

equivalent d-c drift is 5 mv/hr (maximum) and the temperature coefficient of d-c output voltage is 1 mv per degree Celsius. A negative capacitance circuit is provided which improves the overall frequency response of the amplifier but unavoidably adds noise to the input signal if large stray capacitances are compensated. Signals of 40 μ v through 7 Mohm (microelectrode in saline) can be faithfully reproduced.

The amplifier has been tested in physiological experiments in which microelectrodes (0.5 to 3 μ) were used to record resting and action potentials (extracellular) from neurons in frog spinal cord, chicken cerebellum, isolated monkey brain (2), and nerve fibers in vitro. The IGFET amplifier gave consistently better overall results than a variety of commercial electrometer amplifiers (vacuum tube and transistor types) that were used to make the same measurements.

Many other applications for this device and simple associated circuits have already been found. I believe the unusual features of this amplifier make it suitable for routine use in many types of research; it seems to answer the needs of large laboratory instruction classes where 10 to 20 amplifiers are needed and the cost of commercial devices is prohibitive.

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25 July 1966

"Neutral Hydrogen Survey of Andromeda Galaxy": Addendum

Edward Argyle (1) has called our attention to the fact that van de Hulst, Raimond, and van Woerden (2) postulated the existence of a neutral hydrogen ring in M31 in their article published in 1957. We regret that we (3) did not point this out in our report. Their inference, however, was based on peaks found along only a single axis through the ring. Roberts' survey (4) was the first to be made, in a nearly continuous manner over much of the galaxy with sufficiently high resolution, to demonstrate clearly this ring struc-

ture and the marked deficiency of neutral hydrogen inside. Our survey (3) confirmed this result and was the first to delineate the ring completely around the nucleus.

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22 August 1966

Phyletic Position of Tree Shrews

Although much of the recent evidence on the taxonomic position of the tree shrew argues strongly against including the Tupaiodea in the Lemuriformes, the new findings still fail to establish whether or not the tree shrews are closer phyletically to Primates than to any other extant mammalian group. If the Tupaiodea diverged from the Primates very early in the evolution of the Primates, the tupaiids would show hardly any more affinities to the recent groups in the rest of the Primates than to the extant members of any other mammalian order. The data reviewed by Campbell (1) emphasize the distinctiveness of the tupaiids rather than their relatedness to either primate or insectivore types.

Campbell suggests that the extensive visual system in tree shrews and primates may have resulted from convergent evolution. It is of interest that serological studies on primate lens proteins reveal pronounced affinities among loroid, tarsier, and higher primate lenses. However, these studies demonstrate divergence of tree shrew lens proteins from those of primates comparable to that between lens proteins of non-primates and primates (2).

The serological data on serum proteins, gathered since the Burg Wartenstein conference on Classification and Human Evolution, further emphasize the distinctiveness of the tupaiids. Antiserums produced in rabbits to hedgehog serum and to tree shrew serum, while yielding strong homologous reactions, yield very weak reciprocal cross-reactions and unlike the chicken

antisera fail to detect any special correspondence between tupaiids and erinaceoids. Indeed, the precipitins to albumin in the antiserum to tree shrew serum develop larger cross-reactions with human albumin than with hedgehog albumin and the other nonprimate albumins tested (3). Thus the original data (4) obtained with chicken and rabbit antisera to human albumin, and confirmed by Hafleigh and Williams (5) suggesting that *Tupaia* has serum albumin more like that of primates than insectivores, is now directly demonstrated.

The data of Dr. B. H. Hoyer, cited by Campbell, on the homologies of polynucleotide sequences as judged by competition of various primate and nonprimate DNA fragments with those of humans are compatible with the possibility that the Tupaiodea branched off from the base of the Primates. If they did, they should not be expected to show much more relatedness to man than would the nonprimate mammals. Thus the value of 28 percent competition for tree shrew DNA compared to 20 percent for nonprimate mammalian DNA's might prove to be highly significant.

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References and Notes

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29 July 1966

Surveyor I Location

By attempting to correlate the positions of summits of lunar hills, situated beyond the horizon of Surveyor I, with features given on the Aeronautical Chart and Information Center map of the area, Jaffe *et al.* (1) derive a loca-

Table 1. Surveyor landing sites.

Derived from	Site	
	South latitude (deg)	West longitude (deg)
Photo correlation	2.57 $\pm$ 0.02	43.34 $\pm$ 0.02
Tracking data	2.49	43.32

Table 2. Heights (above the plain) of hills from shadow measurements. Feature *B* cannot be measured because shadow falls on hills *D* and *d*.

Feature	Shadow length (km)	Solar altitude (deg)	Height (m)
<i>A</i>	5.4	3.25	300
<i>a</i>	3.0	3.10	160
<i>C</i>	5.0	2.75	230*
<i>D</i>	7.5	2.65	330†
<i>d</i>	6.6	2.60	290†
<i>F</i>	4.5	3.00	230

* Underestimate, because end of shadow falls on hill *D*. † Overestimate, because end of shadow falls in large, somewhat depressed area.

Table 3. Heights of hills from Surveyor data. Feature *d* is invisible to Surveyor.

Feature distance from Surveyor (km)	Height		
	Seen above horizon (m)	Below horizon (calc.) (m)	Total (m)
<i>A</i> , 23.4	180	130	310
<i>a</i> , 24.8	≤ 0	≤ 150	≤ 150
<i>B</i> , 31.3	130	240	370
<i>C</i> , 29.8	40	220	260
<i>D</i> , 30.9	80	230	310
<i>F</i> , 30.0	20	220	240

tion (site I) situated well outside the 2σ uncertainty ellipse based upon the tracking data. Furthermore, the correlation is only partial. By repeating the process with a suitable Earth-based photograph, I find that only one location of Surveyor is possible, well within the tracking-data ellipse.

