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in *Mus*, so that the malleus more resembles that of *Lepus*. The stapes of this family has generally long, slender, and not very divergent crura, and the intercrural canal is wanting.

In the Hystricidæ the great feature is the ankylosis of the malleus to the incus, already well known to zoologists. It is almost invariable in the adults of that family. The manubrium is very broad, and the inner edge above the processus muscularis is very thick. The varieties among the different genera are trifling: the head of the malleus is produced forwards to an extreme degree in *Aulacodus*, *Capromys*, and particularly in *Chinchilla*, but less so in the porcupines and the agouti. The stapes is always proportionally small, with stout and not very divergent crura; a bony intercrural canal occurs in many genera, but is an inconstant feature in individual specimens of the same species.

As the ankylosis of the two outer ossicles occurs in *Dipus*, whilst the head of the malleus remains small and unproduced, and that bone possesses a wide lamina, it must be considered intermediate, as far as those little bones are concerned, between the Muridæ and Hystricidæ.

As occurs in other orders, the fossorial members of the Rodentia present great peculiarities in their ear-bones. In *Geomys* the malleus somewhat resembles that of *Marmotta*; the stapes is remarkable for the large bulla on its base. *Rhizomys* and *Ellobius* approximate most to the rats, *Bathyergus* to the Hystricidæ, which it exceeds in the degree of fusion of the malleus to the incus, which latter bone, however, differs in form from the same in that family. In *Spalax* the malleus approaches the more central type of *Castor* or *Lepus*; but the stapes is of a very unique type, somewhat similar to that of *Chrysochloris*, except that one crus is quite straight and very divergent.

In both species of Elephant the large ossicula appear rather like the modified ear-bones of certain rodents than like any ungulate. There is neither the lamina or long manubrium mallei, nor the thick and divergent processus brevis incudis, nor the quadrilateral stapes frequent among the large Ungulata; on the other hand the short, broad-based manubrium, the thin, short, and hardly divergent processus brevis of the incus, and the wide intercrural aperture of the stapes are characteristic in *Elephas* and common among the Rodentia.

In the Hyraces the ear-bones bear a slight affinity to those of the horse, but none of any importance to the common types among the Ungulata or Rodentia.

The ossicles of the remaining groups of the Mammalia will be described in a subsequent communication.

IV. "On two new Vanadium Minerals." By H. E. Roscoe, F.R.S. Received May 10, 1876.

No. 1.—The first of these remarkable minerals contains 28 per cent. of vanadium pentoxide. It was forwarded to me by Dr. James Blake, of San Francisco, with the following statement:—"I discovered it in a gold-mine, and it serves as the matrix for the gold. It occurs in small bunches, filling cavities in a schistose porphyry."

The mineral occurs in radiating and foliated talc-like masses, greenish grey in bulk, and light greenish yellow when seen in fragments, forming a grey powder. Its lustre is subvitreous to fatty. In mass it is opaque, but is translucent in thin splinters. Its hardness is about equal to that of talc; its specific gravity is 2·902.

Blowpipe reactions.—When heated in thin splinters the mineral fuses easily to a black non-magnetic bead. In a closed tube a little water is given off. With borax and microcosmic salt the reactions of vanadium and silica are obtained. It is only partially attacked by acids.

Composition.—Two complete analyses of the mineral have been made with the following results:—

	I.	II.	Mean.
Silica	41·25	..	41·25
Vanadium pentoxide	28·85	28·36	28·60
Alumina	14·34	13·94	14·14
Iron sesquioxide	1·04	1·23	1·13
Manganese sesquioxide ..	1·45	·85	1·15
Lime..................	·61	·62	·61
Magnesia	1·96	2·06	2·01
Potash	8·25	8·87	8·56
Soda..................	·72	·92	·82
Water..................	·94	1·22	1·08
Moisture..............	2·12	2·42	2·27
	101·53		101·62

The following formula approximately represents the composition of this mineral, a portion of the alumina being replaced by the sesquioxides of iron and manganese, and a portion of the potassium oxide by lime, magnesia, and soda:—

$$2(Al_2O_3 \,.\, V_2O_5) + 2K_2O \,.\, 9SiO_2 + H_2O,$$

or $4AlVO_4 + K_4Si_9O_{20} + H_2O$.

Thus we have:—

	Calculated.	Found.
Silica......................	41·18	40·38
Vanadium pentoxide	27·63	28·00
Alumina	15·59	15·32
Potassium oxide	14·24	15·24
Water	1·36	1·06
	100·00	100·00

Vanadium and aluminium salts cannot be separated by fusion with sodium carbonate and subsequent precipitation by ammonium chloride, as some of the alumina is thrown down as aluminium vanadate together with the ammonium vanadate.

