because of the very minute amount of material in a film a light wave or less in thickness, it is of interest to inquire if it is in the form of a chemical compound with the metal or not. This must of course be answered eventually, if at all, on the basis of proved stoichiometrical proportions. We cannot decide this at present, but we can, however, adduce certain evidence. Each of the three cobalt films sputtered in helium had exactly the same crystal dimensions—20 per cent. increase above the normal face-centred cubic cobalt (the cathode was a mixture of face-centred cubic and hexagonal)—in spite of somewhat different sputtering conditions. All of the seven iron films sputtered in helium had exactly the same crystal dimensions, apparently a swelling of nearly 22 per cent. above the normal. Ten different specimens of nickel, sputtered in different gases, had a common distension of 6 per cent., although with this metal there were other values which occurred in some specimens and not in others. It was possible in the above cases to reduce, by controlled heating, part of the specimen to the pure metal leaving the rest unchanged, as shown by the X-ray picture which showed both forms present at once. This is fair evidence against the idea of simply a solution of the gas in the metal. The case seems to be somewhat different from that of palladium : we sputtered this in hydrogen and found various distensions up to 3 per cent. It was possible, by suitable heating, to reduce the distension, *i.e.* the gas in the palladium, by any desired amount.

We regard this as evidence of a chemical or at least quasi-chemical union of the metal and the gas. Compounds with hydrogen would of course be possible, and with helium and argon at least not unthinkable. The loss of magnetism is possibly to be associated with a changed electron distribution in the metallic atom, due either to the influence of the chemical combination or simply to the increased distance of the atoms apart. (See also L. C. Jackson, *Phil. Mag.*, 2, p. 86, 1926.)

We have been at some pains to forestall the most *obvious* point of criticism, which would be to the effect that small traces of oxygen in the residual gas might cause these metals to sputter as (non-magnetic) oxides which reduced on heating to the pure metal. Some colour is lent to this point of view by the fact that the lattice spacing of cobalt as deposited is almost exactly that of cobalt oxide. There are several reasons why we do not believe this view tenable : (1) We have taken great pains in purifying the gases, particularly as regards removing hydrogen and oxygen from the helium and argon : there was probably a trace of nitrogen in each. (2) If the metal, *e.g.* cobalt, is sputtered as an oxide, it must be of such a character as can be reduced to the metal by heating in a vacuum for a few minutes to, say, 350° C. This possibility is contradicted by chemical evidence, and experiments we have made on cobalt oxide indicate that such reduction is impossible. (3) There are minor differences between the lattice shown by the original cobalt films and cobalt oxide which clearly separate them. It would seem, nevertheless, as if we had here a cobalt helium compound very like cobalt oxide.

The work is to be continued with certain improvements, such as the use of fused quartz instead of glass, on which to deposit the films : also with better means for thorough outgassing and for extreme purification of the residual gases.

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The Spectra of NH Compounds.

IT is well known that the flame of ammonia emits several characteristic bands. The appearance of the bands is strongly influenced by the temperature of the source. Thus the spectrum of the cool flame of ammonia is dominated by the diffuse so-called α-group in the yellow region. In the spectrum of a hot source of ammonia, burning in the electric arc, the β-group with its intensity maxima at $\lambda\lambda$ 3370, 3360 is photographically by far the most intense. From investigations on the exciting conditions and on the structure of these bands, one may suppose that the very complicated α-group is emitted by the excited NH_3 or NH_2 molecules, or a mixture of both, as one can distinguish with some degree of certainty two different systems in α. Judging from some very distinct structural relations holding between the β-group and the long series of known hydride spectra, we refer the origin of this group to the NH dipole. This will be discussed later. Other bands of the ammonia-oxygen flame are referred by Eder to NO compounds. Very recently, K. Gleu, in an interesting
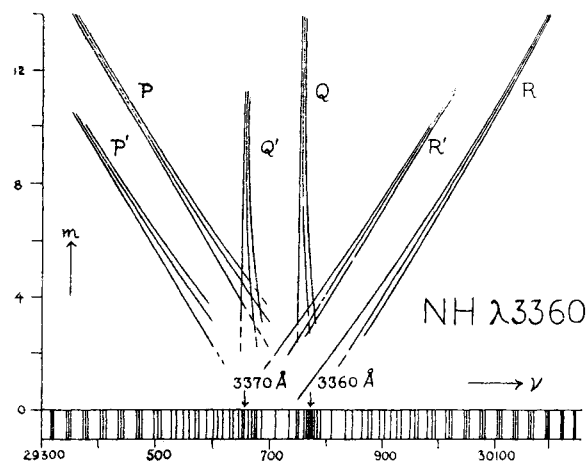

