chamber. On one occasion we inserted an additional sheet of mica in the path of the disintegrating alpha-particles and found that about one in seven has a range in excess of 4.3 cm. (See Fig. 1.)

The fact that the disintegration of boron varies with proton voltage in the same way as in the case of lithium, is particularly interesting. Beyond 400 kilovolts, as has been pointed out by Henderson, the entire increase in the rate of disintegration is accounted for by the greater distance the protons travel in the boron. In other words, the observations for both lithium and boron indicate that the effective collision cross section for disintegration does not increase perceptibly with the speed of the proton beyond four or five hundred thousand volts.

We are continuing the experiments with other elements. It will be interesting to see if any of higher atomic number, particularly those of the $4n+3$ type, have an effective collision cross section for disintegration that attains a constant value at such low voltages.

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Occurrence of $CuAl_2$ in Duralumin

The presence of $CuAl_2$ in the duralumin type of aluminum alloys has been detected in the past both micrographically[1] and by x-ray methods,[2, 3, 4] the x-ray diffraction method being most sensitive and giving unambiguous results while the interpretation of micrographic evidence is often difficult.

Previously, $CuAl_2$ has been found in these alloys (about 4 percent Cu) only in very small quantities after very long accurately controlled heat treatment following quenching.

During an x-ray investigation of the condition of duralumin aircraft propeller blades very large quantities of $CuAl_2$ were found by x-ray diffraction and photomicrographs to exist in certain portions of an old blade that had been in use for twice the number of flying hours of the average blade. Throughout the major part of the blade very little $CuAl_2$ could be found and this only in the outermost fibers. However, an examination of the circular cross section just outside of the position of the steel hub clamp showed that large quantities of this intermetallic compound had precipitated from the solid solution. This region of precipitation extended throughout the entire section, the amount of $CuAl_2$ decreasing from the outside surface toward the geometrical center of the section. Largest amounts of the compound were found in the region of the neutral plane.

The amounts of $CuAl_2$ found in the hub section are much larger than could have been caused by any known type of heat treatment for ordinary lengths of time[5] and it is thought probable that the peculiar combination of forces existent in propeller blades is the cause of this abnormal condition, i.e., lattice strain, fatigue and high-frequency vibration and a combination of these with particular types of heat treatment and a time factor hasten the precipitation of the compounds. The discovery of the causes and the allocation of this excessive precipitation of $CuAl_2$ should be of vital importance in the development of more satisfactory manufacturing methods and of a more stable alloy.

The results of a more detailed study now being made of this and other blades as well as of the specific effects of repeated stress, lattice strain and high-frequency vibration on the precipitation of intermetallic compounds from metastable solid solutions will be published at a later date.

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The Infrared Spectrum and the Molecular Structure of Ozone and Sulfur Dioxide

The writers have been interested in the fine experimental work on the infrared absorption spectrum of ozone by Gerhard,[1] but they cannot agree with his conclusions as to the structure of the ozone molecule, nor with the conclusions of Bailey, Cassie and Angus[2] in regard to that of sulfur dioxide. These authors have postulated for the molecules in question structures in the shape of an isosceles triangle with an apex angle less than 60°, but this seems very unlikely from several points of view.

In the first place, since nearness of approach of two adjacent atoms is one criterion for a chemical bond, and since the distance of approach is a measure of the strength of the bond, the structure mentioned would require two atoms strongly bound to each other (in sulfur dioxide, the two oxygen atoms) and the third less strongly bound to both of these two, or in other words, a ring structure. In ozone a ring structure is unlikely unless it is completely symmetrical, which it clearly cannot be since all three

fundamental oscillations are active, and in sulfur dioxide seems unlikely. Furthermore, the normal coordinate treatment of the fundamental oscillations, though it gives a solution for the triangle with small apex angle which approximately fits the observed frequencies, requires that the binding between the two symmetrically placed atoms be very much smaller than between the other pairs. It is very improbable that the pair of atoms of closest approach should be so weakly bound.

It seems possible that Gerhard has chosen the lowest fundamental frequency wrongly, since Wulf[3] has shown it to be approximately 400 cm^{-1}; and it is rather unlikely that the error in his estimate is as large as would be required by Gerhard's analysis. If this is the case, his explanation for the band at 4.7μ is not valid, since the only band to be expected in this region should be $2\nu_3$, which should have extremely small intensity.

Some years ago G. N. Lewis suggested a probable similarity in the structures of ozone and sulfur dioxide, which is supported by a comparison of their spectra. Mecke[4] has given an analysis of the sulfur dioxide bands compatible with an apex angle of the triangle about 120°, and it appears to the writers that the ozone spectrum may be given a similar analysis which is rather more plausible than that of Gerhard. A comparison of the spectra is made in Table I, where the predicted type of band, whether doublet

TABLE I.

Designation	ν_2	$\nu_1-\nu_2$	$2\nu_2$	ν_1	ν_3	$\nu_2+\nu_3$	$2\nu_1$	$\nu_1+\nu_3$
Predicted type	D	D	D	D	Z	Z	D	Z
O_3	$\sim$440(?)	—	(879?)	1050(D)	1355(Z)	—	$\sim$2110(?)	—
SO_2	$\sim$525(?)	606(D?)	(962?)	1152(D)	1361(Z)	1871(?)	2305(D)	2502(?)

(D) or with central branch (Z), is indicated above, and the observed type after the wave number of the band center.

It is rather difficult to decide in some cases, when insufficient resolution has been employed, whether a given band is of the one type or the other, especially if the central branch is weak. This is the case with sulfur dioxide, particularly in the band at 2502 cm^{-1}, which from the measurements of Meyer, Bronk and Levin[5] appears to be a doublet, but which almost any analysis requires to have a central branch.

The best way to clear up any remaining uncertainties seems to be to study the fundamental band of lowest frequency, which so far has not been done for either of the gases.

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