neutral hydrogen model with uniform density and temperature is not valid in this region.

Using the lower limit of 1 kpc to the distance of AP 2015, we can compute a lower limit to the mean electron density $<n_e>$ in the direction of the pulsar. Adopting a dispersion measure of 14·2 pc cm^{-3} (ref. 9), we find $<n_e>$ $<0{\cdot}015$ cm^{-3}. This is significantly smaller than usually assumed for the interstellar medium.

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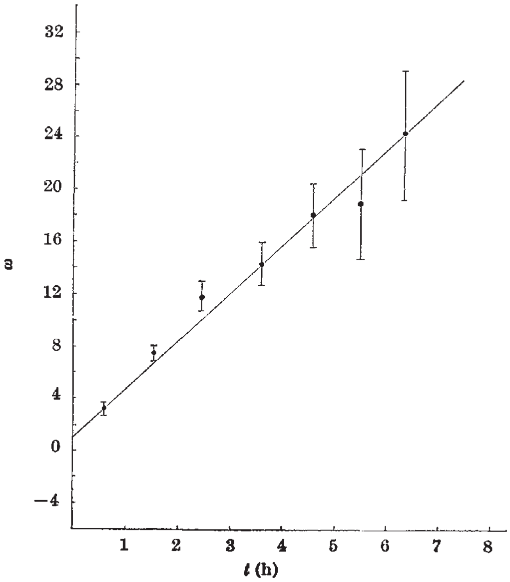

Fig. 2. The displacement of individual clouds in series of plates averaged over intervals of one hour as a function of time. The line corresponds to the four-day rotation of the cytherean upper atmosphere. The bars indicate the Gaussian probable error of the measurements.

Displacement of the Clouds of Venus

THE apparent four day rotation of the cytherean atmosphere was first pointed out by Boyer (private communication) in 1957 and the retrograde sense of the rotation was discovered by Boyer and Camichel[1] from the cloud markings often visible on ultraviolet photographs. The presence of this rotation has been reported several times since (refs. 2–8 and unpublished work of Kuiper *et al.*). The periodicity shows itself in two ways: (*a*) any particular formation, if observed over a period of hours, demonstrates a retrograde rotation of period approximately four days, although the periods obtained in this way scatter about a mean value; (*b*) large scale markings with easily recognizable shapes reappear at intervals of four days or multiples of this value, and the appearance of particular formations can be predicted for long periods in advance. Fig. 1 shows the short term evolution for a type of cloud pattern often observed.

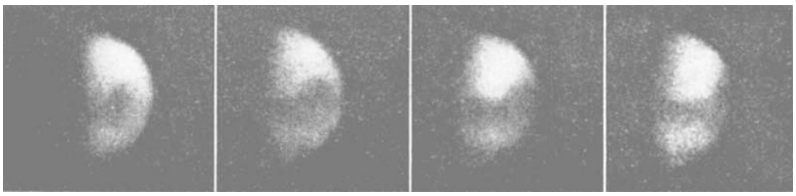

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Fig. 1. The short term evolution of a cloud pattern.

We selected the best photographs of Venus taken in ultraviolet light available at the IAU Planetary Data Centre at Meudon Observatory, and measured the longitudes and latitudes of the well-defined formations (called Y, Ψ and *H* by Boyer) on 300 plates taken during the years 1966–69. We determined the movement of the clouds with time in each time sequence. Then the longitudes of the clouds were averaged in one-hour intervals to get the mean displacement of the individual clouds with time. The results are shown in Fig. 2 indicating a rotation period of $4{\cdot}0 \pm 0{\cdot}5$ days retrograde for the upper atmosphere of Venus. Omitting the errors, we derived from the dispersion of the individual clouds an upper limit of about 740 km h^{-1} for the wind velocity, if we suppose that the clouds are at an altitude of about 95 km from the radar surface ($R = 6{,}052$ km) of Venus (Kuiper, unpublished). The corresponding minimum velocity would be about 320 km h^{-1}.

The reality of this bulk rotation of the upper atmosphere has been demonstrated independently by Guinot[7] by Doppler techniques and a Fabry-Pérot interferometer in the wavelength range 5500–5700 Å. The agreement with the photographically derived period is excellent, the present best estimate reported by Guinot and Feissel[8] being $4{\cdot}3 \pm 0{\cdot}4$ days retrograde, provided the axis of rotation is perpendicular to the orbital plane. As these recent observations on which this figure is based were made at a variety of elongations over a period of years, it seems reliable. The agreement between these two different observational methods is strong evidence in favour of the rapid bulk motion of the cytherean upper atmosphere. The difference between the radar period of 243 days retrograde and the ultraviolet period of four days retrograde possibly indicates a complex planetary atmospheric circulation, the nature of which is obscure.

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