pair of neutrinos, whereas the emission of a single neutrino would violate the conservation of spin. Of course, in distinction to processes considered by Fermi, the emission of a pair of neutrinos will not affect the charge of the heavy particle.

The Coulomb interaction of charged particles may be deduced from the laws governing the emission and absorption of photons by a charged particle. Exactly in the same way we may calculate the interaction of particles endowed with the power of emitting and absorbing pairs of neutrinos. For the potential energy V of such an interaction one gets

$$V = \frac{\eta_1 \eta_2}{r^5} \dots (1)$$

where r is the distance between the particles and the 'neutral charges', η_1 , η_2 , are constants, characterising the properties of the particles in question. It may be assumed that the η -charge of neutrons and of protons are numerically equal and of opposite sign. If one takes account of the finite radius r_0 of heavy particles, one finds that (1) is valid only so long as