It is clear, therefore, that a radiating small mass will also trace a geodesic.

Another point[3] arises here which is of considerable theoretical interest. For a non-radiating mass, equation (3) gives a constant m, and the equation of conservation of momentum (2) thus splits up into the two

$$\text{(i)} \quad \frac{dm}{ds} = 0, \qquad \text{(ii)} \quad m(v^\mu)_\nu v^\nu = 0 \qquad (5)$$

The corresponding classical equation of conservation of momentum does not imply the constancy of inertial mass as in (5i), and Mach had to supplement, therefore, the Newtonian laws by his theory of the inertial mass determined by the ponderable bodies of the universe.

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[1] Larmor, Sir Joseph, "Coll. Papers", 2, 672 (1929), or NATURE, 117, 300 (Feb. 27, 1926). See also "Astronomy and Cosmogony" by Sir James Jeans, 298 (1929).
[2] Narlikar, V. V., NATURE, 141, 906 (May 21, 1938).
[3] Eddington, Sir A. S., "The Mathematical Theory of Relativity", 127 (1924). The interpretation of (5) is not, however, mentioned in Eddington's book.

Infra-Red Absorption Spectrum of Sulphur Trioxide

THE infra-red absorption spectrum of gaseous and liquid sulphur trioxide has been determined by us, in the laboratory for physical research at the Sorbonne, in the region extending from 7μ to 14μ, with the help of the self-registering rock salt infra-red absorption spectrometer developed and described by Lambert and Lecomte[1].

In the final experiments, the absorption of the vapour at ordinary temperature was measured in an atmosphere of air in a tube of about 10 cm. length—closed at both ends by plates of rock salt—forming part of an all-glass apparatus possessing a reservoir filled with liquid sulphur trioxide, separated from the absorption tube by a glass wall which was broken immediately before the beginning of the measurements. The apparatus was filled at Amsterdam by the technique developed by Smits. Owing to a small quantity of water vapour present in the air, some 'fog' was sometimes formed, but in such a small concentration that it did not give any trouble. It is of great importance, but not easy, to avoid this formation of 'fog', which causes a rapid attack on the plates of rock salt. Some preliminary experiments on the absorption of concentrated sulphuric acid in a layer of some microns thickness, between plates of fluorite, have shown that its absorption is very weak.

For the vapour two infra-red absorption bands were found, at $8 \cdot 9 \, \mu$ and at $7 \cdot 5 \, \mu$, with the latter the stronger, corresponding with frequencies of about 1120 and 1330 cm.⁻¹. The Raman spectrum of gaseous sulphur trioxide shows with certainty only a frequency-shift of 1069 cm.⁻¹, while from experiments with the liquid at different temperatures and mixed with sulphur dioxide, the vibrational frequencies 531, 1068 and 1389 (double, in reality 1379 and 1404) for the simple molecule in the *liquid* may be inferred[2].

The complete absence of the intensive Raman shift 1068 in the infra-red absorption in the vapour proves that the *free* molecule of SO_3 has a plane, practically symmetrical configuration[3]. For such a molecule the symmetrical pulsatory vibration is not combined with a change in the electric moment of the molecule, so that in infra-red absorption it is inactive.

The number of fundamental modes of vibration of such a molecule amounts to four, probably corresponding with frequencies of about 530 and 560 (symmetrical and anti-symmetrical deformation vibration respectively)—the latter inferred from the absorption band at 1120 cm.⁻¹, supposing it to be a first harmonic—and further, 1069 and 1330. (Owing to the much larger mass of the sulphur atom in SO_3, compared with the central atoms in the related groups CO_3'' and NO_3, the frequency of the vibration (560), whereby the central atom moves fairly strongly perpendicular to the plane of the O-atoms, may be expected to be considerably smaller for SO_3, than for the groups mentioned, where 870, 835 respectively have been found.)

For the liquid, several absorption bands corresponding with frequencies (in cm.⁻¹) of about 795 ($12 \cdot 6 \, \mu$); 860 ($11 \cdot 6 \, \mu$); 940 ($10 \cdot 6 \, \mu$, weak); 1065 ($9 \cdot 4 \, \mu$, strong); 1205 ($8 \cdot 3 \, \mu$, moderately strong); 1330 ($7 \cdot 5 \, \mu$, moderately strong) have been found, without doubt belonging to different kinds of molecules present in this partially polymerized liquid[2]. The strong appearance of the frequency 1065 in absorption in the *liquid* proves that in this state the single molecule SO_3 is considerably deformed from the plane symmetrical configuration it possesses in the vapour state.

No sign of absorption in the neighbourhood of 1390 cm.⁻¹ ($7 \cdot 2 \, \mu$) has been found in the vapour or in the liquid.

It is a curious fact that the absorption bands at $12 \cdot 6 \, \mu$ and $11 \cdot 6 \, \mu$ are in their intensity dependent on the circumstances of the experiments. For example, in a mixture of sulphur trioxide with about the same volume of carbon disulphide, the intensity of the band at $12 \cdot 6 \, \mu$ diminishes considerably, while that of the other increases.

Our hearty thanks are due to Prof. A. Cotton for his hospitality and to Prof. A. Smits for permission to construct the apparatus at Amsterdam.

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[1] Lambert, P., et Lecomte, J., C.R., 189, 155 (1929).
[2] Gerding, H., Nijveld, W. J., and Muller, G. J., NATURE, 137, 1033 (1936); Z. phys. Chem., B, 35, 193 ff. (1937).
[3] Compare also "Die Theorie der Komplexität und der Allotropie" 262 (1938).

CH Bands in the Night Sky Spectrum

So long ago as 1934, we observed, in the night sky spectrum, radiations characteristic of the nuclei of the comets, at about λλ 4300 and 4050 A.[1]. Their origin was then unknown. The recent identification[2] of cometary radiations near λ 4300 with a band of the CH molecule induced us to search systematically for the CH bands in the sky spectrum. For this purpose we used unpublished tables of wave-lengths measured by Gauzit in the ultra-violet and by Cabannes and Dufay in the blue and violet regions of the visible spectrum.

Band λ 4300. The dispersion of the spectrograph