LETTERS TO NATURE

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80 MHz Observations of the Scorpius X-1 Source

Andrew and Purton¹ discovered a weak high frequency radio source, which they identified with the strong X-ray source Sco X-1. The identification was confirmed by Ables², who also discovered significant changes in the source's flux density. A subsequent high resolution study of the region by Hjellming and Wade³ at 2,695 and 8,085 MHz showed clearly the presence of three closely spaced sources; the central source was found to be highly variable over a period of hours and was identified with the optical object associated with the X-ray source. It was noted that its flare emission tended to be considerably stronger at 2,695 MHz than at 8,085 MHz, with spectral indices of up to 1.5.

Unsuccessful efforts have been made to detect the Sco X-1 source at lower frequencies by Apparao⁴ (327 MHz) and Jauncey⁵ (408 MHz). In Jauncey's observation the region could be observed for a total time of only about 1 min. This was adequate for setting an upper limit to the intensity of the outer non-variable sources, but the chances of observing flare activity on the variable source were slight. Apparao's observations covered a total of 10 h distributed over five nights, but his sensitivity was sufficient to detect only a strong flare of ~ 0.05 flux units at 2,695 MHz with a spectral index of 1.5 continued to 327 MHz.

During four nights in May and July 1971 the 80 MHz radio-heliograph operated by the Division of Radiophysics, CSIRO, at Culgoora, NSW, was used to observe the Sco X-1 region for a total of 14 h. The observations were made by straddling the declination of the X-ray source with eight $3'.7 \times 3'.7$ beams spaced $2'.1$ apart in declination. The region was permitted to drift through the beams, which were repeatedly placed ahead of the source in a 64 s cycle; the scans surveyed an area of $15' \times 16'$ arc centred on Sco X-1. The outputs corresponding to the eight beams were recorded digitally and hour-long blocks of scans were later averaged.

We failed to detect a source in the region in any of the 14 hour long averages. The r.m.s. fluctuation in each averaged scan was ~ 0.25 f.u.; with a detection criterion of $6 \times$ r.m.s. fluctuation the upper limit to the flux density of Sco X-1 averaged over any 1 h (the duration of a typical centimetric radio flare) was 1.5 f.u. Although the two non-variable sources of Sco X-1 lie within one radioheliograph beamwidth of the central source, they would not have been detected with this sensitivity. But even one of Hjellming and Wade's weaker flares of 0.02 f.u. at 2,695 MHz would have been visible if a spectral index of ≥ 1.2 had continued to 80 MHz.

These observations combined with those of Apparao represent a total low frequency observing time of 24 h distributed over nine nights. Hjellming and Wade's observations indicate that several radio flares would be expected to occur in that time. We therefore conclude that the high spectral indices noted by

them are not continued into the low frequency end of the spectrum.

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¹ Andrew, B. H., and Purton, C. R., *Nature*, **218**, 855 (1968).

² Ables, J. G., *Astrophys. J.*, **155**, L27 (1969).

³ Hjellming, R. M., and Wade, C. M., *Astrophys. J.*, **164**, L1 (1971).

⁴ Apparao, Krishna M. V., *Nature*, **229**, 114 (1971).

⁵ Jauncey, D. L., *Nature*, **230**, 200 (1971).

Organic Analyses of Selected Areas of Surveyor III recovered on the Apollo 12 Mission

THE Apollo 12 astronauts recovered the television camera, the trenching scoop and a few smaller items from Surveyor III, which had been on the Moon for 31 months¹. They noticed that the white surfaces of the spacecraft had become tan. The television camera remained in the Lunar Receiving Laboratory (LRL) during quarantine period and afterwards preliminary microscopic visual examinations and extensive photography were conducted at the LRL. The camera was then shipped to Hughes Aircraft Company for detailed studies and disassembly. Whenever possible the camera was handled and examined in laminar flow clean areas. On close examination, optical interference patterns were found on the camera mirror. The effects of lunar particles on this mirror had been observed earlier². We report here the organic contamination of the mirror surface and camera exterior (shroud) attributable to the spacecraft outgassing, Lunar Module (LM) descent engine blasting, possible Surveyor III engine exhaust products—although thought to be unlikely due to the spatial configuration of the spacecraft components—and unknown sources. A more detailed report of these data will be published by NASA³.

The camera mirror and middle shroud were extracted for organic material by washing the surface with benzene or benzene and methanol (3:1) squirted on by a syringe and collected in a beaker. The area of the mirror which was washed with benzene was approximately 35 cm². The whole operation was carried out in a class 100 organic clean room. These wash solvents (redistilled nanograde purity), as well as the sample washes, were concentrated on a rotary evaporator and the total residues subjected to high resolution mass spectrometry. The mass spectrometer system consisted of a modified GEC-AEI MS-902 high resolution mass spectrometer on-line to an XDS Sigma 7 computer⁴⁻⁶.