while the principle of conservation of momentum requires

$$\frac{M_p\beta_p c \cos\theta}{\sqrt{1-\beta_p^2}} = \frac{h\nu}{c} + \frac{M_q\beta_q c \cos\phi}{\sqrt{1-\beta^2_q}}, \quad . \quad . \quad . \quad (2)$$

and

$$\frac{M_p\beta_p c \sin\theta}{\sqrt{1-\beta_p^2}} = \frac{M_q\beta_q c \sin\phi}{\sqrt{1-\beta_q^2}}. \quad . \quad . \quad . \quad (3)$$

Solving for $h\nu$ we find

$$h\nu = \frac{(M_p^2 - M_q^2)c^2}{2M_p} \cdot \frac{\sqrt{1-\beta_p^2}}{1-\beta_p\cos\theta}. \quad . \quad . \quad (4)$$

Now, if $\beta_p c$, the velocity of the atom before the emission of the quantum, is zero, then the quantum emitted is $h\nu_o$, where

$$h\nu_o = (M_p^2 - M_q^2)c^2/2M_p, \quad . \quad . \quad . \quad (5)$$

so that equation (4) may be written

$$\nu = \nu_o\sqrt{1-\beta_p^2}/(1-\beta_p\cos\theta). \quad . \quad . \quad . \quad (6)$$

If β_p is small, then writing $\beta_p = v/c$ we have

$$\nu = \nu_o \times c/(c - v\cos\theta), \quad . \quad . \quad . \quad . \quad (7)$$

the formula for the Doppler principle. It seems therefore that the Doppler principle may be deduced without recourse to a wave theory.

If $\beta_p = 0$, we may solve for the velocity of recoil $\beta_q c$ and find

$$\beta_q c = c(M_p^2 - M_q^2)/(M_p^2 + M^2_q) = 2M_p h\nu_o/(M_p^2 + M_q^2)c. \quad (8)$$

For light of about 4000 Å.U. emitted by the hydrogen atom:

$\beta_q c = 100$ cm./sec., while $(M_p - M_q) = 5 \times 10^{-33}$ gm.

G. E. M. JAUNCEY.

Washington University,
St. Louis, U.S.A.,
January 22.

An Australian Fossil Jelly-fish.

QUITE recently a remarkable discovery of a fossil jelly-fish has been made in the fine-grained blue mudstone of the lower part of the Silurian at Brunswick, Victoria. It was in the same locality, but at a higher horizon, that another unique discovery was made about twenty-four years ago, of an exquisitely preserved crinoid, *Helicocrinus plumosus*, of which the entire organism was found, including the coiled distal end of the column.

The present fossil occurrence is unique for Australia, so far as I am aware, and the only other related form is a Discophyllum (*D. peltatum*) figured and described by James Hall in 1847, from the Hudson River Series, below Troy, New York.

It is especially noteworthy that our basal Melbournian stage of the Silurian comes, in point of geological time, immediately after the American sediments, so that these two widely separated occurrences practically agree both in morphological affinity and in age.

The Victorian Silurian jelly-fish is shown in strong relief on the two halves of a slab. The umbrella is radiately ribbed and concentrically frilled. The genital pockets are distinct and there is a zone of comparatively short tentacles more or less clearly marked.

Notwithstanding the paucity of definitely preserved skeletons of invertebrates, such as mollusca and arthropods, in the Victorian mudstone, very much original structure has been retained in fossils that would not, in the ordinary way, be regarded as good museum specimens. From similar fine-grained mudstones in Victoria, the soft gill-plumes of the Serpula-like Trachyderma have already been described, in which even the eyes are still visible as carbonised spots. There is little doubt that a careful and prolonged search amongst these supposed unfossiliferous mudstones would result in many thrilling discoveries, and it is fortunate that the above fossil fell into the hands of so careful a collector as its discoverer, Mr. R. Evans. FREDK. CHAPMAN.

National Museum, Melbourne,
January 12.

Measurement of Radiation Intensities by Photographic Methods.

DR. HOUSTOUN, referring in NATURE of January 30, p. 159, to Dr. Toy's note on the above, deprecates the use of 'neutral' absorbing screens, and recommends that the intensity of a beam of radiation be reduced by increasing the distance between source and screen and applying the inverse-square law. In view of the simplicity of action and ease of calibration of neutral screens or wedges, it is surprising that at this stage in the development of photometry, a method possessing so many disadvantages as that suggested by Dr. Houstoun should be seriously considered. If large variations in the intensity of radiation are required, say of the order of 2000 to 1, any instrument depending on the direct application of the inverse-square law must necessarily be extremely cumbrous. Further, the effect of reflected radiation from adjacent surfaces is difficult to eliminate, and the necessary correction for the absorption of the intervening medium detracts from the apparent simplicity of the method.

The 'neutral' wedge, on the other hand, provides an accurate and compact means of altering the radiation intensity throughout a very wide range. Wedges can be obtained which are practically neutral over a large portion of the visible spectrum. Even if the absorption varies with wave-length, as it does, for example, in the ultra-violet, the wedge is easily calibrated in its actual position in the apparatus, so that its lack of neutrality is not really detrimental to its use. Again, the wedge produces a continuous change of intensity, whereas any method depending upon the inverse-square law can in practice only change the intensity by finite amounts. Optical wedges have been used here in many different types of researches and have proved both convenient and accurate. I. O. GRIFFITH.

Clarendon Laboratory,
Oxford.

What is a Beam of Light?

PROF. GILBERT LEWIS'S views (NATURE, February 13, p. 236) stretch far, but will he, or any one else, begin at the first stage?

As any group of incandescent atoms must be at every variety of phase of distance, why does any beam of light behave as if it all started from an identic single phase? How can interference appear if two streams of waves moving at every phase interact? There cannot be lamination of space at a wave-length apart, as wave-lengths are varied, and incandescence is the same in all directions.

Another difficulty; in a bundle of waves vibrating in all azimuths, how does polarisation separate the whole light into two parts vibrating at right angles? A selective action might only transmit waves nearly in the same plane, but polarising appears to take all light up to 45° from its plane. Is every separate vibration, or quantum, or corpuscle split into two components?

To the outer layman it looks as if the clearing of these fundamental questions would be a useful preliminary to further theories. F. P.