

is a very sensitive means of measuring temperature.

The new pyrometer can measure temperatures as low as 1,000 degrees Centigrade, and has no upper limit, Dr. Koller said. It is instantaneous, and is not injured by the furnace or its contents. This is a very needful apparatus in these times of high temperatures in modern industrial processes. Lack of adequate means of measuring high temperatures in furnaces has handicapped their use.

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#### PHYSIOLOGY

### Accepted Theory of Sense Of Balance May be Revised

**T**HE GENERALLY accepted theory of how the sense of balance operates may have to be revised as a result of research reported by Dr. Franklin Fearing of Northwestern University.

Dr. Fearing has made a study of the behavior of birds after certain operations had been performed on the inner ear. Previous to the operation, the birds had been trained to follow a simple maze which required them to hop, perch, walk up an inclined plane, and to do other stunts that would show up any disturbance in their ability to maintain their equilibrium.

The birds showed no serious disturbances after the removal of from two to four centimeters of one of the semi-circular canals, although any flow of fluid through that part of the canal was then impossible. Such a flow has been supposed to produce the feeling of equilibrium or lack of it. On the other hand, removal of a single ampulla, the enlargement at the end of the canal, produced disturbances in the balancing behavior of the birds. The nature of these disturbances differed in the different birds.

#### Greatly Variable

"Contrary to the classical and contemporary reports of the results of this type of investigation, there is enormous variability both as to type and severity of the symptoms following surgical interference with the canals, but there appears to be but little constancy as to the time of appearance of the symptoms and the rate of recovery of the bird," Dr. Fearing reported. He added that there was evidence that the function became completely restored even in the case of birds showing the most severe type of symptoms.

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#### LARGEST OF HIS TIME

*Such was the distinction of the Uintatherium, with three pairs of horns, that lived in North America 55,000,000 years ago. In great contrast are the tiny four-toed primitive horses which were about the size of a collie dog. They are known as Orohippus. This restoration of prehistoric life is a mural painting by Charles R. Knight, now on exhibition at Field Museum of Natural History, Chicago. It is one in a series of twenty-eight presented by Ernest R. Graham.*

#### PHYSICS

## New Method Measures Speed Of Electrons in Dense Solids

**A** METHOD used by astronomers to determine the velocity of stars has been applied in a slightly modified form to the atom to furnish the first direct evidence that electrons, negatively charged electrical portions of atoms, move about at high speeds within bodies which are solid.

The experiment, conducted at the California Institute of Technology by Dr. Jesse W. M. DuMond, research fellow, and Dr. Harry A. Kirkpatrick, teaching fellow in physics, was the second crucial test of activities of the electrons within the atom. The first test was reported last January.

In explaining the application of the Doppler effect to the experiment, Dr. DuMond declared that if the source of the light or sound is in motion the successive vibrating waves or ripples are crowded together on the forward side of the motion's direction, and spaced farther apart on the rearward side.

A similar phenomenon explains the fact that the sound from a train whistle approaching a stationary listener is of higher pitch than the sound of the same whistle when the train is receding from

the listener. In the same way, stars approaching an observer emit spectral lines shifted toward the violet end of the spectrum, whereas receding stars emit lines shifted toward the red.

When the electron scatters X-radiation a similar effect occurs. If that part of the radiation which is scattered at a definite angle to the incoming beam is observed with a spectroscope, the spectral line which was in the original radiation is found to be shifted toward longer wave-lengths and the spectral line is found to be broadened. The shift may be regarded analogically as a Doppler effect caused by the velocity of the electron recoiling away from the light under the impact that the light has given it. The increased breadth of the line may be regarded as a composite Doppler effect of the chaotic motion of all the electrons in the myriads of atoms scattering the X-radiation. Dr. DuMond set the average speed of the invisible electrons which make up solid matter at 1,500 miles per second for the case of carbon.

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