liquid, which was much yellower than in the previous cases, indicated the presence of a series of alkyl di and tri-sulphides, starting with $(\text{CH}_3)_2\text{S}_3$ and increasing in alkyl chain length, as deduced from the mass spectra of the various fractions. The yellow colour was found to be free polymeric sulphur, predominantly S_8 . This is a very interesting result, as free sulphur (and subsequent ammonium polysulphides) have been proposed to account for the yellow and yellow-brown coloured layers on Jupiter¹⁴. Noticeably absent were the cyclic amines produced in the $\text{CH}_4:\text{NH}_3$ experiments; the exposure here was a relatively short one and the result may reflect the relative reactivities of H_2S and NH_3 .

In experiment four, a mixture of CH_4 with nitrogen was used instead of CH_4 and NH_3 . The gas phase contained the same species as in the NH_3 cases but the liquid, similar in appearance to the others, contained a much larger proportion of alkyl amines relative to the cyclic amines.

The last cell, containing only CH_4 , was run as a check on possible contributions of the apparatus itself to the final irradiation products. The gas phase again contained simple hydrocarbons, but also a trace of NH_3 , caused by the nitrogen remaining in the cell after pumping and filling. The clear non-viscous liquid formed contained a mixture of higher molecular weight hydrocarbons, both saturated and unsaturated. No traces of any compounds containing nitrogen or sulphur were found.

It is obvious from the above results that energetic protons can be an effective energy source for the formation of complex molecules from simple ones. Subsequent decomposition of the products is not as serious a problem as might be believed as there are likely to be processes, such as convection and condensation, in the atmospheres for removing the molecules from the reactive zone, and there were found to be fair amounts of the liquids formed on the rear windows of the cells in the centres of the proton beams. In spite of the extreme energies involved (2 MeV) as compared to typical bond energies, there seems to be some sensitivity to different initial reactants, as different results were obtained for the $\text{CH}_4:\text{NH}_3$ and CH_4N_2 mixtures, both containing only C, N and H. With the exception of the sulphide compounds none of the molecules that were identified are coloured; however, the colouring agents could be contained in the unresolvable fractions. It should be noted that no coloured compounds were produced in the pure CH_4 experiment; the presence of N or S seems to be necessary for their formation. Future experiments are being designed to probe this and other aspects relative to the outer Solar System colouring problem.

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Particle Formation from $\text{NH}_3\text{-SO}_2\text{-H}_2\text{O-Air}$ Gas Phase Reactions

RECENT articles on the formation of atmospheric aerosols from $\text{NH}_3\text{-SO}_2\text{-H}_2\text{O}$ gas phase reactions^{1,2} have considered only those products formed between the anhydrous gases to give 2:1 and 1:1 ($\text{NH}_3:\text{SO}_2$) compounds. I wish to draw attention to my work³ on the reaction between these gases at partial vapour pressures in air of 50 to 500 N m^{-2} . Solid products were formed only in the presence of water vapour at 20° C. Analyses showed that the compounds formed were either ammonium sulphite (with excess NH_3) or ammonium pyrosulphite (with excess SO_2). Vapour pressure measurements at 0 to 23° C indicated that the extrapolated vapour pressures of NH_3 and SO_2 above the sulphite in dry air at -70° C would be about 1×10^{-4} and 5×10^{-5} N m^{-2} respectively. With 50% saturation of the air with water vapour at -70° C, however, these vapour pressures would be depressed to 8×10^{-6} and 4×10^{-6} N m^{-2} respectively, that is, to concentrations approximately equal to those reported for the 2:1 compound. The partial vapour pressures of the pyrosulphite under similar conditions would be 3.3×10^{-5} N m^{-2} for both gases. At -52° C the vapour pressures of these gases in dry air would be identical for both the 2:1 compound and ammonium sulphite.

It seems, therefore, that there will be competition between the formation of the 2:1 compound and ammonium sulphite in the stratosphere except under completely anhydrous conditions.

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Thorium Determination in Glasses using Fission Track Technique

WE have applied the fission track technique to the determination of thorium in glasses. Neutron-induced fission occurs for thorium and uranium, the isotopes ^{232}Th , ^{235}U and ^{238}U fissioning with fast neutrons, and ^{235}U with thermal neutrons. Two irradiations are performed. The first irradiation is with predominantly thermal neutrons for determination of the uranium content (comparing to a standard and knowing the isotopic ratio of uranium) and the second irradiation is with predominantly fast neutrons which gives the uranium and thorium contents combined. The 'track excess' from the