17-Mev is present at all energies although its intensity relative to the total γ-intensity does vary by a factor of about two. Measurements of the γ-radiation asymmetry near resonance, as a function of γ-energy, indicate that the 17-Mev γ-component is responsible for most of the asymmetry, which confirms the conclusion that γ-radiation from the broad level contains an appreciable 17-Mev component. This result would be expected from the known properties of the ground state and 3-Mev level of Be[8].

In making measurements of the angular distribution, particularly near resonance where the asymmetry is small, due regard must be paid not only to the effect of the recoil of the Be[8] nucleus on the angular distribution, but also to the effect of the Doppler frequency shift on the efficiency of detection of the γ-radiation. By deliberately increasing dependence of γ-detection on γ-energy, we have observed a change in apparent angular distribution agreeing with that to be expected for a Be[8] nucleus recoiling with full energy. This is consistent with a short lifetime ($<10^{-14}$ sec.) for the compound Be[8] nucleus.

Details of the above measurements, and their interpretation, and of investigations of other (p, γ) reactions will be published elsewhere.

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Nitrous Oxide in the Earth's Atmosphere

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A SERIES of solar spectra in the wave-length range from 2.5μ to 5.0μ have been obtained at the Solar Physics Observatory, Cambridge, England (30 m above M.S.L.) during the last week of July, 1948, using a spectrometer with a lithium fluoride prism and a Hilger-Schwarz thermocouple as detector. They show convincing evidence of the existence of nitrous oxide (N$_2$O) in the atmosphere above the observatory.

This region of the solar spectrum contains numerous bands, many of which are intense absorptions due to carbon dioxide and water vapor, but bands at 3.90μ, 4.06μ, and 4.50μ agree in wave-length with known absorptions of nitrous oxide[1] and give satisfactory agreement in position, relative intensity, and contour with bands delineated in the laboratory with the same spectrometer, using a Nernst filament as source and an absorption cell filled with N$_2$O. Nitrous oxide also has other weaker bands at 3.57μ, 2.97μ, and 2.87μ; these are concealed, in the solar spectrum, by the water vapor bands in this region.

In the region around 4.0μ in the solar spectrum, one remarks immediately a doublet of moderate intensity centered at 3.9μ (Fig. 1a). Spectra taken at different solar altitudes show a marked intensification of this band at low
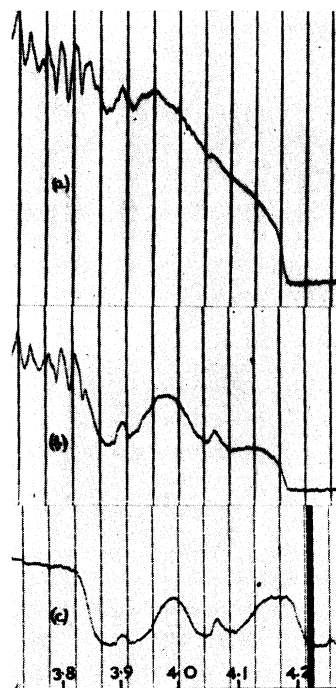

FIG. 1. (a) The solar spectrum from 3.7μ to 4.2μ. Complete absorption beyond about 4.2μ is due to CO$_2$. (b) Spectrum of sunlight, in the same region, after passage through an absorption tube containing 7 atmos./cm of N$_2$O. (c) Spectrum of the radiation from a Nernst filament, in the same region, after passage through 25 atmos./cm of N$_2$O and about 4 meters of air. Absorption bands due to N$_2$O at 3.90μ and 4.06μ and due to CO$_2$ at 4.26μ.

solar elevations and, if the beam of sunlight is passed through an absorption tube containing N$_2$O, the band is intensified but unchanged in position and general appearance (Fig. 1b). A comparison with this band, as obtained from a laboratory source and known amounts of nitrous oxide, indicates that the amount of N$_2$O present in the atmosphere above Cambridge is of the order of 1.0 atmos./cm, which is in good agreement with the value estimated by Sutherland and Callendar[2] from Adel's[3] work at Flagstaff.

The 4.5μ N$_2$O doublet is a very intense band, but in the solar spectrum it is partially masked by the CO$_2$ band at 4.3μ which gives complete absorption over a wide region of the spectrum. The central hump and longer wave-length half of the N$_2$O band are, however, clearly present and confirm the evidence of the 3.9μ-band (Fig. 2). The band at 4.06μ is a much weaker absorption, but its presence too can be observed in the solar spectrum when the sun's altitude is low.

Bands at 7.8μ and 8.6μ, on which Adel[3] based his first suggestion of nitrous oxide in the earth's atmosphere, had previously been sought by us, using a rocksalt prism, but their presence in the solar spectrum could not be definitely established. The region around 7.8μ is largely masked, when observing from such a low altitude station, by the edge of the great 6.3μ-water-vapor band. The 8.6μ-band is a weak one, and even in this region the solar spectrum shows a
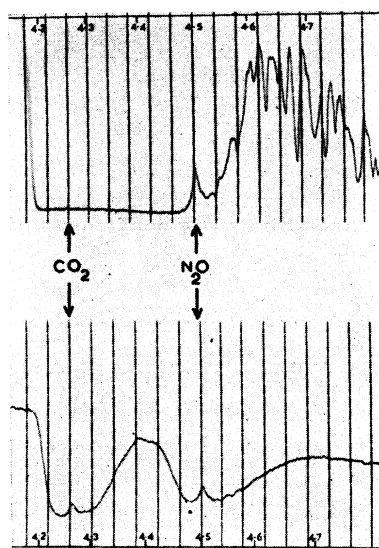
FIG. 2. The upper tracing is a portion of the solar spectrum from 4.2μ to 4.7μ, showing the nitrous oxide band at 4.5μ at the edge of the wide CO_2 band. The lower tracing is a comparison spectrum of the same region using a Nernst filament and an absorption tube containing 2 atmos./cm of N_2O, the beam also traversing about 4 meters of air.

number of intense narrow absorptions which would hide the contour of a weak band.