Figure 1 depicts the NE portion of the large, incomplete ring Flamsteed P (2); it was made from two stacked negatives taken with my laboratory's NASA-sponsored 61-inch (153-cm) reflecting telescope at 0315 hours U.T., 2 April 1966. The lines of latitude and longitude were carefully transferred from (3). The radial lines represent the directions of horizon features *A*–*F* (1, fig. 16), the azimuths having been adjusted for the computed inclination of the lunar surface from the plane perpendicular to the line of sight. The small dot indicates the location of Surveyor for optimum correlation between these lines and the various hills, while the ellipse represents the theoretical horizon as seen from Surveyor's camera. Table 1 gives the coordinates of the

landing site derived from the preceding correlation and from the tracking data; the former is approximately 2.4 km south of the latter, well within the 2σ uncertainty ellipse.

In order to verify the correctness of the correlations, the heights of several hills in the group were obtained from shadow measurements made on a print similar to Fig. 1 (Table 2). These values may be compared with those calculated from the angular dimensions given in (1, table 2) and the assumed position of Surveyor (Table 3). The agreement is remarkably good in view of the uncertainties of the shadow measurements; differences do not exceed 10 m except where the shadows are cast on rising or falling terrain. Hill *d* appears larger than *D* in Fig. 1, but *D* is higher since it casts a longer shadow and thus occults *d* in the Surveyor view. Feature *E* is not identified; the walls of the small crater situated at the location indicated are well below Surveyor's horizon, so this feature is presumably a small object situated relatively close by. The summit of *a* must be almost exactly at horizon level.

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11 July 1966

Toxic Impurities in Nalgene Filter Removed

I should like to comment on the impurities derived from the Nalgene Filter Unit which Simpson (1) has found to be inhibitory to *Leishmania tarentolae*.

There is little likelihood that the reported effect was derived from some materials extracted from the plastic body of the Filter Unit. The plastic is the best grade of polystyrene; it is the kind commonly used in manufacturing disposable syringes and other medical items and has been shown repeatedly to be nontoxic. Nalgene, incidentally, is not the name of the plastic, but is the registered trademark of our laboratory products.

The inhibitory effect that was indeed present has been traced to the residue of a sizing agent in some of the polyole-

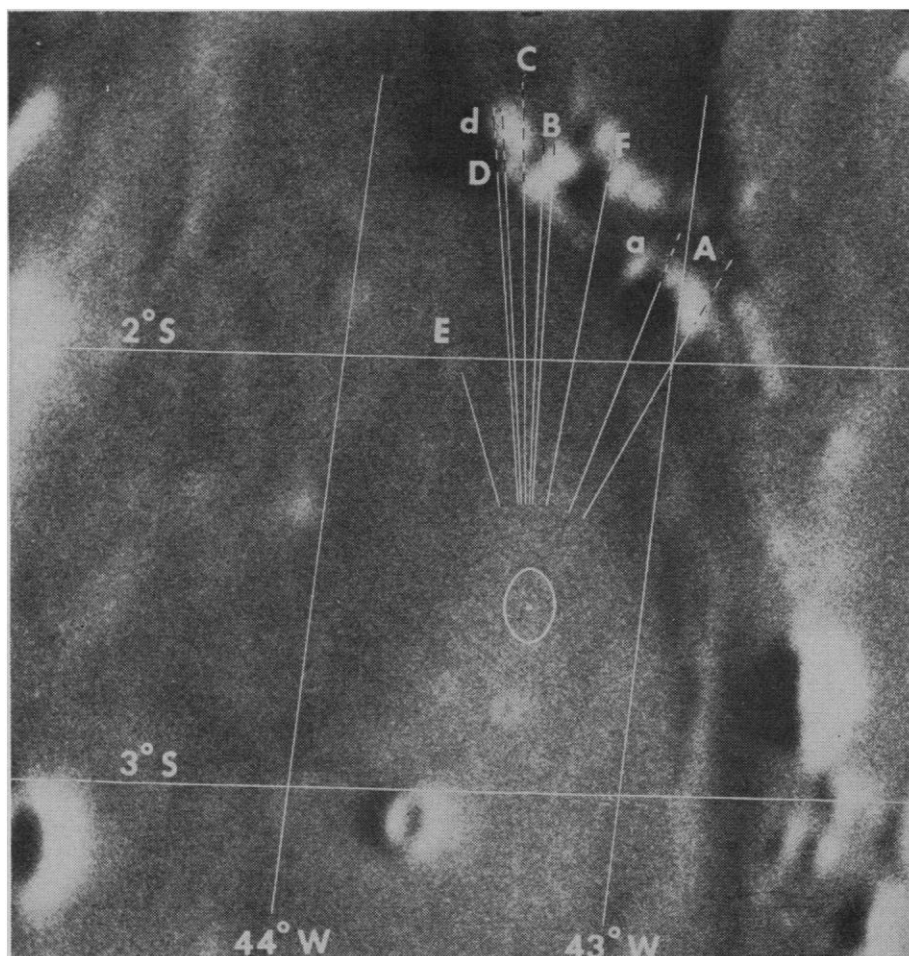


Fig. 1. Northeast portion of Flamsteed P, showing Surveyor location derived from horizon features; $1^\circ \approx 30$ km.