

a plane glass grating of 10,800 lines to the inch, a vacuum spectrograph; and X-ray tube with a graphite target in the same vacuum, we find that the K line of carbon can be photographed from the 18th negative order to the 13th positive order, or over a range of $n\lambda$ from 0 A. to 810 A. In this way, using a small dispersion, the carbon K line has been compared with the copper $L\alpha$ and $L\beta$ lines in their second and fourth orders, the wave-lengths 44.7 A. and 44.8 A. being obtained for the carbon line relative to 13.32 A. for the copper $L\alpha$ line. The approximate coincidence of different orders has also been used to compare the wave-length of the first order K lines of aluminium lines reflected from a sugar crystal with the wave-length of the $K\alpha_{1,2}$ copper lines in the 5th and 6th orders. We find $Al K\alpha_{1,2} = 8.315$ A. relative to $Cu K\alpha_{1,2} = 1.5392$ A.

T. H. LABY.
R. BINGHAM.

University of Melbourne,
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Structure of Hydrogen Sulphide, Hydrogen Selenide, and Nitrogen Dioxide at Liquid Air Temperature.

In connexion with previous determinations of the structure of solid α -nitrogen¹ and of solid carbon monoxide, we have during last year carried out a structure analysis of solid hydrogen sulphide, hydrogen selenide, and nitrogen dioxide by means of powder diagrams obtained with an apparatus described in a previous paper. A more complete description of the results will appear elsewhere, but I want here briefly to state some of the principal results.

Solid hydrogen sulphide and selenide are both isomorphic with a cubic elementary cell containing four molecules. The sulphur and selenium atoms are arranged in a face-centred lattice. If the hydrogen atoms are to be given definite positions in the lattice, a discussion of all possible arrangements leads to the result that the atoms of a molecule must be situated on a straight line.

The most probable space group would be T^4 , if the molecule is asymmetric, and T^6_2 , if it is symmetric. For the side of the cell (a) and the density (ρ) we found for hydrogen sulphide, $a = 5.76$ A.; $\rho = 1.17$; for hydrogen selenide, $a = 6.10$ A.; $\rho = 2.34$.

These determinations were finished in July this year.

Solid nitrogen dioxide has also a cubical structure, but much more complicated than that of hydrogen sulphide and selenide.

The side of the elementary cell (a) is 7.77 A. The density (ρ) of solid nitrogen dioxide was determined separately to be 1.93, which gives six molecules in the cell. All lines observed fulfil the condition: $\Sigma h =$ an even number, which means that the lattice may be regarded as composed of cube centred lattices.

After having discussed all space groups fulfilling these conditions, we find T^5 to be the only one possible. This space group gives one parameter for the nitrogen atom, and three parameters for the oxygen atoms. By making certain assumptions regarding the limits for the nearest approach of the atoms, we have succeeded in determining the parameters so as to give a remarkably good agreement between observed and calculated intensities.

A more detailed description of this rather complicated structure will be reserved for a subsequent paper.

L. VEGARD.

Physical Institute, Oslo,
Nov. 6.

¹ L. Vegard, *Zeit. f. Phys.*, 58, 497; 1929.

Isomorphism and Chemical Homology.

IN April 1929 I published a paper on "Monofluorophosphoric Acid and the Similarity of its Salts to the Sulphates" in the *Berichte der Deutschen Chemischen Gesellschaft*, p. 793. I stated that I had succeeded in preparing the monofluorophosphates, which I described in detail and also that the ion PO_3F^- shows all the properties of SO_4^{2-} . I pointed out that the salts of monofluorophosphoric acid resemble completely the salts of sulphuric acid and that the crystallographic investigation of the new salts was being carried out. I considered that the reasons for the similarity of chemical properties of the two ions lay in the similarity of the radii of the two central atoms, in the equality of their co-ordination number and of the electric charges of the anions and also in the equality of the volumes of O^- and F^- . At the end of the paper I stressed the fact that this investigation was still in progress. The direction in which the investigation was being continued is revealed in a petition which I addressed on April 29, 1929, to the *Notgemeinschaft der deutschen Wissenschaft* which contains this statement: "monofluorophosphoric acid H_2PO_3F resembles sulphuric acid H_2SO_4 so closely that it even gives alums, which are isomorphous with ordinary sulphate alums". Since the discovery of alums was to be foreseen by anyone after the publication of these facts, I delayed immediate publication of the new results, since they did not involve any new point of view.

I was, therefore, surprised to see in NATURE of Aug. 30, p. 310, a paper by Sir P. C. Rây on monofluorophosphates in spite of my notice that my work was being continued. Amongst other matters he prepared the alums which were to be foreseen. He also described as quite new facts his results, which he obtained with the aid of the conclusions which I had already indicated, without any mention of my name or acknowledgment of my work. Moreover, he did not give the method by which he prepared the PO_3F^- ions. I can only suppose then that Sir P. C. Rây is unaware of my work, although it appeared in one of the most widely circulated journals, and was indeed abstracted in *British Chemical Abstracts*, vol. A, p. 663, and in the *Chem. Zentralblatt* I, p. 2626, and in *American Chemical Abstracts*, vol. 23, p. 4903.

WILLY LANGE.

Chemisches Institut,
Universität Berlin,
Oct. 30.

Raman Lines of Simple Polyatomic Molecules.

IN the course of a study of the structure of simple polyatomic molecules, the Raman spectrum of hydrazine, N_2H_4 , was obtained with the view of finding the Raman line or lines which correspond to the symmetrical vibration N-N in polyatomic molecules. We should expect to find a line in the neighbourhood of 1600 cm^{-1} , but the hydrazine spectrum showed three lines of roughly equal intensity at 3196 cm^{-1} , 3270 cm^{-1} , and 3344 cm^{-1} , along with a very doubtful line at 1720 cm^{-1} . These three lines are obviously due to N-H vibrations, and it seems curious that the symmetrical vibration should be so weak (if present at all) in the spectrum of this molecule.

Hydrazine hydrate, $N_2H_4 \cdot H_2O$, gave the same three lines but with very much weaker intensity for comparable times of exposure. Both gave much continuous background, especially the latter. It appears from the results of other workers on polyatomic molecules that the vibration frequencies which turn up with greatest intensity in the Raman effect are those which correspond to symmetrical (inactive)