So many farmers and planters in the West Indies and British Guiana have faith in the new moon or the full moon bringing rain, that it seemed of value to determine, from the Diamond data, what factual foundation there is for the belief.

Popular belief does not definitely fix the fall of rain for the actual date of the new or full moon, but for some time near the date. Thus one frequently overhears such remarks as: "It will be new moon to-morrow and we should get some rain to-night or to-morrow", or "The moon is full to-night so we may get some rain to-night or to-morrow". It was therefore decided to compare the average rainfall for:

(*a*) The three-day period made up of the day before new moon, the new moon day and the day after new moon;

(*b*) The three-day period immediately preceding (*a*);

(*c*) The three-day period immediately following (*a*);

(*d*) The three-day period made up of the day before full moon, the full moon day and day following the full moon;

(*e*) The three-day period immediately preceding (*d*);

(*f*) The three-day period immediately following (*d*).

This was done for the year as a whole and for the dry seasons only, since it might be argued that it is only during the latter that farmers are worried about rain and trouble to note the supposed relationship between precipitation and moon phases. At Diamond the weekly rainfall averages less than two inches from the week ending January 21 to that ending April 29, and again from the week ending August 12 to that ending November 25. These periods were taken as constituting the dry seasons. During the rest of the year the rainfall averages more than two inches per week.

Comparison of Average Rainfall (1914–34) in Inches at New and Full Moon with Rainfall Prior and After, at Diamond, E.B., Demerara, British Guiana.

	New Moon			Full Moon		
	3 Days prior (*b*)	3 Days at (*a*)	3 Days after (*c*)	3 Days prior (*e*)	3 Days at (*d*)	3 Days after (*f*)
Year	0·81 ± 0·06	0·82 ± 0·07	0·78 ± 0·07	0·85 ± 0·08	0·74 ± 0·06	0·93 ± 0·09
Dry Season	0·50 ± 0·06	0·51 ± 0·07	0·51 ± 0·08	0·48 ± 0·07	0·50 ± 0·07	0·62 ± 0·10

The results obtained for 259 new and 261 full moons (1914–1934), for the whole year, and for 147 new and 146 full moons, for the dry seasons, are set out in the accompanying table.

The differences between the means are as follows:

	Whole Year	Dry Season
a and *b*	0·01 ± 0·092	0·01 ± 0·092
a ,, *c*	0·04 ± 0·099	0·00 ± 0·106
d ,, *e*	0·11 ± 0·100	0·02 ± 0·099
d ,, *f*	0·19 ± 0·108	0·12 ± 0·122
a ,, *d*	0·08 ± 0·092	0·01 ± 0·099

It will be seen that none of the differences is significant and that there is no support whatever for the belief that there is likely to be more rain at the new or full moon than during the days just before or just after these phases. It is of interest to note, too, that the average rainfalls for the new moon and full moon periods are very similar.

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Another Double Star Process giving Very Fast Particles

IN a recent letter[1] I pointed out that in order to explain the energies found in cosmic radiation it is necessary to introduce only one hypothesis: that the components of the double stars are magnetic dipoles (as the earth and the sun). Then a rotating double star acts as a cyclotron. A more detailed calculation[2] shows that energies of 10^{10} or 10^{11} (perhaps 10^{12}) electron volts are attainable, but as the accelerating process is rather complicated it seems unlikely that it can be responsible for the total intensity of cosmic radiation. Therefore it may be of interest to point out that there are also other—and more simple—double star processes which are able to give high-energy particles.

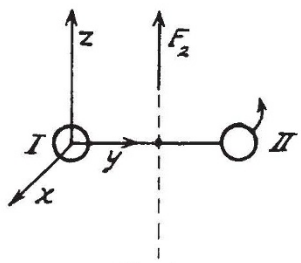

Fig. 1.

Let us assume that the two components I and II of a double star are parallel magnetic dipoles with the same moment (*a*). The star II rotates around I in the $x\,y$ plane with the constant angular velocity ω_0 and at the constant distance R_0 from I. If we follow the symmetry line parallel to the z-axis, the resulting magnetic field is always parallel to it. This means that charged particles can move freely in this direction. The field along this line is composed of the field H_1 from the component I supposed to be in rest, and the field H_2 from the component II which moves with the velocity $R_0\omega_0$. Now a moving magnetic field gives rise to an electric field. In our case the electric field component along the symmetry line is

$$F_2 = \frac{R_0\omega_0}{c} H_{2y},$$

where H_{2y} is the y-component of the magnetic field from II and c the velocity of light. The energy V (in electron volts) gained by a charged particle which has travelled from the $x\,y$-plane to infinity is

$$V = 300 \int_0^\infty F_2 dz,$$

and as $H_{2y} = \frac{3}{2} a R_0 z \left[z^2 + \left(\frac{R_0}{2}\right)^2 \right]^{-5/2}$, we find

$$V = 1{,}200 \frac{a\omega_0}{cR_0}.$$

If the period of the double star is 1 day, R_0 is 7×10^{11} cm. (ten times the radius of our sun) and

a is $2 \cdot 5 \times 10^{34}$ gauss cm.^{3} (five times the magnetic moment of the sun), we have

$$V = 10^{11} \text{ electron volts.}$$

If the orientation of the magnetic moments in relation to the rotation is the same as in our solar system, the accelerated particles have a positive charge.

