THE PHYSICAL CONSTITUENTS OF THE ATMOSPHERE OF VENUS.

BY CHAS. E. ST. JOHN AND SETH B. NICHOLSON.

THE literature on planetary atmospheres is permeated with the assumption that the atmosphere of Venus is similar to our own, in particular as to the presence of oxygen and water vapor. This assumption rests upon spectrographic observations with low dispersion in which an increased intensity of the terrestrial lines was thought to be seen in spectra of Venus. Spectrograms of Venus with a dispersion of 3 Å. per mm. when the relative velocity was sufficient to separate lines due to atmospheric absorption in Venus from the corresponding terrestrial lines show, however, no trace of lines in the positions in which the Venus components should appear. From comparison with laboratory observations it is deduced that companions to the terrestrial lines should have been detected, if the light had penetrated a layer of oxygen on Venus equivalent in radial depth to 3 meters of oxygen under normal conditions.

In the depth penetrated in the planet's atmosphere there was then less than one five-hundredth part of the amount of oxygen in the earth's atmosphere.

As to water vapor it is deduced that if the solar beam had traversed, in and out, one millimeter of precipitable water, the water-vapor lines would have been doubled.

According to Jewell's observations the water vapor in the atmosphere over Baltimore is equivalent to 40 mm. of water. Moore gives it as about 50 mm. for the ordinary American climate.

MOUNT WILSON SOLAR OBSERVATORY.

THE SEPARATION OF MERCURY INTO ISOTOPES.

BY WILLIAM D. HARKINS AND R. S. MULLIKEN.

THE paper reports the details of the apparatus used in a separation of the isotopes of mercury amounting to 127 parts per million. It is found that the separation attained varies as the logarithm of the cut and as the square of the difference of atomic weight (when there are only two isotopes), and inversely as the mean atomic weight.

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THE CRYSTAL STRUCTURE OF MERCURY.

BY L. W. MCKEEHAN AND P. P. CIOFFI.

THE crystal structure was determined by the "powder" method developed by A. W. Hull,[1] and with standard equipment for the use of molybdenum x-rays obtained from the General Electric Company. The low temperature required to keep the mercury frozen was obtained by boiling liquid air by an electric heater in a small vacuum flask and allowing the vapor to escape through

[1] PHYS. REV. (2), *10*, 661 (1917).

a glass tube in which the cylindrical sample was mounted axially. A temperature of about $-115°$ C. was thus maintained. To prevent the deposit of ice crystals on the air conduit it was made double walled with vacuum heat insulation. The sample itself consisted of a thin coat of minute mercury droplets condensed on the outer surface of a paraffin- or shellac-coated glass capillary tube mounted in metal bearings and provided at one end with a light screw propellor. The cooling air thus supplied the motive power for rotating the sample. Since much of the radiation utilized had to traverse six thicknesses of glass, the thinnest practicable walls were used and pyrex glass was chosen, further, to minimize absorption. Even so, exposures up to nearly thirty hours were required with 30–35 milliamperes through the x-ray tube, and the photographs are too faint for easy reproduction.

Preliminary trials, using the plots furnished with the apparatus[1] showed the best fit with a rhombohedral lattice with the axial ratio 1.94. It was assumed in the calculations that the agreement between the spacings of (111) and (110) planes was exact, which requires

$$\lambda = \cos^{-1}\tfrac{1}{3} = 70° - 31'.7,$$
$$C = \tfrac{1}{2}\sqrt{15} = 1.9365,$$

and gives a pattern of great simplicity. The tabulated values include all the

Miller Indices.	Theoretical Spacings.	Observed Spacings.		Relative Intensity Estimated.
		No. 1.	No. 2.	
	$a = 3.025$			
	$\lambda = \cos^{-1}(\frac{1}{3})$			
100	2.761	2.760	2.771	8
111	2.250	2.245	2.255	10
100				
$10\bar{1}$	1.747	1.748	1.750	6
$11\bar{1}$	1.476	—[2]	1.474	4
211				
210	1.381	1.382	1.379	2
100(2)				
221	1.235	1.255	1.235	2
$20\bar{1}$				
111(2)	1.127	1.125	—	1
110(2)				
$21\bar{1}$	1.083	1.085	—	1
$2\bar{1}\bar{1}$	1.008	—	1.035	1
311				
321	0.947	—	0.943	1
310				

[1] A. W. Hull and W. P. Davey, PHYS. REV. (2), *17*, 549 (1921).

[2] Bad spot on film too close to estimate position of line.

Rhombohedral System:	$\lambda = 70°\ 31'.7$,	$a = 3.025 \times 10^{-8}$ cm..
Hexagonal System:	$C = 1.9365$,	$a = 3.493 \times 10^{-8}$ cm.
Atomic volume:	23.82×10^{-24} cm.[3],	

distinct lines on the two best photographs, and show excellent agreement with the assumed structure. The calculated density if one atom is associated with each cell (simple rhombohedral lattice) is 13.97 gm./cm.^{3} If the value of Mallet[1] for the density of solid mercury at its melting point, 14.193 gm./cm.^{3}, and that of Dewar[2] for its density in liquid air, 14.382 gm./cm.^{3}, are accepted, the density at $-115°$ C. should be about 14.29 gm./cm.^{3}, which differs from the value here determined by considerably more than its probable error, and may indicate that a closer packing of atoms can occur in large ingots than in microscopic droplets.

The other members of the group to which mercury belongs are magnesium, zinc, and cadmium, all of which form close packed hexagonal lattices, the axial ratio increasing from that appropriate to spheres, 1.624 in the case of magnesium[3] though 1.860 in the case of zinc,[4] to 1.89 in the case of cadmium.[4] The structure of mercury here found is not a close packing for spheroids, and is the first simple rhombohedral arrangement obtained for an elementary substance.

RESEARCH LABORATORIES OF THE
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[1] J. W. Mallet, Roy. Soc. Lond. Proc., *23*, 71 (1877).
[2] J. Dewar, Chem. News, *85*, 277 (1902).
[3] A. W. Hull, Nat. Acad. Sci. Proc., *3*, 470 (1917).
[4] A. W. Hull, PHYS. REV. (2), *17*, 571 (1921).