The seemingly large percentage of error for the oolitic sand is not due to lack of efficiency of the instrument, but to the range in specific gravity of the oolites. The error for the beach sand is due to the heterogeneous character of the material both in respect to shape and specific gravity of the particles.

This apparatus enables a rapid, accurate method of counting sand grains. The limiting factor is the size of the holes that can be drilled. The smallest drill I have been able to obtain has been a .004″ (.10 mm) jeweler's drill, which is extremely delicate and breaks easily. A small 25-hole plate made with this size drill worked well for the $\frac{1}{8}$ mm grade size. A larger plate has not yet been attempted. For grains larger than $\frac{1}{2}$ mm the punched brass plate made by the Harrington and King Perforating Co., Chicago, worked satisfactorily. Smaller diameter holes must be drilled by hand, or may possibly be made by means of the x-ray.

Although this instrument was made for counting sand grains, it can be applied for counting small particles of other types.

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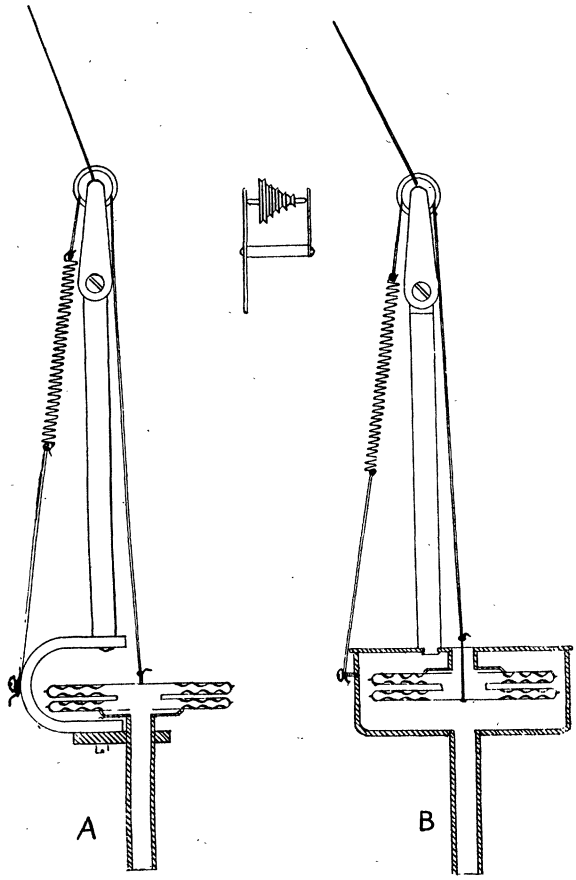
A UNIT FOR KYMOGRAPH RECORDING[1]

THE rubber membrane of the Marey tambour is the unsatisfactory feature of the usual method of pneumatic recording. If it is delicate it must be replaced frequently and it is difficult to calibrate if calibration is important.

This pneumodeik (Fig. A) replaces the Marey tambour. The essential part of this recording unit is a quadruple, corrugated, very thin phosphor-bronze diaphragm, 4 cm in diameter, such as is used for airplane instruments. The diaphragm is attached to a horizontal rod at the end of which an aluminum pulley-cone is mounted on needle-point bearings. A light silk thread is fastened to the front disc of the diaphragm, passed round one of the pulleys and brought back on the other side of the rod where it is fastened to a delicate steel spring, the tension of which can be regulated by a thumbscrew attached to the mounting. A thin stylus of bamboo is glued to the broader base of the pulley-cone and tipped with a glass filament or a tiny bit of photographic film. The deik can be constructed at a cost of from 10 to 12 dollars.

The rubber tube conveying the pneumatic impulse is attached to a metal tube leading directly to the diaphragm. When the diaphragm is displaced by the air pulses, the thread rotates the pulley-cone; the diameter of the pulley selected and the length of the stylus determine the amplification. As the pulley can be made to slide easily under the thread, it is possible to shift the position of the stylus while it is writing on the drum. The writing stylus may be replaced by a small mirror and a beam of light recording on a moving photographic strip.



A useful modification of the pneumodeik (Fig. B) responds to changes in negative pressure. Muscular contraction can be conveniently recorded by applying to the surface over the muscle a light celluloid cup two or three cm in diameter with a light rubber tube leading to the deik. A simple aspirator connected by a Y-tube holds the cup in position by a negative pressure of c. 30 cm of water. No other attachment to the moving limb is necessary. Variations in the negative pressure caused by the bulging of the surface are easily recorded by the deik and furnish an accurate tracing of the muscular contraction at all speeds of movement.

