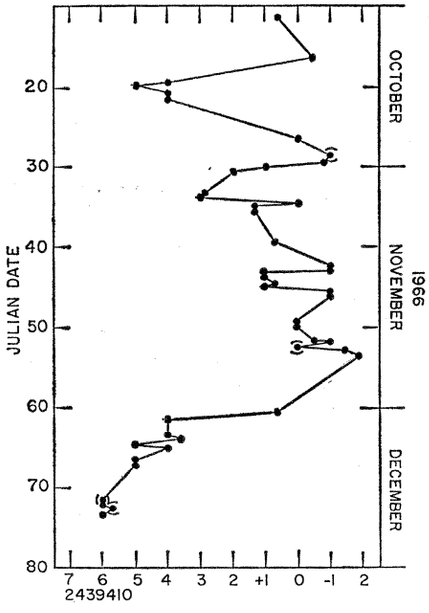

Fig. 1. Blue magnitude variations in quasar 3C 446. The abscissa is graduated arbitrarily; it spans a total of about 0.8 magnitude. The ordinate records the Julian date. Points in parentheses are uncertain.

Wherever possible, two plates were exposed during the same night. The exposures were all made with K 103a0 emulsion. The eye estimates, by use of three comparison stars, were made with a × 10 enlarging eyepiece.

Note added in proof. T. D. Kinman, Lick Observatory, informs us that his observations with the 120-inch (3-m) Lick reflector confirm that rapid light fluctuations occur in this object.

A. J. WESSELINK
J. HUNTER, JR.
Yale University Observatory,
Box 2023, Yale Station,
New Haven, Connecticut 06520

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Ambiguities in the Use of the Term Circadian

The term *circadian* means different things to different people. One group of investigators uses it to denote *all* biologic rhythms with a period of about 24 hours (*1*). Another uses it to identify a special family of 24-hour rhythms, namely, those which have been shown to be generated by endogenous mechanisms, and which have a characteristic free-running cycle that changes in a predictable way when animals are kept in continuous light or darkness (*2, 3*). Some investigators believe that *all* 24-hour rhythms are also endogenous and potentially free-running. However, this assumption has not been supported by recent studies on the rat pineal gland. At least two cycles in this organ [hydroxyindole-*O*-methyl transferase activity and norepinephrine content (*4*)] appear to be generated by an exogenous sensory input (light).

The ambiguity which surrounds the use of *circadian* might not have been very important when this term was first introduced about 8 years ago (*1*). At that time, rhythm studies were largely concerned with functions that could be measured repeatedly in the same animal (such as cycles in body temperature, physical activity, and blood cortisol levels). These rhythms could be studied in individual animals that were blinded or kept in darkness, and the characteristics of their free-running periods could be defined without too much difficulty. By the time the rhythm was called *circadian*, it had generally been shown to be so in both senses of the word.

Now many investigators are performing another kind of rhythm study, in which the cyclic function is sampled only once in each experimental animal. In the typical experiment, rats are synchronized to a particular lighting schedule and are killed in groups, at intervals of 3 or 4 hours. A tissue is removed from each animal, and is assayed for its biochemical contents (as in *5*) or physiological activity in vitro (*6*). Data obtained from all of the animals that were killed at the same time are pooled. It is observed that the function passes through a maximum and a minimum value once during each 24-hour day.

It seems much more difficult to study the free-running characteristics of this type of rhythm than of one involving a function which can be monitored continuously. When rats are placed in continuous light or darkness (to deprive them of their external photic synchronizer), it cannot be assumed that as the cycle length changes all of the animals remain in phase. Even if they do remain synchronous, it is very difficult to demonstrate a small change (such as 15 minutes) in cycle length without killing vast numbers of animals. If the function is sampled at an inadequate number of intervals during the test day, it is possible that a rhythm whose period differs from 24 hours might be mistaken for one of that duration, just because a single high and a single low value were obtained at the times fortuitously chosen for sampling. Probably it will be a long time before it can be determined whether such tissue rhythms actually are *circadian* in the second sense (that is, they free-run with a period of about 24 hours).

If tissue rhythms are labeled *circadian* before appropriate experiments are performed to elicit their mechanisms, the ambiguities now present in the use of this term may prove troublesome. The casual reader who is accustomed to the more restrictive definition may draw several unwarranted conclusions from an article entitled "Circadian rhythms: Variation in sensitivity of isolated rat atria to acetylcholine." He may assume not only that cardiac responsiveness varies during the day, but also that this variability is the result of an endogenous mechanism whose free-running characteristics have been studied and found to share the characteristics of other well-known circadian systems [for example, the rhythm obeys Aschoff's rule (*2*)].

Perhaps the rhythms demonstrated by McGeer and McGeer, Rapoport *et al.* and Spoor and Jackson actually are *circadian* in either sense. Perhaps they are not. This should be explored in the laboratory. Meanwhile, it would probably be more appropriate to label all three of them "daily rhythms," or "24-hour rhythms."

RICHARD J. WURTMAN*
Laboratory of Clinical Science,
National Institute of Mental Health,
Bethesda, Maryland

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* Present address: Massachusetts Institute of Technology, Cambridge.

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