from ± 0.25 to ± 1.0 flux units. The maximum range in flux reported by Sholomitskii for CTA 102 is 2.3 flux units. Thus the range of variation is not much larger than the greatest errors quoted by Sholomitskii *et al.* Sholomitskii *et al.* report some of the details of their radiometer, but the characteristics of the antenna they used have not yet appeared in the literature. Until the characteristics of this antenna are published, it is difficult to evaluate any observations made with it. To cite one specific example, it is impossible to judge the effect of solar radiation entering the antenna side lobes when no information has been published about the reception pattern of the antenna.

Sandage and Wyndham (1965) have identified CTA 102 with a quasi-stellar object. If CTA 102 has a radio luminosity equal to that of other objects in this class, it is possible to calculate a minimum diameter for the source region. The observed radio spectrum requires that the source be optically thin for frequencies above 10^3 Mc/s. Cutoff frequencies for synchrotron self-absorption, free-free absorption, and the Tsytovich effect (see Scheuer 1965 for a review of these mechanisms) must be less than this value. If we assume that the density of thermal electrons is $\leq 10^2$ cm^{-3} and the magnetic field is in the range 10^{-2} to 10^{-4} oersted, then the minimum size is about 100 pc.

Sholomitskii has pointed out that an intensity variation with a period of 100 days requires a source diameter of 0.1 pc or less. A detailed consideration of the problem of variation in radio sources is beyond the scope of this Letter. If the radio emission from quasi-stellar objects must be revised, their large redshifts, in particular, would then be of other than cosmological origin.

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REFERENCES

Anderson, B., Donaldson, W., Palmer, H P , and Rowson, B 1965, *Nature*, **205**, 375.
Harris, D E , and Roberts, J. A 1960, *Pub. A S.P* , **72**, 237.
Kellermann, K. I. 1964, *A J.*, **69**, 205.
Maltby, P. 1962, *Ap. J. Suppl.*, **7**, 124.
Moffet, A. T. 1962, *Ap. J. Suppl* , **7**, 93.
Read, R. B 1961, *Trans. I.R.E.*, **AP-9**, p 31.
———. 1963, *Ap. J.*, **138**, 1.
Sandage, A , and Wyndham, J. D. 1965, *Ap. J* , **141**, 328.
Scheuer, P. A. G 1965, *Quasi-Stellar Sources and Gravitational Collapse*, ed. I Robinson, A Schild, and E. L Schucking (Chicago: University of Chicago Press), p. 373.
Sholomitskii, G B. 1965, *Inform. Bull. on Var. Stars, Comm. 27 of the I. A. U* , No 83.
Sholomitskii, G. B , Kuril'chik, V N , Matveenko, L. I., and Khromov, G. S. 1965, *Astr Zhur* , **41**, 832 (trans. *Soviet Astr.—A.J.*, **8**, 660).

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PHOTOMETRIC RESULTS OF A SPECIAL SURVEY FOR INTERLOPERS

In the course of optical identification of quasi-stellar radio sources (QSS) by the two-color method (Ryle and Sandage 1964), a number of ultraviolet objects were found far from the radio positions on plates centered on the radio region. Photoelectric photometry of the first four objects, called interlopers, near the radio positions of 3C 194, 3C 205, 3C 225, and 3C 280 showed each to have the highly peculiar colors characteristic of QSS's, but the disagreement of the radio and optical positions showed that the objects were radio-quiet to 9 flux units at 178 MHz.

A small special survey was made in February of this year to find similar objects in large numbers to study their group properties. Two wide-field (6.°5 × 6.°5) plates were taken with the Palomar Schmidt using the two-color method. The exposure times were 60 min behind an ultraviolet Schott UG2 filter, followed by an 8-min exposure behind a blue Schott GG13 filter on the same 103a-O plate. Thirty-one interlopers with strong ultraviolet excess were found. The exposure ratios and the criteria for selection were such that objects with $U - B$ bluer than about $-0^{m}.05$ were catalogued. The survey should be reasonably complete for objects brighter than $B \simeq 19^{m}$ which meet this color restriction.

Photoelectric photometry of twenty-one of the objects, designated "BSO" for "blue stellar objects," showed that fifteen had the characteristic colors of QSS's, five had colors of luminosity III–V stars near the main-sequence line in the $U - B$, $B - V$ diagram, and one had the color of an extreme F subdwarf. This evidence, together with the colors