The inertia of the moving parts of the deik is small, the system is under slight tension, and the rate of transmission is approximately that of a low sound wave. Tests show that the lag is less than .01 second, which is below the limit of error for ordinary kymographic work. The natural frequency of such a system is from 50 to 75 per second and is well damped

[1] Acknowledgments are due to Mr. B. J. Smyth, the Oberlin mechanician, who worked out the details of the design.

so that it does not interfere with physiological recording. The deik will respond to the pneumatic pulses generated by trilling with the tongue up to 30 per second and the vibrations of the voice at c. 200 show clearly in such a tracing.

The pneumodeik is compact, and six of these units may be placed parallel on a drum 15 cm wide. They can be calibrated so that tracings from different subjects and at different times may be compared. This is important in phonetics, for example, where the actual air pressures and the actual extent of minute movements are significant.

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SPECIAL ARTICLES

CORRELATION OF THE FISH LAKE VALLEY AND CEDAR MOUNTAIN BEDS IN THE ESMERALDA FORMATION OF NEVADA

THE relations of the Fish Lake Valley and Cedar Mountain faunas have, in the past, been somewhat confused. Merriam (1916) compared the Cedar Mountain fauna with that of the Barstow and Santa Fé Miocene; furthermore, he called attention to Buwalda's (1914) work on the geology of the region in which the Tertiary sediments of Stewart and Ione Valleys were traced stratigraphically into the Esmeralda formation. Aside from the mammalian evidence, remains of plants and animals have thrown little conclusive evidence on the age of the Esmeralda formation. Lucas (1900) considered the fish as presumably of Pliocene rather than Miocene age, whereas Berry (1927) identified the plants as "most certainly Upper Miocene."

The results of a University of California expedition to Cedar Mountain in 1925 yielded sufficient material for a much better identification of the mammalian fauna. The available evidence seems to justify the assumption that both Miocene and Pliocene epochs are represented. While the fossil material is not as complete nor the fauna as extensive as might be desired for correlation purposes, certain distinctions are apparent.

Evidence for the existence of two faunas in the Cedar Mountain Tertiary deposits is most clearly shown by the horse teeth. There are also certain differences in the preservation of the material from these two faunal assemblages. The *Merychippus* teeth from U. C. Loc. No. 2027 and especially the associated bony elements are heavily water worn, harder and more silicified than the softer and lighter colored specimens from the lacustrine deposits discussed by Buwalda (1914). *Merychippus, Pliohippus* and *Hipparion* teeth are present from localities in Stewart Valley, but in no instance has *Merychippus* been found in association with *Pliohippus* or *Hipparion*. The teeth of *Pliohippus* and *Hipparion* represent advanced types; therefore it is difficult to conceive of their being contemporaneous with *Merychippus*. The Miocene anchitherine horse *Hypohippus* near *osborni* from U. C. Loc. 2027 is smaller and distinct from the larger *H. nevadensis* from the lacustrine beds.

The Carnivora from the Middle Miocene locality are more primitive than most Pliocene genera. *Tephrocyon* near *kelloggi,* although represented by fragmentary material, is characteristically different from the customary Pliocene aelurodons.

Among the Artiodactyla, *Procamelus gracilis*[1] is found in the Fish Lake Valley beds and in the lacustrine deposits at Cedar Mountain. The identity of this material from both beds is one of the best indications of their contemporaneity.

The fossil beavers from Loc. 2027 are more primitive than *Eucastor tortus* from Fish Lake Valley and compare favorably with remains from the Santa Fé and Coalinga Miocene deposits. A description and discussion of these species will be made in a paper on the fossil Castoridae.

There is one species which is reported both in the Fish Lake Valley Pliocene and the Cedar Mountain Miocene fauna. Hall (1929) referred a series of edentulous lower jaws from locality 2027 to *Meterix latidens,* a Fish Lake Valley species. It is questionable whether the lower jaws from Cedar Mountain belong to *M. latidens,* since no teeth are present to afford characters for comparison. When teeth are found from the Cedar Mountain Miocene deposits they will probably represent a new species.

The Miocene deposit, U. C. Loc. No. 2027, in the Cedar Mountain beds may be described as a lense of rewashed materials. The fossil mammal remains were found in a small area of brown sandstone lying in the fourth gully south of where the old road branches, one branch going to Stewart Spring (see Buwalda's map opposite p. 338, 1914).

The Fish Lake Valley fauna is predominantly Lower Pliocene and equivalent to the Upper Snake Creek and Valentine of Nebraska, also, the Little White River of South Dakota. The species do not compare closely with those from Thousand Creek or Rattlesnake. There are, possibly, some relations with

[1] The species *Procamelus cortatus* described by Stirton (1929) is probably conspecific with *P. gracilis* Leidy.