Ca^+ layer, since one does not yet know the density law of the ionised hydrogen. Pannekoek and Minnaert's work indicates it only so far as 3000 km. approximately, and precludes extrapolation by suggesting that their empirical law for H_γ ceases to be valid at that height.

This work, too, it may be mentioned, gives a fairly rapid falling off of the hydrogen line intensities with increasing height in agreement with Mr. Gurney.

I attempt a discussion of the equilibrium of the hydrogen in my paper, but reach no positive conclusion.

W. H. McCrea.

Göttingen, Mar. 5.

Insects Flying to Ships.

All those who have travelled about the world in recent years must have noticed the insects which fly to ships at anchor, attracted by the bright electric lights. Some years ago I secured a most interesting series (including a new species of moth) off the coasts of Chile and Peru, and in many other places have made collections where I could not go ashore. The most remarkable occasion of this sort was perhaps at Diamond Harbour, on the Hooghly River, near Calcutta, in December 1927. Going up, we waited some time, and again going down (on the way to Rangoon). The latter delay was caused by a railway accident in France, which prevented the through mails from arriving in time, so we had to wait until they were brought out in a tender some time in the night. Thus the deplorable accident brought good fortune to an entomologist travelling in India—a curious example of the interdependence of things. Diamond Harbour is not really a harbour, but merely a station on the river where ships anchor to await favourable conditions, with the shore distant perhaps half a mile.

The insects which came on board at Diamond Harbour were of various orders, but I will now only enumerate the remarkable series of Carabidæ or ground beetles, and a few beetles of other families, all identified for me through the kindness of the Imperial Bureau of Entomology. The Carabidæ were determined by Mr. H. E. Andrewes, the well-known authority on this group.

Carabidæ.

Casnoidea cyanocephala Fb.
**Clivina tranquebarica* Bon.
**Tachys impressipennis* Mots.
Tachys unistriatus Putz.
Apotomus hirsutus Bates.
**Oodes westermanni* Laf.
**Diplocheila impressa* Fb.
**Diplocheila polita* Fb.
Liodaphus birmanus Bates.
**Anoplogenius microgonus* Bates.
Anoplogenius new species.
**Stenolophus smaragdulus* var. *quinquepustulatus* Wied.

Andrewes has just published a long list of the Carabidæ of Ceylon, which includes, of the above list, those marked by an asterisk. Will some of the others presently reach there on ship-board, and is it possible that some already noted in both lists were carried to one or the other place on ships? Three of the above genera are at present apparently absent from Ceylon.

Some other beetles represented at Diamond Harbour were:

Cicindelidæ: *Cicindela sexpunctata* Fb.
Staphylinidæ: *Pæderus fuscipes* Curtis; *Philonthus quisquiliarius* var. *inquinatus* Steph.
Mycetophagidæ: *Litargus varius* Grouv.
Donaciidæ: *Donacia delesserti* Guér.
Halticidæ: *Chætocnema concinnipennis* Baly.
Hispidæ: *Hispa armigera* Ol.

It is a remarkable fact that both the species of Staphylinidæ cited also occur in Britain, and *Pæderus fuscipes* also flew on to the ship when we were anchored off Sourabaya, Java, on Mar. 7. Who can doubt that these have been spread by shipping?

We have in recent years heard a great deal about the spread of insects by automobiles, but perhaps we have not always appreciated the important part which must be played by ships, now that the vessels are so large, and carry so many electric lights. I suggest that travellers, even if not entomologists, might frequently do a good service by collecting the insects coming on board; especially the beetles, which need only to be put in a small bottle of alcohol. A more ambitious but interesting project would be to take out a small vessel with a bright light and determine just how far from the shore insects of different kinds can be attracted.

T. D. A. Cockerell.

University of Colorado,
Boulder, Jan. 29.

Fine Structure Absorption Edges in Metals.

It is well known from the experiments of Lindh and others that when pure metals are examined, in general no fine structure edges (as distinguished from the secondary absorption edges) are observed. If, as is generally believed after Kossel, the fine structure edges originate in the removal of the electron from the K shell to the various optical levels in the atom in question, it is difficult to understand why these edges should be absent in them. The non-appearance of the fine structure edges when metallic plates or metallic crystals (in the form of powders) are used as absorption screens can be explained on the hypothesis of the existence of free electrons in metals. The primary absorption edge originates from the removal of an electron from one stationary orbit inside the atom to another optical orbit, both these orbits possessing definite energy value.

In metallic plates the outermost electron or electrons may be supposed to be free, and as such the optical levels of definite energy values, as are usually observed in the vapours of these metals, can have no real existence. The removal of an electron by the absorption of radiation from the K shell to the periphery of the atom simply sets the electron free from the atom, and unless the former has sufficient energy it will be confined to the metal itself. The extra energy necessary to take the electron out of the metal depends on the nature of the material and the crystal lattice, and is generally of the order of 4-5 volts. Thus not only the fine structure according to Kossel will be absent in metals, but also the most intense position of the white absorption will be confined to a range (of about 4-5 volts) smaller than the ionisation potential of the atom in question.

This statement is supported by the works of Fricke (aluminium and magnesium), Lindh (potassium, titanium, vanadium, chromium, manganese, and iron), and Chamberlain (titanium, vanadium, and chromium) in metals. Though we may not have fine structure edges of metal as predicted by Kossel, which should appear only in vapours of these elements, one can surely expect secondary absorption edges of these metals caused by the multiple absorption of the incident radiation by two or more electrons occupying different energy levels of the atom under consideration (see Ray, Nature, Nov. 17, 1928, p. 771; Lindsay and Voorhees, *Phil. Mag.*, November 1928).

In vanadium metal, Lindh has observed a secondary absorption edge with a separation of 8·7 volts from the primary. Evidently this edge cannot be included under the category of Kossel's fine structure edge,