

served. The different phases of luminescence indicate the presence of different trace elements acting as luminescence activators;  $\text{Ca}_3(\text{PO}_4)_2$  of the bones working as the luminophoric base.

The conclusion that the intense bright red luminescence is due to the  $\text{Ca}_3(\text{PO}_4)_2$ -Bi phosphor and thus indicates the presence of Bi in the bones mentioned is drawn from the following facts:—

(1) If the specimens are boiled for more than 12 hrs. with 5% NaCl or 1% KOH solution at the beginning, then the color of luminescence is very faint blue even when treated in the same manner as mentioned above. Boiling for more than 12 hrs. with  $\text{CHCl}_3$  or water does not alter the red luminescence.

(2) Pure  $\text{Ca}_3(\text{PO}_4)_2$  is prepared with elaborate care and heated at  $950^\circ$  for 2 hrs. The luminescence obtained is the same as in (1). But when Bi is chemically added to the  $\text{Ca}_3(\text{PO}_4)_2$  in the ratio  $10^{-6}$ : 1 and the same heat treatment is given, the same bright red luminescence as mentioned above is produced.

(3) Bi was microchemically detected in the above NaCl extract. A solution in which Bi is concentrated was obtained from 320 g. of the bones of *Paralichthys olivaceus*. A drop of the solution when added to the specimen of (1), reproduces the bright red luminescence. This solution also gives  $\text{CaS}$ , the well known violet blue luminescence of  $\text{CaS}$ -Bi phosphor.

(4) When Bi is chemically added to the specimen of (1) in the ratio  $10^{-6}$ : 1, the bright red luminescence is also reproduced.

The same bright red luminescence is also observed in the case of human teeth when treated in the same manner as in the case of the vertebrae mentioned above.

A decayed tooth showed no such bright red luminescence.

The writers surmise that Bi may be a "nutritional trace element" which is indispensable in the metabolism of  $\text{Ca}_3(\text{PO}_4)_2$  in the animal body. With respect to this point, further research is still being done. The cathodo-luminescence method will offer a convenient method for studying the manner of the trace of Bi in bones and teeth.

## The Presence of Bismuth in Fish Bones and Human Teeth as Revealed by Cathodo-luminescence Method of Analysis

By Shin'ichiro HAKOMORI and  
Shohei TAMURA

(Received April 16, 1951)

The vertebrae of *Cololabis saira* and *Paralichthys olivaceus* are well washed with water, dried and heated at  $950^\circ$  for 2 hrs. The specimens are excited with cathode ray and the colors of luminescence produced are ob-

Chemical Institute, Faculty of Science  
Tohoku University, Sendai,