The results of the present work may be considered to confirm Adel's[3, 4] identification of nitrous oxide in the atmosphere and also to show that the amount present is of the same order both in England and in America. It is thus reasonably certain that its presence is a world-wide and not merely a local phenomenon, and it becomes a matter of some urgency to determine, if possible, its vertical distribution. If the maximum concentration is in the upper atmosphere, it may play an appreciable role in the atmosphere's radiative equilibrium.

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Theory of Internal Conversion

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THE theory of internal conversion has been given by Mott and Taylor[1] and by Hulme,[2] making use of a retarded interaction between the nuclear particle and the electron.

Recently Schönberg developed a formalism of quantum electrodynamics,[3] eliminating all the divergences. The interaction between the particles consists of two parts: an unquantized relativistic generalization of the Coulomb forces and a field of photons with positive and negative energies. The unquantized part consists of an interaction in which each particle acts on the others by means of a force corresponding classically to one-half the sum of its retarded and advanced fields. Schönberg gave tentatively a physical interpretation for his formalism. In the special case of internal conversion, this rule leads to the result that the interaction between the nuclear particle and the electron is half-retarded—half-advanced.

We computed the internal conversion coefficient for an electron on the K-shell as a function of $\theta = mc^2/hV$, assuming a dipolar transition. The details of the calculations will be given elsewhere. The results for an atom with $Z = 84$ are shown on curve I on Fig. 1, curve II representing the internal conversion coefficient computed by Hulme. For the highest energy we considered, the difference between the two curves is about 30 percent. At the actual state of experimental technique a decision between the two interactions seems to be difficult. If the half-retarded—half-advanced interaction does not agree with experiment, Schönberg's physical interpretation rule should be modified in order to obtain a correct result.
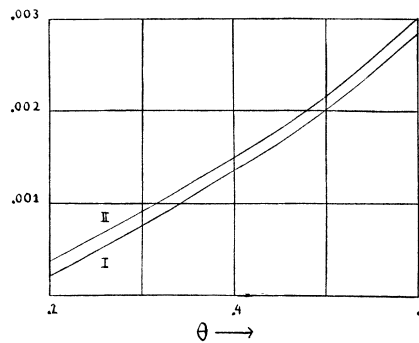

FIG. 1.

We are computing now the quadripole transitions.

We thank Professor M. Schönberg for the suggestion of the problem and for the helpful discussions, and Professor G. Beck for his kind interest.

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Nuclear Relaxation in Ice at −180°C

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THE spin-lattice relaxation time for protons in ice has been measured at −180°C, using a sample of conductivity water which had been redistilled in quartz.
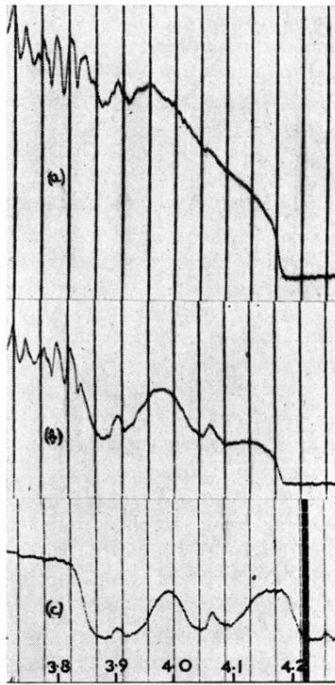
FIG. 1. (a) The solar spectrum from 3.7μ to 4.2μ. Complete absorption beyond about 4.2μ is due to CO_2. (b) Spectrum of sunlight, in the same region, after passage through an absorption tube containing 7 atmos./cm of N_2O. (c) Spectrum of the radiation from a Nernst filament, in the same region, after passage through 25 atmos./cm of N_2O and about 4 meters of air. Absorption bands due to N_2O at 3.90μ and 4.06μ and due to CO_2 at 4.26μ.
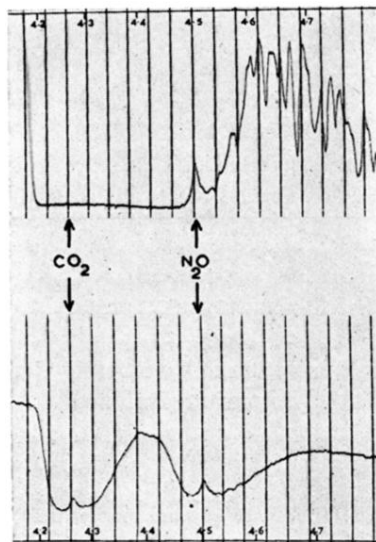
FIG. 2. The upper tracing is a portion of the solar spectrum from 4.2μ to 4.7μ, showing the nitrous oxide band at 4.5μ at the edge of the wide CO_2 band. The lower tracing is a comparison spectrum of the same region using a Nernst filament and an absorption tube containing 2 atmos./cm of N_2O, the beam also traversing about 4 meters of air.