TABLE 1

COORDINATES AND PHOTOMETRY OF INTERLOPERS AND SURVEY OBJECTS

Object	α(1950 0)	δ(1950 0)	V	$B-V$	$U-B$
Near 3C 194	$08^{h}06^{m}22^{s}.16$	+42°37′45″0	17 72	+0 45	−0 83
Near 3C 205	08 35 28 22	58 03 04 6	18 13	+ 46	−0 77
Near 3C 225	09 40 00 36	14 02 41 6	19 25	+ 23	−0 81
Near 3C 280	12 54 23 44	47 40 13 4	19 48	+ 23	−1 16
BSO 1	12 46 29	37 46 25	16 98	+ 31	−0 78
2	12 48 21	33 47 06	18 64	+ 28	−0 98
3	12 49 22	36 08 06	17 30	+ 52	−0 22
4	12 52 53	35 28 51	...		...
5	12 57 04	36 35 10	17 48	− 04	−0 77
6	12 59 29	34 27 00	17 87	+ 05	−1 01
7	13 07 03	35 55 11	18 34	+ 22	−0 88
8	13 09 15	34 02 19	17 43	+ 36	−0 77
9	13 11 16	34 46 04	19 10	+ 26	−0 89
10	13 11 27	33 02 28	...	...	...
11	13 11 16	36 16 30	18 41	+ 06	−0 85
12	14 45 13 8	42 58 10	17 55	+ 24	−0 83
13	14 50 18	45 45 23	17 29	− 35	−1 19
14	14 50 24 5	43 15 00	14 60	− 23	−1 00
15	14 52 13	44 18 32	17 83	+ 31	−0 55
16	14 52 44	47 32 16	16 17	− 25	−1 01
17	14 54 54 8	45 29 36	18 63	+ 14	−0 82
18	14 55 23 5	43 30 20	17 67	+ 45	−0 68
19	14 56 57	45 48 22	17 84	+ 13	−0 83
20	14 57 24	44 00 48	...	...	...
21	14 58 36 5	42 17 29	13 88	− 27	−1 05
22	14 58 40 5	42 17 56	18 17	+ 32	−0 80
23	15 02 13 5	44 21 14			
24	15 04 35	42 04 37			
25	15 06 28	45 16 59			
26	15 09 07 6	42 43 05			
27	15 09 21 3	42 46 00			
28	15 09 45	45 28 33			
29	15 11 53	44 46 05	17 36	− 16	−0 97
30	15 14 49	43 55 50	17 29	−0 09	−0 93
31	15 15 22	44 07 41			

of the first four interlopers, provided the initial clue to the existence of radio-quiet, blue, quasi-stellar galaxies (QSG) whose optical properties are similar to those of QSS's (Sandage 1965).

Spectrograms were subsequently obtained for BSO 1, BSO 8, and BSO 16 by Schmidt and by Sandage in an attempt to verify the existence of QSG. The spectrum of BSO 16 shows that this object is a hot star having the Balmer lines in absorption near their rest wavelengths. This was expected on the basis of the non-peculiar $U - B$, $B - V$ colors. The spectrum of BSO 8 (called "BSO 105" by Sandage 1965 on an older numbering system) is continuous with no prominent absorption or emission lines. BSO 1 has a large redshift of $\Delta\lambda/\lambda_0 = 1.2410$, as described elsewhere (Sandage 1965).

Table 1 lists the precise optical positions of the first four interlopers, and estimated positions, accurate to perhaps $\pm 20''$, for the thirty-one survey objects. Where available, the colors and magnitudes determined photoelectrically at the 200-inch are also shown.

These blue objects are undoubtedly of the same class as the faint objects in the catalogues of Iriarte and Chavira (1957), Chavira (1958), and Haro and Luyten (1962). With the identification of most of these objects as intrinsically bright stellar-appearing galaxies, these catalogues provide a large finding list that can be surveyed by radio techniques to determine if the QSG's are weak radio emitters. It is expected that such study will shed light on the evolutionary process of radio decay after the intense QSS radio phase.

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REFERENCES

Chavira, E. 1958, *Bull. Obs. Ton* , No. 17, p. 15.
Haro, G., and Luyten, W. J. 1962, *Bull Obs. Ton* , No 22, p 1.
Iriarte, B., and Chavira, E. 1957, *Bull. Obs. Ton.*, No. 16, p 3.
Ryle, M., and Sandage, A. 1964, *Ap. J.*, **139**, 419.
Sandage, A. 1965, *Ap. J.*, **141** (in press).

COSMIC BLACK-BODY RADIATION*

One of the basic problems of cosmology is the singularity characteristic of the familiar cosmological solutions of Einstein's field equations. Also puzzling is the presence of matter in excess over antimatter in the universe, for baryons and leptons are thought to be conserved. Thus, in the framework of conventional theory we cannot understand the origin of matter or of the universe. We can distinguish three main attempts to deal with these problems.

1. The assumption of continuous creation (Bondi and Gold 1948; Hoyle 1948), which avoids the singularity by postulating a universe expanding for all time and a continuous but slow creation of new matter in the universe.

2. The assumption (Wheeler 1964) that the creation of new matter is intimately related to the existence of the singularity, and that the resolution of both paradoxes may be found in a proper quantum mechanical treatment of Einstein's field equations.

3. The assumption that the singularity results from a mathematical over-idealization,

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