FIG. 1.

paper on the chemi-luminescence of chlorine trinitride in hydrogen trinitride (*Zeits. f. Phys.*, 38, p. 176, 1926), reported some new bands of nitrogen hydride. From their symmetric positions around the β-group and their comparatively simple structure we suggest that they also belong to the spectrum of the NH dipole.

We have lately studied the structure of the β-group, using Fowler and Gregory's measurements (*Phil. Trans. Roy. Soc. London*, A, 218, p. 351, 1919) as well as our own, taken from spectrograms of high dispersion (1 Å.U. = 1·2 mm.). Fig. 1 gives a rough view of the system arranged in a ν-m diagram. The characteristic triplets on both sides of the intensity maximum at λ 3360 are shown as P- and R-branches, while the intensity maximum itself is supposed to be made up of the overlapping lines of the corresponding Q-branch. The long-wave component (Q_1), especially in the Q-triplets, thus causes the region which is still unresolved with a very high dispersion at λ 3360·31. As in the cases of many other band spectra, this arrangement gives rise to a 'combination defect' which has to be explained by assuming a separate set of rotational terms for the Q-branches *vis-à-vis* with those of the P- and R-branches. From a closer analysis of the spectral terms, it appears that the initial state contains an electronic triplet, while the final state is a singlet. The final state, however, includes a rotational triplet of unknown nature in which the very

small term separation increases linearly with m ($\sim 0.010\,m$). Accurate figures for the electronic frequencies cannot be obtained (~ 29750 cm.$^{-1}$) owing to the difficulties in computing the series down to their origins. If we denote by σ and ϵ the quantum numbers of the total electronic angular momenta parallel and perpendicular to the figure axis of the dipole, it appears from the analysis that the initial term contains distinct σ, ϵ components, while in the final state, $\sigma = 0$, $\epsilon = \frac{1}{2}$. The nuclear spacing of the molecule in its final state is $r_o = 1.10 \times 10^{-8}$ cm.

The above statements are in agreement with the hypothesis on the appearance of Q-branches in band spectra, and also point to some clear relations holding between this spectrum and those of the hydrides as they appear in the periodic table. All the known hydride spectra are associated with electronic transitions of the type $S \longrightarrow S$ or $S \gtrless P$. These two types can sometimes be distinguished from each other by the fact that bands of the first type contain only P- and R-branches, while those of the second type have Q-branches in addition. This seems to be a general rule holding for all band spectra. Consequently we assign to the β-group of the NH spectrum a $^3P \longrightarrow {}^1S$ transition, where ^3P separations should agree in magnitude with those in the spectrum of the preceding atom, here carbon, which spectrum, however, is still imperfectly known.

While the spectrum discussed above apparently forms the spectrum of the non-vibrating molecule ($n_1 = 0$, $n_2 = 0$), the secondary maximum at $\lambda\,3370$ with the faint triplets on both sides of it can be explained in detail as the corresponding first vibration spectrum ($n_1 = 1$, $n_2 = 1$).

