character, as shown by its occurrence not merely among the Kadars but also among the Pulayans and the Malsers. It is not impossible that such a type exists among other aboriginal tribes of Southern and Central India in regions which have not so far been carefully explored. Dr. J. H. Hutton's discovery ("Man in

FIG. 1.—Kadars of the Cochin Hills with woolly and frizzly hair respectively.

India", vol. 7, No. 4, pp. 257-262) of spirally curved hair among a section of the Angami Nagas would extend it to the eastern frontiers and lend support to the view of the wide distribution of the negrito type at one time in India.

The results of my investigations on the Kadars of the Cochin and Anaimalai Hills will be published as soon as the details are worked out.

B. S. GUHA.

Zoological Survey of India,
Indian Museum, Calcutta.

Penetrating Radiation and de Broglie Waves.

BOTHE and Kolhörster have recently published a preliminary account of an experiment on the absorption coefficient of the penetrating radiation (NATURE, April 27, p. 638). They conclude that this radiation is of corpuscular rather than of gamma type. The purpose of this note is to show that their experiment may be inconclusive.

The de Broglie wave-length (de Broglie, "Ondes et Mouvements", 1926, p. 10) for an electron moving with velocity v is

$$\lambda_B = \frac{h\sqrt{1-\beta^2}}{m_0v}$$

If this electron were suddenly stopped, the wave-length of the emitted quantum would be, on the basis of Einstein's photoelectric equation,

$$\lambda_E = \frac{h}{m_0c} \frac{\sqrt{1-\beta^2}}{1-\sqrt{1-\beta^2}}$$

The ratio
$$\frac{\lambda_E}{\lambda_B} = \frac{\beta}{1-\sqrt{1-\beta^2}}$$

approaches unity for wave-lengths of the order of magnitude of those under discussion. For example, Millikan and Cameron (*Phys. Rev.* [2], 31, 921; 1928) give 0.00008 Å. for the wave-length of their most penetrating radiation. If one takes $\beta = 0.99999$, then $\lambda_E = 0.000109$ Å. and $\lambda_E/\lambda_B = 1.0045$.

The results of experiments (Davisson and Germer, *Phys. Rev.* [2], 30, 705; 1927; Kikuchi, *Proc. Imp. Acad. Tokyo*, 4, 471; 1928) have shown that the de Broglie wave-length of low velocity electrons can be used to explain their reflection from and diffraction in crystals. It is suggested by analogy that, in the scattering of high velocity electrons and high frequency electromagnetic radiations of the same energy, the distribution in angle and the energy re-

lations between the incident and scattered rays may be nearly identical.

If one assumes the mass of an electron and the mass of a quantum to be respectively

$$m_e = \frac{m_0}{\sqrt{1-\beta^2}}, \quad m_\gamma = \frac{h\nu}{c^2},$$

and uses the above expression for λ_E , it is seen that

$$\frac{m_e}{m_\gamma} = \frac{1}{1-\sqrt{1-\beta^2}}.$$

For the velocity considered above $\frac{m_e}{m_\gamma} = 1.0045$.

From this, one may derive further grounds for extending, by analogy, the already established duality to the present case. In the scattering formula of Klein and Nishina (*Zeits. f. Physik.*, 52, 853; 1929), ν occurs only in the factor $h\nu/m_0c^2$. Therefore, if one substitute m_e for $h\nu/c^2$ the numerical result is changed only slightly for large values of β .

If the above hypothesis should be valid, the analysis of penetrating radiations at the surface of the earth into electrons or light-quanta might be impossible by means of simple scattering or absorption experiments.

It is also possible that some of the rays from radioactive substances recently classified as short wave gamma-rays may in reality be high speed beta-rays.

F. T. HOLMES.

Sloane Physical Laboratory,
Yale University,
New Haven, Conn., May 23.

Magnetic Properties of Isolated Atoms of Cobalt.

FERRO-MAGNETISM is one of the most complicated and least explained subjects. This is because in most of the experimental work what are observed are statistical phenomena from which it is difficult to arrive at a knowledge of the elementary mechanism. It was therefore thought interesting to investigate alloys of a small percentage of cobalt with platinum; namely, 10 per cent Co - 90 per cent Pt and 5 per cent Co - 95 per cent Pt, in which the ferro-magnetic cobalt atoms are not generally surrounded by other magnetic atoms, but by non-ferro-magnetic platinum atoms.

These alloys were found ferro-magnetic, the Curie point being 249° C. and 49° C. for the 10 per cent and 5 per cent alloys respectively. The magnetisation, I , at different temperatures, from that of liquid air up to the Curie point, was found for each alloy, the decrease in magnetisation near the Curie point being most rapid for the 5 per cent alloy. For small values of the applied magnetic force ($H = 0$ to 100 gauss), I increased at first with temperature, but for greater values of H it decreased steadily. The greatest values of I obtained ($H = 565$ gauss) were 364 and 254 C.G.S. units for the 10 per cent and 5 per cent alloys respectively. This corresponds to a magnetic moment per cobalt atom 25 per cent and 60 per cent greater than that calculated from the saturation magnetisation of pure cobalt, assuming the platinum atoms do not contribute to the magnetisation.

Finally, various hysteresis loops, showing the relation between I and H , were obtained. These were found to vary considerably with the heat treatment. For wires in the hard drawn state, the 5 per cent alloy gave the larger and more rectangular loops, with a coercive force as great as 100 gauss; but after annealing at different temperatures, the hysteresis was greatly reduced, the 5 per cent alloy showing a coercive force of only 20 gauss as against 28 for the 10 per cent alloy. This last result, for the annealed wires, is in accord with Heisenberg's theory of ferro-magnetism based on the resonance between the