of the known size spectrum (Fig. 1). In fact, it is exactly an analogous threshold effect of lack of observation which depresses the Vela size spectrum low end by up to three orders of magnitude.

Even if (on the basis of no single-event observation) an upper limit below the −1.5 index extrapolation were found, this alone would not prove either the size spectrum model or the origin hypothesis suggested[1]. Such a result would imply only that the source distribution is not infinite in extent, assuming that the average absolute magnitude of emitters is independent of distance.

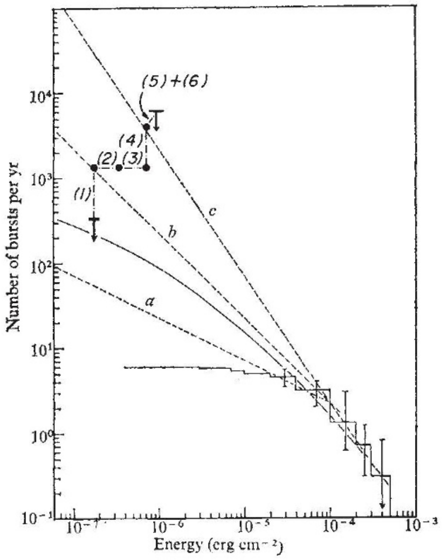

Fig. 1. The γ-ray burst results of *Carter et al.*[1], adjusted by six factors, numbered accordingly. Compare with Fig. 1 of ref. 1.

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CARTER ET AL. REPLY—Cline and Schmidt[1] have presented a series of subjective arguments in an effort to show that our earlier reported upper limit to the rate of γ-ray bursts[2] can be made to conform with a hypothetical number–size spectrum with an index of $-3/2$. We believe that they have become too attached to this hypothesis. In fact, the data from the Vela satellite is equally consistent with an index of -2, although this does not have the same cosmological attraction. If the power-law index were $-3/2$ then a detector with an energy of 10^{-7} erg should record a burst approximately every 2 h or so. No such evidence exists.

Our criterion for the recognition of γ-ray bursts was that the counting rate in each of three consecutive, and independent, measurements should exceed the background by 3σ. Unless one has a coincidence in a second, remote, sensor it would seem imprudent to claim excesses in a single measurement interval to be a genuine γ-ray burst. There is evidence of some poorly understood events in which anomalous increases arise in a single resolution element as well as effects which lead to the occasional saturation of a complete telemetry frame[3,4]. Since the basic resolution time in our particular experiment was 0.6 s, an intrinsic limit of 1.8 s is set in our burst search. Although our main data analysis was confined to the above selection criterion, we did in fact search for possible shorter events. In this case, however, we required a coincidence in the counting rate from at least two of the differential energy channels. No evidence for γ-ray bursts was detected using this criterion either.

We had not discussed the rationale of our selection criterion nor the details of our analysis methods, in our original brief contribution since they are fairly standard procedures.

In the following sections we comment on the numbered points raised by Cline *et al.*

(1) From the existing published data[5,6] it may be seen that the typical size for a γ-ray burst is 3–5 s and the first peak lasts ~2 s. The temporal variations seem to be of the same magnitude as the basic time resolution of the particular experiment. Our selection criterion, therefore, will be met by a substantial majority of these events. We will, admittedly, lose those events having a duration $\leqslant 1$ s but we estimate this loss to be about 20% of the total.

(2) The limit shown in our figure corresponds to the selection criterion outlined above. We could have set a lower energy limit had we considered only longer bursts. But, since the typical length of γ-ray bursts is longer than our measurement interval and since the average intensity represents the first moment of the generating function, the upper limit deduced on this simple average basis is an adequate representation of the burst energy.

(3) The correction factor suggested here seems rather naive. First, there is no experimental evidence that the spectra of all bursts extend below 100 keV. From a comparison of the OGO and Vela results we estimate that only 60% of the events would meet this criterion[7]. Second, if the burst spectrum did, in each case, extend below 100 keV, the correction factor for the missing energy would be a function of the particular experiment. The use of a constant factor as suggested by Cline and Schmidt is absurd. The correction factor in our case was estimated to be 1.3.

(4) This point was adequately discussed in our text which we had expected to have been regarded as an integral part of our presentation.

(5) When atmospheric effects, including multiple-Compton scattering had been taken into account we estimated that the effective field of view of our detector was $\sim 1.5\pi$ sr.

(6) The comments raised in this section have been discussed in the past in the context of cosmic-ray physics. Deductions from the mathematical treatment suggested by them is unwarranted in the absence of any established power-law index. The expression suggested by Cline and Schmidt is clearly erroneous since the value $\overline{S}/Z$ can be seen to be independent of the zenith angle for $\gamma = 3/2$. The expected number of bursts with a detector floating in the atmosphere can be written as

$$N_{\mathrm{B}} = \Sigma_i \, w_i \, N(E_i)$$

where w_i is the solid angle and E_i the average threshold energy in the ith element. The expression can be solved to the required degree of accuracy with a knowledge of $N(E)$, the integral size spectrum of γ-ray bursts which is as yet unknown. Alternatively, the correction may be evaluated approximately, in a more practical way, independent of the size spectrum. For a given detector the energy deposited by a γ-ray burst must lie between E and $3E$ for zenith angles ranging between $\theta = 0$ and $\theta = 75°$. This is due to a decrease in the effective area by a cosine factor. The detection efficiency at large zenith angles, however, increases due to increased path length in Na I by sec θ. Therefore the detector can be regarded as being less sensitive by a factor of about two. Such a consideration will make our earlier results an absolute upper limit for bursts with energy greater than 5×10^{-7} erg.

We conclude that the second-order refinements discussed above can, at most, contribute a factor of about two, both in burst energy and in burst rate. Cline and Schmidt are entitled to make their own assessment of our results but we maintain that these corrections do not materially change our conclusions and that, at this stage, we see no compelling reason to reconcile our results with their hypothesis.

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