making angles approximating to 90° with the basal plane give relatively high scattering factors.

These results point either to a pronounced asymmetry of the atoms, consisting of an elongation in the direction of the c-axis, or to a similar asymmetry in the lattice vibrations. The effects are too large to be attributable to atomic asymmetry, but may be explained in terms of a greater lattice vibration along the c-axis than normal to it. This is in accord with the work of Grüneisen and Goens on the thermal expansion of zinc and cadmium; they have explained their results in terms of two mean characteristic temperatures which for zinc are $\bar{\Theta}_z = 200°$ in the direction of the c-axis and $\bar{\Theta}_x = 320°$ normal to the c-axis. Since the r.m.s. amplitude of lattice vibration is approximately proportional to $1/\bar{\Theta}$, it follows that the mean amplitude along the c-axis is *greater* than normal to it approximately in the ratio 320/200, that is, 1·60. It will be shown in detail elsewhere that the X-ray scattering factors for zinc and cadmium are in full agreement with the view that the amplitude of vibration along the c-axis is greater than normal to it, and for intermediate directions has intermediate values.

Note added to proof: February 7. Since the above was written, a theoretical paper by Zener has appeared in the *Physical Review* giving results similar to those found experimentally.

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Crystal Structure and Shape of Colloidal Particles of Vanadium Pentoxide

THE analysis of the crystal structure of V_2O_5 seemed to be of special interest in relation to the well-known tendency of vanadium pentoxide in colloidal solution to form rod-like particles. Further, practically nothing is known about the structure of compounds of the form A_2B_5, such as Nb_2O_5 and Ta_2O_5, as well as V_2O_5.

Rotation diagrams around the three principal axes using copper $K\alpha$- and chromium $K\alpha$-rays, of crystals isolated from fused V_2O_5, showed them to be rhombic with the following cell-dimensions:

$$a = 11{\cdot}48 \pm 0{\cdot}01\ \text{A.};\quad b = 4{\cdot}36_0 \pm 0{\cdot}005\ \text{A.};\quad c = 3{\cdot}55_5 \pm 0{\cdot}005\ \text{A.}$$

This elementary cell contains two molecules of V_2O_5.

An exhaustive examination of the space-groups of the rhombic system leads to the conclusion that only the space groups C_{2v}^7 and V^3 are not immediately excluded by the observed intensities. However, the structure in C_{2v}^7 alone is in accordance with the observed absence of reflections $h0l$ with $h + l \neq 2p$, and the total absence of fifth order reflections on the diagram round the a-axis. The vanadium atoms are situated on one 4-equivalent place (4b), the oxygen atoms on two 4- and one 2-equivalent place (2a):

$$2(a): 0uv,\ \tfrac{1}{2}\bar{u}\tfrac{1}{2} + v.\quad 4(b): xyz,\ \bar{x}yz,\ \tfrac{1}{2} - xy\tfrac{1}{2} + z,\ \tfrac{1}{2} + x\bar{y}\tfrac{1}{2} + z.$$

The ten parameters involved in this structure were determined, using the observed intensities only, without taking into account the spatial arrangement. The best agreement between calculated and observed intensities is obtained with the following set of values:

$$x_m = 0{\cdot}146 \pm 0{\cdot}0030 \quad x = 0{\cdot}155 \pm 0{\cdot}007 \quad x = 0{\cdot}195 \pm 0{\cdot}007$$
$$y_m = 0{\cdot}095 \pm 0{\cdot}005 \quad y = 0{\cdot}45 \pm 0{\cdot}01 \quad y = 0{\cdot}04 \pm 0{\cdot}01 \quad u = 0{\cdot}17 \pm 0{\cdot}02$$
$$(z_m = 0) \quad z = 0{\cdot}92 \pm 0{\cdot}02 \quad z = 0{\cdot}46 \pm 0{\cdot}02 \quad v = 0{\cdot}11 \pm 0{\cdot}03$$

This structure of V_2O_5 can be described as built up from deformed tetrahedrons of oxygen atoms round each vanadium atom, arranged in chains along the c-axis by sharing corners; the chains are in the same way connected to form planes parallel *to 010* (each tetrahedron sharing three corners) in accordance with the observed cleavage: 010 > 100 > 001.

The presence of these chains thus explains the building up of rod-like particles in a V_2O_5-sol. An investigation of colloidal V_2O_5 showed, indeed, that the particles are rods parallel to the c-axis; for example, in a two weeks' old sol: A = 15–20 A., $B < 10$ A., $C = 150$ A. This lath-like rather than rod-like form of the particles causes a hitherto unknown anisotropy effect, as it was found that in a film, formed by exsiccation of a sol, the particles were oriented with their 010-planes parallel to the film, but otherwise at random.

The investigation of the crystal structures of Nb_2O_5 and Ta_2O_5, which are isomorphous with each other but not with V_2O_5, although the cell dimensions show a close similarity, has not yet been completed.

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Use of Multiphase Oscillators with a Cyclotron (Lawrence) for the Production of High-Velocity Particles

THE cyclotron at present has a limited voltage amplification due, in part, to a space charge built up within the duants. The space charge density may be lowered by reducing the intensity of the ion beam alone, or by increasing the high-frequency alternating potential on the duants, thereby reducing the number of times the ion must circulate before attaining the desired velocity. These two methods of lowering the space charge are obviously undesirable. If the number of times the ions is accelerated in one revolution is increased there will be a resultant decrease in space charge density.

In connexion with the construction of a cyclotron now under way here, it is planned to experiment with multiphase oscillators connected with corresponding multisector accelerators. For example, with a three-phase oscillator connected (Y connexion with neutral connected to case of accelerating chamber) to triants A, B, C in the cyclotron, the ion will be accelerated three times per revolution (as compared with two times per revolution in the duant cyclotron); the space charge is reduced 50 per cent; capacity of the electrodes 33 per cent; and the root mean square high-frequency potential, the magnetic field, and the frequency of the oscillator are still the same. The maximum accelerating potentials, V_{AB} max., V_{BC} max., V_{CA} max. (for the three-phase triant type) for a forward direction are separated