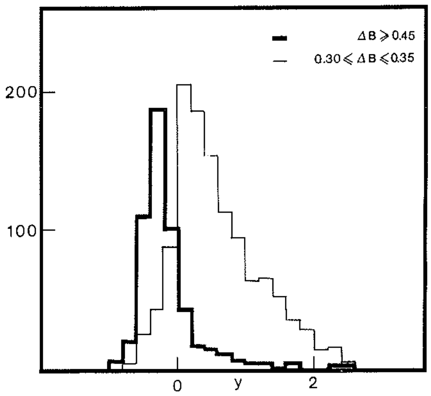

Figure 2: *Histograms of "y" for the objects with $\Delta B \geq 0.45$ mag. and for the objects with $0.30 \leq \Delta B \leq 0.35$.*

ling 3665 mm^2 or 1.28 deg^2, because measurements of weak stars near bright stars are very uncertain. Galaxies were removed from this sample using an algorithm based on maximum density versus image area, using twelve of the plates with the best seeing. The resulting sample contained 809 quasar candidates.

Reliability and Completeness

We have to ask how many of these objects are quasars and how many quasars have been missed.

In a first step, we compare the U-B/B-R diagrams for the highly variable objects ($\Delta B \geq 0.45$ mag) and for the low variability objects ($0.30 \leq \Delta B \leq 0.35$) (Fig. 1); we immediately see that, if we call $y = (U\text{-}B) + 0.74\,(B\text{-}R) - 0.32$, almost all highly variable candidates have $y < 0$ while very few low variability objects have. Figure 2 shows the histograms of y for the two classes of objects. It clearly shows that most quasars have $y \leq 0$ and that very few low variability objects are quasars.

From the total of 809 variable candidates, 587 have $y \leq 0$. Figure 3 shows the fraction of candidates with $y \leq 0$ in various ranges of variability amplitude. For $\Delta B \geq 0.50$, this fraction is constant and equal to ~90%; it rapidly drops for lower values of ΔB, being only 42% for $0.35 \leq \Delta B < 0.40$. Among the 39 objects with $\Delta B \geq 0.50$ and $y > 0$, 18 are confirmed Seyfert 1 galaxies or quasars (and 9 have $z > 2.7$), 7 are either stars or galaxies while we have no spectra for 15 of them.

On the other hand, all 73 objects with $\Delta B \geq 0.50$ and $y \leq 0$ for which we have a spectrum are confirmed quasars except one which is a dwarf nova, therefore at least 94% of all highly variable objects are quasars.

To find out how many quasars we have missed because they have a variability amplitude smaller than 0.35, we have extracted all objects in the field with $U\text{-}B \leq -0.40$, $y < 0$, and $B_{min} \leq 21.0$, irrespective of their variability.

We have found 602 such objects. 325 of them have an amplitude of variability $\Delta B \geq 0.35$. This suggests a completeness level of 54%. However, 45 objects have $B\text{-}R < 0$, only two of them with $\Delta B \geq 0.35$; they are most probably hot stars; this brings the statistic to 323 variable quasar candidates for a total of 557, or 58%.

Comparison of the histograms of the U-B colour index for the highly variable objects ($\Delta B > 0.50$) and the low variability objects ($\Delta B < 0.30$ and $B\text{-}R > 0$) suggests that only half of those are quasars; the other half could possibly be the weak blue galaxies found by Gallagher and Hamilton (1988) and Koo (1986). If this is the case, 90 of the low variability objects would not be quasars and therefore the variable quasars (323) would constitue 69% of the total.

Spectroscopy

In the course of several observing runs with the AAT and the ESO 3.6-m telescope, we have made spectroscopic observations of 176 variable objects. 140 of them turned out to be quasars, 48 having $z > 2.2$, the largest redshift being $z = 3.58$ (# 695); there is a bias against redshifts larger than this value in a survey based on IIIa-J plates because for larger redshifts, a large k correction applies due to Lyα leaving the bandpass. Three additional objects are Seyfert 1 galaxies (# 23, 211 and 746); two more (# 7 and 24) show a continuous spectrum and have a strong polarization as shown by measurements made at La Silla with a Wollaston prism; they are most probably BL Lac objects. Two objects (# 19 and 668) are dwarf novae; the others are galaxies (3), stars or objects of unknown nature due to a poor signal-to-noise spectrum. Of those objects, all have a positive y except for the two dwarf novae and two objects of unknown nature (# 10 and 24); this confirms that most objects with a negative y are quasars.

Conclusions

This paper is a first step to addressing the problem of obtaining unbiassed samples of quasars, especially with regard to redshift, for the purpose of studying the evolution of the luminosity function. We have reasons to believe that the strong redshift biases associated with other methods of finding quasars are not relevant to selection by variability. With a well sampled search period of some 11 years, we have shown that our sample, in a regime

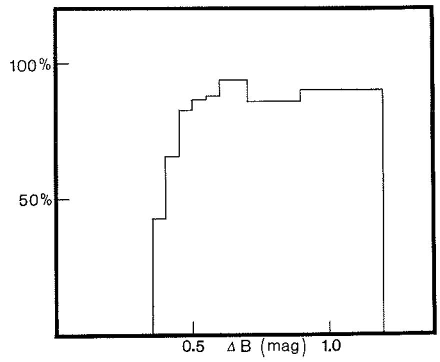

Figure 3: *Fractions of the variable quasar candidates (galaxies and objects near a bright star excluded) with $y < 0$ in various bins of variability amplitude.*

where contamination from non-variables is not significant, is about 70% complete. So far, most work has been done from searches based on blue passband plates, but we now have a baseline of 9 years for red passband plates, which should provide an excellent basis for searching for quasars in the redshift range 3.5 to 5.

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