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Physics. — "*Electric double refraction in some artificial clouds and vapours*" (second Part). By Prof. P. ZEEMAN and C. M. HOOGENBOOM.

10. The condenser mentioned in the experiment of § 3 was placed in the interior of the horizontal glass tube; the metal plates were of 18 cm. length, their distance being 16 mm. The investigation of gases and vapours, acting chemically upon the metal of the condenser plates is better conducted in an apparatus with external plates and the same apparatus may be serviceable also in other cases as it is more easily cleaned. An apparatus made of glass and of parallelepipedic form was therefore constructed, (length 46,5 cm., distance between the insides of the vertical walls 5 mm., height 10 cm. thickness of glass 3 mm.). At the outside strips of tin foil 40 × 3 cm. were arranged. The tube is closed by plates of thin coverglass.

11. The experiment with the sal-ammoniac cloud produced in an anteroom (§ 4), was repeated with the new condenser, but with the old optical arrangement (§ 3).

It now appeared that the result obtained in § 4, indicating solely a double refraction induced in the sal-ammoniac cloud, was a rather special case.

The sal-ammoniac cloud now exhibited dichroism also. As it is probably the greater density of the cloud operative in the new apparatus, which made it easier to observe the new property, the anteroom (§ 4) was removed altogether. In our further experiments the gases, hydrochloric acid and ammonia, were introduced directly

into the observation room, the cloud produced being now much denser than before.

Small differences of potential caused a downward motion, accompanied with a slight fading of the black band (§ 3), a potential difference of 8000 Volts made it disappear completely. It became visible again by a clock-wise rotation of 10° of the analyser, which had been crossed with the polariser before establishing the field. The position of the polariser is defined in § 15.

This experiment proves that in a sal-ammoniac cloud double refraction, accompanied by dichroism is induced by electrostatic fields.

12. No effect was exhibited by the unmixed gases, hydrochloric acid or ammonia.

13. Strong currents of ammonia and of hydrochloric acid were introduced into the apparatus, a dense cloud being produced. Under the action of the electric field or by a slight rotation of the analyser, the transmitted light looks yellow red. If the currents of gases are interrupted after a while there is only a general diminution of the light of the NERNST filament. That there is still absorption by a cloud, is proved by the illumination of the field of view produced when a current of neutral gas displaces the cloud.

The slow change of colour of the sal-ammonia cloud was observed in a separate experiment, using a glass tube of 3 or 4 cm. width and of 50 cm. length. This change of colour apparently varies with the size of the particles in the cloud.

14. It is extremely remarkable that in parallel with this change of colour there occurs a change of the electric double refraction of the sal-ammoniac fog.

Producing a fog as in § 13 above and crossing the nicols with a field zero, the black band became invisible with a potential difference of 9000 Volts. By a clock-wise (§ 11) rotation of the analyser it reappeared; its displacement was *downward*.

The supply of the gases being interrupted the effect remained the same for perhaps a quarter of an hour. Then the effect apparently had diminished and finally the sign of the double refraction appeared to be the reverse of the original one. On throwing on the electric field the black band jumped *upwards*. In order to produce complete blackness of the band, again a clock-wise (§ 11) rotation of the analyser is necessary.

Hence we see that the sal-ammoniac cloud undergoes in the course of time a remarkable change; the induced double refraction is at first positive, afterwards negative; the dichroism does not change its direction.

15. The direction of vibration which is more strongly absorbed is very easily determined.

We know that a clock-wise rotation of the analyser (§ 11) was necessary in order to produce complete blackness of the band. The direction of vibration of the polariser joined the upper left, and the lower right quadrant. Hence it follows, as is easily seen, that *the vibrations parallel to the electric force are the more strongly absorbed ones.*

16. This result may be controlled by the following experiment. If we turn the polariser through an angle of 90° from its former position (§ 15) then we shall expect that in repeating the experiment of § 11, an anti-clock-wise rotation of the analyser will be necessary in order to see most clearly the neutral axis. This consideration is confirmed by experiment.

17. Our observations hitherto given, prove that *at least* two different modifications of sal-ammoniac clouds exist, which exhibit double refractions of opposite sign, at the same time the absorption of vibrations parallel to the field always exceeds that of vibrations at right angles to the field.

One of the special intermediate states of the cloud, when under electric action, exhibits dichroism *alone* and *no* double refraction.

(To be continued).

Chemistry. — “*Das Gesetz der Umwandlungsstufen in the light of the theory of allotropy*”. By Prof. A. SMITS. (Communicated by Prof. A. F. HOLLEMAN).

(Communicated in the meeting of December 30, 1911).

Introduction.

Already in 1836 FRANKENHEIM¹⁾ pointed out that it cannot be said that a depositing pure substance will be solid or liquid according as the temperature at which this takes place lies under or above the melting-point of this substance. Thus phosphorus and sulphur, e.g. can deposit from solutions in liquid state, in spite of the temperature lying below the point of solidification. The same phenomenon has sometimes been observed when vapours were cooled.

Concerning this FRANKENHEIM writes as follows:

“Schwerer als aus Auflösungen kann ein Körper aus dem Dampfe flüssig niedergeschlagen werden, wenn die Temperatur unter dem Schmelzpunkte steht. Jod, welches sehr leicht, auch bei gewöhnlicher Temperatur sublimiert, habe ich nur in Krystallen erlangen können.... Bei dem Phosfor war jedoch das Resultat entscheidend. Ich brachte ihn auf ein etwas hohl geschliffenes Glas, legte eine dünne Glas-

¹⁾ Pogg. Ann. 39, 380 (1836).