chloride the main product is diazoacetophenone, and they therefore suggest that I and my collaborators, in this case Clibbens, have published statements which cannot be corroborated. I would point out that since they conducted the experiment in accordance with the second alternative method of Arndt, it is not surprising that they obtained the result which they might have anticipated had they been acquainted with Arndt's work, and not the result which would have been arrived at if they had followed the procedure of the Nierenstein reaction, as confirmed by Arndt.

I also take this opportunity of correcting a somewhat serious mis-statement which the same authors make in reference to my work. They express surprise that I should have stated that a certain substance containing two active Ph. Br. CO. groups should "crystallise unchanged from alcohol" (*J. Am. C. S.*, 47, 1730; 1925), referring to this alleged statement as an "unconventionality." Reference to the paper will show that the substance is said to "crystallise in long needles from benzene," and that alcohol is not mentioned as a solvent from which the substance can be crystallised.

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Infra-red Emission of Carbon Dioxide.

DURING the course of an investigation into certain infra-red emission spectra, we re-examined that of burning carbon monoxide. In the absorption spectrum of carbon dioxide it is necessary to presume the existence of three fundamental vibrations in the near infra-red; in this way the other bands observed in the so-called rotational-vibrational spectrum can be accounted for as a system of harmonics and combinations: nevertheless the observed values depart from those calculated by several units per cent.

If the emission spectrum is analysed, it is found that most of the bands have shifted towards the longer wave-lengths and so become exact multiples of a frequency, $\nu = 16 \times 10^{11}$, in the far infra-red. Our observations are recorded in the following table: the values for the absorption spectrum are taken from the work of Schaefer and Philipps (*Zeit. f. Physik*, 36, 641, 1926).

No.	Emission.				Absorption.	
	λ .	$n\nu_0$.	$\nu \times 10^{11}$.		λ .	$\nu \times 10^{11}$.
1.	1.70 μ	110 ν_0	1760	1764	1.61 μ	1864
2.	1.99	94 ν_0	1504	1508	2.02	1486
3.	2.40	78 ν_0	1248	1250	..	..
4.	2.79	67 ν_0	1072	1074	2.69	1115
	2.84	66 ν_0	1056	1056	2.72	1102
	2.87	65 ν_0	1040	1045	2.76	1086
5.	4.46	42 ν_0	672	673	4.25	706
6.	[15.6]	12 ν_0	192	..	14.87	202
7.	[187.4]	ν_0	16	..	..	..

No. 3 is new, not having been previously observed either in absorption or emission; No. 4 is a doublet which can just be resolved with a rock-salt prism spectrometer; No. 5 is generally quoted as 4.40 μ , but most careful calibration of the two spectrometers used, together with frequent repetition, confirms our result, the corresponding value for the bunsen flame at a lower temperature being 4.44 μ .

Many interesting theoretical points present them-

selves, but it seems that here we are dealing with a pure rotational spectrum; it is suggestive that the Krüger gyroscopic molecule (founded on the earlier Bohr atom) executes a regular precession at low temperatures which changes to a true rotation at more elevated ones.

A corresponding simplicity underlies the water vapour emission spectrum which we have also investigated.

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May 25.

The Spectrum of Ionised Sodium.

IN a noteworthy article with the above title (*Phil. Mag.*, 5, 150; 1928), Prof. F. H. Newman has given a new list of wave-lengths of the spark spectrum of sodium, which had previously been investigated by Foote, Meggers, and Mohler. The lines in question lie mainly in the near ultra-violet, between 2300 Å. and 4800 Å. No analysis of the Na II spectrum is attempted in the above-mentioned paper, but a number of pairs showing constant differences are given. I wish to show that using one of those differences (most of the others seem to be accidental) it is possible to arrange numerous strong lines as combinations of four s terms with ten p terms, corresponding to the transition ($3s^1^3P - 3p^1^3(S, P, D)$). The wave-length arrangement is the following:

	$(s_5)^3P_2$	$(s_4)^3P_1$	$(s_3)^3P_0$	$(s_2)^1P_1$
p_{10}	3533	3631	3711	...
p_9	3093			
p_8	3056	3130		3463
p_7	3008	3079	3136	3400
p_6	2918	2984	...	3286
p_5	2860	2924	2975	3212
p_4	2842	2905		3190
p_3		2881?		...
p_2	2810	2872	2921	3150
p_1		2586		2810

The frequency differences between the four lower levels $^3P_2, ^3P_1, ^3P_0, ^1P_1$ are respectively: 765, 592, 2481 cm^{-1} . The sum of the second and third of these is the difference 3073 cm^{-1} the occurrence of which was found by Prof. Newman. It is noteworthy that the difference $^3P_2 - ^3P_0 = 1357 \text{ cm}^{-1}$, which may be interpreted as an L doublet yields, when inserted into the relativistic doublet law, exactly the same screening constant, 3.20, as the corresponding difference 780 of Ne I. For the comparison of the four differences of Na II with the corresponding ones of Ne I (417, 360, 1070), reference may be made to a paper by Mack, Laporte, and Lang (*Phys. Rev.*, June 1928). In every respect the above arrangement is similar to the first member of the principal series of Paschen's famous neon classification. As is easily seen, the next member of this system of series must lie deep in the Schumann region.

Parts of the diffuse series

$$3p^1^3(S, P, D) - 3d^1^3(P, D, F)$$

have also been found. All the strong and many of the weaker lines have thus been classified. The complete numerical material will be published soon.

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