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Dec. 18.

[1] NATURE, **138**, 761 (1936).
[2] *Z. Phys.*, in the press.

Luminous Efficiency of Rays entering the Eye Pupil at Different Points

WE have shown[1] that the impression of brightness produced by a light ray which forms an image on a fixed area of the retina depends in high degree on the position of entry of the ray in the eye pupil. For the ratio η of the apparent brightness for peripheral entry to the apparent brightness for central entry, values as low as 0·2 were found for white light and foveal vision. The following new features of the phenomenon have been revealed by later work:

(1) Measurements with white light. When the ray is imaged at the fovea the variation of apparent brightness with point of entry is large whatever the brightness level to which the eye is adapted. When the ray is imaged at a point a few degrees to the side of the fovea (parafoveal vision) there is very little variation of apparent brightness with point of entry

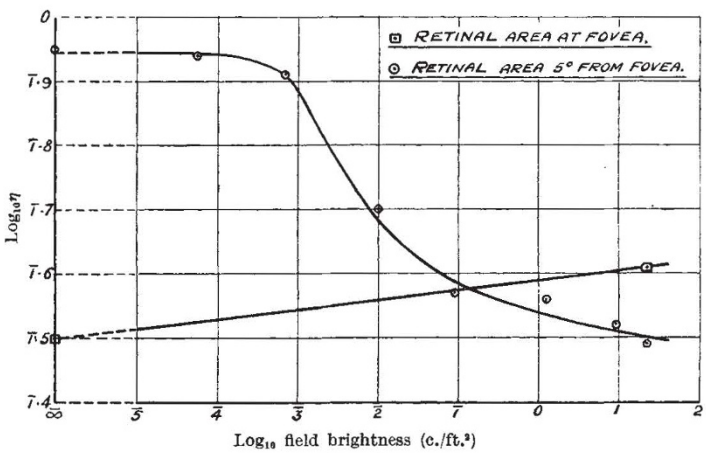

Fig. 1.

for brightness levels below 0·001 c./sq. ft. As the brightness level is increased beyond this value, the effect sets in and is fully developed at a brightness level between 0·1 and 1 c./sq. ft. Fig. 1 shows the variation of $\log_{10}\eta$ with the logarithm of the brightness level, for foveal and parafoveal vision. In these experiments adaptation was secured by viewing a uniform brightness of the desired value. η was deduced from determinations of the smallest intensity of a ray, entering peripherally or centrally and imaged at the fovea or in the parafovea, which the subject could just perceive (liminal brightness increment).

(2) Measurements with monochromatic light. Foveal vision. The change of apparent brightness with point of entry shows a relatively small variation with wave-length, being greatest in the blue, least in the yellow. It was observed, however, that the monochromatic light changes colour as its point

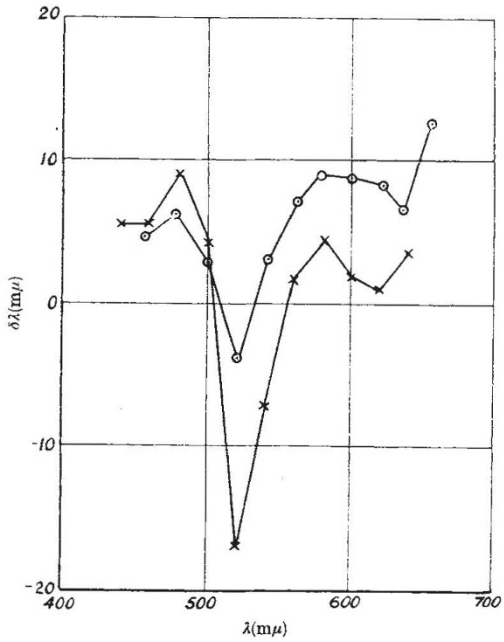

Fig. 2.

of entry is varied. The difference ($\delta\lambda$) in apparent hue for central and peripheral entry as a function of wave-length λ for two subjects is depicted in Fig. 2. In addition, in the green and blue-green, the peripheral ray appears more saturated.

Full details of these investigations are being published, but we may perhaps add here the following comments:

(*a*) The retinal origin of the effect is definitely confirmed.

(*b*) For the parafovea, the effect sets in at the brightness level commonly associated with the change-over from scotopic to photopic vision.

(*c*) The three types of receptors of the trichromatic theory must exhibit the effect in different degrees. This appears to be necessary to explain the observed colour change of physically homogeneous light.

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Dec. 24.

[1] Stiles and Crawford, *Proc. Roy. Soc.*, B, **112**, 428 (1933).

Forbidden Transition in the Spectrum of Interstellar Ionized Titanium

AN exploration of the ultra-violet spectra of a number of stars has recently been undertaken in collaboration with Dr. Walter S. Adams, using the aluminized mirror of the 100-inch telescope, a new grating of high efficiency ruled by R. W. Wood on an aluminized Pyrex disc, and an off-axis Schmidt