The triplets in the β-group are of the same type as those forming the bands of the second positive group of nitrogen. It is, however, interesting to note here that the regular alternation of intensity observed in the short-waved component (a narrow doublet) of the N_2 triplets has no counterpart in the NH triplets, the components here being all single so far as can be judged from our spectrograms. This also confirms the assumption of Mecke, according to which such anomalies are to be found in the spectra of symmetric molecules as H_2, He_2, HCCH, N_2 (see also Slater's hypothesis on this problem, NATURE, April 17, 1926, p. 555).

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Icebergs in Relation to Water-Temperature.

IN an article in NATURE of Nov. 20, p. 750, which discusses means of enabling a vessel to detect the proximity of icebergs at sea, a remark is made which indicates that the attempt to do so by means of the temperature of the water has proved unavailing. When the conditions are considered it could scarcely be otherwise. I was impressed by this during two seasons spent in investigating the currents in Belle Isle strait, in 1894 and 1906, when the matter was looked into.

In that strait the surface water may warm up to 57° F. in summer, while the deeper water remains little above freezing point. Hence, with a heavy wind across the strait, the surface water may be driven to the leeward shore, allowing the cold under-water to come up to the surface. A vessel on its way through the strait might thus find the temperature so low as 45° or even 35° in the summer time, which is a large change compared to any lowering of the temperature by ice.

It is also to be noted that in currents at sea the velocity decreases from the surface downward; and an iceberg which may have a draught of 150 feet to 300 feet (as shown by the depth in which it grounds) will move at the average velocity of the current between the surface and that draught. Accordingly, there is normally a flow of surface water past an iceberg, due to difference of velocity, when it travels in a marine current. The only chill to the water is therefore in the tailing or wake, on one side of the iceberg, in the line of flow. Unless a vessel approaches towards that side it would detect no difference in the water temperature.

The amount of chill in the region of Belle Isle strait, in water which is already cold, was investigated with a boat, going close up on all sides of the icebergs. When the general surface temperature was 35.5° F. the water tailing from an iceberg was 35°, while on its other sides no difference was found. A small berg aground in a bay in which the surface temperature ranged from 34° to 34.5°, chilled the water to 33.5° close around it. In the case of a large iceberg (780 feet by 290 feet at the water-line, and aground in 57 fathoms) the water temperature, 37°, did not vary within 130 feet of it. Such small differences could not be considered as an indication of practical value, especially when within a few hundred feet of the bergs.

Nevertheless, Dr. H. J. Barnes was hopeful of more definite indications by means of his highly sensitive thermometer, especially near the meeting-place of the Labrador Current and the Gulf Stream, where the water is warmer and almost motionless. But a further feature was encountered under these conditions; for the water chilled by the iceberg sank vertically down from its sides. With an iceberg in relatively warm and still water there is thus theoretically a movement of the surface water inward towards the berg, instead of any spread of chilled water around it. The lowered density of the sea water due to dilution from the melting ice does not seem to counteract this, because of the rapid rate of increase in the density of water with fall of temperature.

When such conditions are understood, the uncertainty of any temperature warning against floating ice will be appreciated. W. BELL DAWSON.
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The Chromosome Number in *Dactylis glomerata* (Cocksfoot).

IT is only recently that the attention of cytologists has been directed to the ascertaining of the chromosome number in the herbage grasses. In a letter to NATURE of Dec. 11 (vol. 118), p. 841, Mr. Gwilym Evans states that he has discovered the number in the Lolium spp. and has given a tentative estimate of the number in the two varieties of *Festuca elatior*.

Whilst engaged at the Welsh Plant Breeding Station, Aberystwyth, in carrying out preliminary investigations on the genetical behaviour of *Dactylis glomerata*, it was thought expedient to ascertain the chromosome number of this species. The nuclear divisions, both somatic and meiotic, have been extensively investigated; the root-tips being selected as the most promising material for an examination of the somatic, whilst the meiotic divisions were studied in the anther.

The root-tips were fixed in Flemming's Solutions, in some cases a little modified. For the fixation of the anthers, Flemming's Solutions proved entirely unsuitable. Excellent fixation was, however, obtained with Bouin's Picro-formol and with Allen's modifica-