The vanadate of aluminium and the ferric oxide precipitated together by acetate of ammonium are separated by fusion with sodium carbonate and subsequent boiling with water. The vanadic acid in the acidified solution is then reduced by sulphur dioxide, the liquid well boiled, and the vanadium estimated volumetrically by means of potassium permanganate. The larger portion of the vanadium remains in solution after the addition of ammonium acetate, and this is precipitated as lead metavanadate by the addition of lead acetate solution. The lead salt is dissolved in nitric acid, and the lead thrown down by sulphuretted hydrogen, the filtrate on evaporation yielding pure vanadium pentoxide, which after ignition is weighed. This method was likewise made use of for the separation of vanadium in the portion of mineral which served for the estimation of the alkalies.

A direct assay of the vanadium was made by heating 0·5105 grm. of the mineral with strong sulphuric acid, diluting with water, reducing with a current of sulphur dioxide, and titrating with a standard solution of permanganate of 1 cub. centim.=0·00534 grm. of metallic iron. Of this solution 17·3 cub. centims. were needed; this corresponds to 29·5 per cent. of vanadium pentoxide, the change of oxidation being from V_2O_4 to V_2O_5. From this must, however, be deducted the amount of vanadium pentoxide equivalent to 1·13 per cent. of ferric oxide; this leaves 28·21 per cent. of V_2O_5, an amount closely approximating to that (28·6) obtained by analysis.

Dr. James Blake, in his communication referred to above, states:—"At the suggestion of my friend Professor Gibbs, I propose to name the mineral Roscoelite, should the name not be already appropriated."

No. 2.—The second vanadium mineral, to which I propose to give the name of Mottramite, occurs as a crystalline incrustation on Keuper sandstone found at Alderley Edge and at Mottram St. Andrew's, in Cheshire, and at other localities.

The incrustation is usually very thin; but occasionally it becomes 3 or 4 millimetres in thickness, and in one or two cases masses almost the size of a walnut have been found. Sometimes the incrustation has a black velvety appearance, and consists of numerous extremely small crystals, so minute that their form has not yet been ascertained. More commonly, however, the mineral possesses a compact character. The crystals are black by reflected light, but very thin particles are subtranslucent and transmit yellow light. The compact mineral is purplish brown and opaque. The lustre of the crystals is resinous. Streak yellow. Hardness of compact portion about that of calc-spar. Specific gravity 5·894.

Behaviour before the blowpipe.—In the closed tube a little water is evolved on heating, and the mineral fuses very easily. On asbestos it fuses easily and slightly tinges the flame green. Heated on charcoal with sodium carbonate in reducing flame, a yellow incrustation and grey malleable bead are obtained. On dissolving the bead in nitric acid and adding ammonia in excess, a blue solution is obtained. Heated with borax on platinnm wire in the oxidizing flame the bead is yellow when hot, then becomes green, and when cold is blue. In the reducing flame the borax bead is bluish green, with a red skeleton of reduced copper.

Analysis.—Two complete analyses of this mineral, freed as much as possible from the matrix, gave the following results:—

	I.	II.	Mean.
Vanadium pentoxide	16·78	17·49	17·14
Lead oxide	50·49	51·45	50·97
Copper oxide............	19·72	18·48	19·10
Oxides of Fe, Zn, Mn	2·52	2·52	2·52
Lime	2·61	1·64	2·13
Magnesia	0·37	0·16	·26
Water	3·63	3·63	3·63
Moisture	0·22	0·22	0·22
Silica..................	0·87	1·25	1·06
	97·21	96·84	97·03

Taking the oxides of vanadium, copper, and lead, together with the water, and omitting the small quantities of the other constituents, the proportions are those required by the following formula:—

$$(Pb\,Cu)_3\,V_2\,O_8 + 2\,(Pb\,Cu)\,(OH)_2.$$

Thus:—

	Calculated.	Found.
Vanadium pentoxide	18·74	18·87
Copper oxide	20·39	21·02
Lead oxide................	57·18	56·12
Water	3·69	3·99
	100·00	100·00

As this mineral contains no aluminium, the determination of vanadium is made by fusing the mass, after separation of copper and lead, with sodium carbonate, treating the fused mass with water, and precipitating the soluble sodium vanadate as ammonium salt.

In addition to the above constituents the mineral contains traces of arsenic, cobalt, and sodium.

Mottramite is interesting as forming the third term in a second (doubtless) isomorphous group of phosphates, arsenates, and vanadates corresponding to the well-known pyromorphite, mimetesite, and vanadinite group. The new group is:—

Dihydrite .... $Cu_3\,P_2O_8 + 2\,Cu\,(OH)_2$.
Erinite ...... $Cu_3As_2O_8 + 2\,Cu\,(OH)_2$.
Mottramite.... $(Cu\,Pb)_3V_2O_8 + 2\,(Cu\,Pb)\,(OH)_2$.

The crystalline form of these three minerals remains yet to be determined.