Fig. 3. A 24-h event record showing time of day of urination for eight rhesus monkeys. The record starts with midnight (M) in the upper right hand corner and reads from right to left in 4-h blocks.

these patterns to time and amount of water intake, activity, and other measures, several interesting findings can be obtained from the single-day record in Fig. 3. Six of eight animals urinated within a few minutes of each other at 6:45 a.m. and again at approximately 9:50 p.m. While the time of urination is more variable at other times of the day, seven animals urinated within a 15-min period at approximately 12:30 p.m. and six animals urinated within

a 15-min period at 2:15 p.m. In addition, even though all animals except Animal 8 had urinated at least twice before 8:00 a.m. and thus probably voided most of the overnight urine retention, four animals urinated within a few minutes of each other at 8:15 a.m. Each of these periods was correlated with human activity either in the test room or in adjacent areas to the test room.

Individual differences are also of

interest. The frequency of urination is 4, 12, 12, 6, 20, 11, 15, and 9 for Animals 1 through 8, respectively. Animal 1 urinated a large amount at 6:30 a.m., and then voided only three times thereafter. Animal 3 voided at 2:45 a.m., whereas no other animals voided in the middle of the night.

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An electroluminescent lamp device for critical flicker fusion and apparent motion

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A circuit that uses electroluminescent lamps as light sources for the study of critical flicker fusion (CFF) and apparent motion phenomena is described. The

technique involves the modulation of a 2-KHz exciting current with a multivibrator-formed pulse adjustable over a suitable range of frequencies. Components are readily available from commercial sources.

Wide use of the perceptual test of critical flicker fusion (CFF) and apparent

motion phenomena is limited by the expense and complexity of commercial circuitry. Most of this equipment uses xenon-filled crater lamps (RC 1130 B) which require high-power vacuum-tube driver circuits. A further disadvantage is that this type of light source produces an intense spot rather than a uniform field of illumination.

Fig. 1. Q1 and Q4 are inexpensive high-voltage transistors (Industro) requiring heat sinks, while Q2 and Q3 are low-voltage NPN silicon switching transistors. M1, M2, M3, and M4 are BRS Digi-bit modules Type MV-209 and FF-201. The modules have been modified from negative to positive logic by changing the applied voltage from the 0 and -12 V required to +12 and 0 V, respectively. All diodes are Type 1N4005. R1 and R2 are 20-W resistors, all others are ½-W. EL1 and EL2 are night lights, 2¼ x 1¼ in., 1/10-W, 125-V, sold in "blister" packs.

The circuit described here uses electroluminescent lamps (EL) in a manner first proposed by Montagu (1966). The transistorized circuitry provides for either synchronous or alternate illumination of two such EL sources so that the E can produce either the CFF or apparent motion phenomena.

The EL lamp is made by embedding an electroluminescent phosphor in an insulating substance between two parallel conducting plates, one of which is optically transparent. When an alternating current is applied to these conductors, it causes the phosphor to glow much in the same manner as does the coating on the face of a cathode-ray tube. The color of the light produced is a function of both the composition of the phosphor and the frequency of the applied current. While EL lamps are available in sizes up to 12 x 12 in., and in several colors as well as "white," the inexpensive lamps used in this circuit produce a greenish-yellow glow and are sold in hardware stores as night lights.

Since dc current will not cause the phosphor to glow, the EL must be powered by a pulsed dc or ac source at a frequency above the flicker-fusion threshold of the dark-adapted eye. The light output vs excitation frequency curve of these lamps rises slowly with increasing frequency until saturation occurs, and ultimately a drop in

light output takes place at still higher frequencies.

Since it was desirable to produce both maximum light output in the lamp and to avoid visible "beat" phenomena between the excitation frequency and the modulation frequency (0 to 60 Hz), an excitation frequency of 2 KHz was chosen. Because of the nonlinear relationship between applied voltage and brightness in the EL, sinusoidal modulation produces a distorted brightness-frequency output characteristic. Accordingly, square-wave dc pulsed modulation and excitation was used. The circuit diagram for this device is shown in Fig. 1. Operation is as follows:

Standard logic modules are used for M1, M2, M3, and M4. They produce a +12-V level in the "on" state and 0 level in the "off" state and are capable of delivering 30 mA of output current. The multivibrator M4 produces the excitation frequency that is used to drive M3, the output of which modulates the bases of transistors Q1 and Q4. These two transistors are special high-voltage transistors that contain the ELs in their collector loads. Thus, with only the excitation signal applied to base of Q1 and Q4, both lamps would be "on" at an apparently steady level of brightness. M1 is a free-running multivibrator variable from 0 to 60 Hz that drives M2, a flip-flop

providing base signals to transistors Q2 and Q3. Thus, the frequency setting of M1 is the modulation frequency and causes the EL lamps to be switched on and off at that rate. The EL lamps may be switched alternately, as shown by the indicated switch position in the drawing, in which case Q2 and Q3 are alternately turned on by the opposing sides of M2. When the "alt-sync." switch is thrown to the "sync." position, both lamps are flashed synchronously at the frequency determined by M1.

The power supply for the lamps should be able to provide regulated 300-V dc with a current capacity of 100 mA or greater. The resistors, R1 and R2, are paralleled across the EL lamps to provide a discharge path for the lamp during the "off" state. Modules (M1 through M4) require a regulated 12-V supply with the negative side connected to the negative of the 300-V excitation supply.

It is evident that when used in the apparent motion mode (50% duty cycle), one light is extinguished and is followed immediately by the illumination of the second. The circuit shown has operated in a virtually trouble-free fashion and has required a very minimum of construction, time, and material since commercial (BRS digi-bits) modules (modified from negative to positive logic) were used wherever possible. As suggested by Montagu, the EL lamps may be mounted at the ends of a binocular arrangement, thus permitting their use with a S in a normally lighted room.

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