I am tempted, in closing, to tell of the remark made to me by one of the older inhabitants of East Hampton who had paid my laboratory a visit. The milky way happened to be overhead and the mouth of the telescope pit was filled with hundreds of star images. "What are they all anyway?" he asked. "Suns like ours, only bigger," I replied. "You don't say so," he answered, "and have they earths and planets and things going round 'em, and are they all inhabited?" "Very likely," said I, "some people think so." He scratched his head and then turned to me with a restful smile and said, "Well, do you know, I dunno as it makes so *much* difference after all whether Taft or Bryan's elected."

The similarity between the two conversations leads me to believe that Professor Campbell's questioner was leading for an opening to repeat the remark of the old farmer.

Others have been similarly victimized, for in G. Lowes Dickinson's "Appearances" published in 1915, on page 163 a similar conversation occurs between the author and a lone telegraph operator in a railroad shack in the Rockies.

From one newspaper topic to another we passed to the talk about signalling to Mars. Signalling interested the youth; he knew all about that, but he knew nothing about Mars or the stars. These were now shining bright above us, and I told him what I knew of suns and planets, of double stars, of the moons of Jupiter, of nebulæ and the galaxy, and the infinity of space and of worlds. He chewed and meditated, and presently remarked, "Gee! I guess that it doesn't matter two cents after all who gets elected president."

Should it be discovered that the story appears also in the writings of Galileo, or Copernicus, or Pythagoras, it will mean that I too have been victimized.

R. W. WOOD

ARE THE LANCE AND FORT UNION FORMATIONS OF MESOZOIC TIME?

IN a paper recently published by Dr. Stanton we have for the first time a description of the complete fauna of the Cannonball member of the upper Lance formation, consisting of 73 forms; 2 are sharks' teeth, 6 are cup corals (described in an appended paper by T. W. Vaughan), 2 are foraminifers, and the rest are molluscs (31 bivalves, 1 scaphopod, and 31 gastropods). There are 41 new forms, and 2 remain unnamed specifically. Of the 71 invertebrates, but a single bivalve passes upward into the Fort Union freshwater beds (*Corbula mactriformis*), while 24 forms occur below in the marine Fox Hills or older Cretaceous formations. Not one of the species of the entire Cannonball fauna is known in the marine Eocene province of the Gulf of Mexico. In other words, "40 per cent. of the molluscan species in the Cannonball fauna are known in the combined Pierre and Fox Hills or Montana fauna of the same general region, and 30 per cent. of them have been found in the Fox Hills fauna. . . . The fauna clearly belongs to the open sea and was modified after Fox Hills time by the extinction" of the ammonoids and other forms, "and by the introduction of a considerable number of new types that are not known in the Fox Hills and Pierre faunas" (p. 12). This new element, however, is not distinctively Cenozoic, but consists of types that are elsewhere found in the Cretaceous.

Again, the Fox Hills fauna is about of the time of the *Exogyra costata* zone of the Atlantic and Gulf Coastal Plain. The last named fauna has, according to Stephenson, 168 molluscs, and yet not a single one passes upward into any Cenozoic formation. From these and other facts Stanton concludes that "a large element in the Cannonball fauna is directly descended without specific change or with only slight change from the preceding Cretaceous faunas of the Rocky Mountain and Great Plains region. These late Cretaceous faunas show a progressive modernization due to the gradual elimination of distinctive Mesozoic generic types and the concurrent introduction of modern generic types which continued through the Tertiary and are still living in the Recent fauna" (p. 12).

[1] "The Fauna of the Cannonball Marine Member of the Lance Formation," by T. W. Stanton, U. S. Geol. Survey, Prof. Paper 128-*A*, pp. 1–66, Pls. 1–10, 1920.

"It is my opinion that the fauna of the Cannonball marine member of the Lance formation indicates that the formation belongs within the hiatus discussed by Stephenson and below the line which he postulates as separating Cretaceous from Eocene. It is certainly somewhat younger than the zone of *Exogyra costata* and most probably considerably older than the Midway formation" (p. 15).

The regularly bedded marine Pierre strata pass unbroken into the irregularly bedded Fox Hills formation, this irregularity of bedding being due to tidal currents in the shallowing waters of a retreating sea. Above the Fox Hills, and without important break, lies the Lance, which is in the main of fresh-water beds ranging in thickness from 400 to 525 feet, and which has a Fort Union-like flora and ceratopsian dinosaurs. Then the marine waters return for the last time in the area of the Great Plains and deposit in the eastern part of the area of the Lance formation the Cannonball marine member, whose fresh-water equivalent is known as the Ludlow lignitic member, the two having each a maximum thickness of about 300 feet. To quote Stanton again:

> The Cannonball marine member rapidly thins toward the west until it is reduced to one or two thin beds which extend as tongues into the predominantly continental deposits of the Ludlow lignitic member (p. 9).

On the other hand, this lignitic member is difficult to distinguish from the overlying Fort Union. Hence we see that there is here a continuous and unbroken series of deposits from the Pierre and Fox Hills into the top of the Fort Union, and that the reported erosion contacts between the several formations are due to nothing more than changes from marine to brackish and fresh-water deposition, or to the irregularities characteristic of continental sediments, the local breaks not representing a loss of geologic time of any marked historical value.

Finally, Stanton presents two paleogeographic maps, one showing the position of the marine Lance with reference to the Pierre sea, and another to the Eocene seas. These maps are a most striking summation of the problem in hand, and at once bring out the fact that the Cannonball member is most closely related to the final Cretaceous seas, since there is no possibility of connecting these marine beds with those of the Eocene of the Gulf of Mexico area, or the Pacific Ocean.

Modern stratigraphers know well that it is more commonly the earlier and especially the middle formations of the periods that are preserved, and that the later parts are more or less absent. As a result of this, the systems of rocks are separated from one another by "breaks," representing intervals of time of varying length, when erosion was going on. No geologist can tell from the stratigraphy or the entombed faunas and floras how long these intervals lasted, but in favorable localities are often found sediments not only hundreds but thousands of feet in thickness which on the basis of their contained organic evidence can be shown to supply the record lost elsewhere in one of these breaks. Why is it that the later parts of the systems of strata are absent? In some cases this is due to lack of deposition, but, as above indicated, in most instances it is because of the inter-system erosion times. The strata last deposited are first to vanish under the influence of erosion, and their absence is almost general in stratigraphy for all the older periods of geologic time. In the more modern periods, however, we should expect the preserval of some of these latest strata of the rock systems, and the Lance with its marine Cannonball member and the overlying Fort Union appear to be the last deposits of the Cretaceous. They have long been known as the transition formations into the Eocene, but even so they do not fill the entire gap between the Pierre of the Cretaceous and the Wasatch of the Eocene. As LeConte says:

> But, as the change was gradual and the sedimentation continuous, of course the strata were in places conformable throughout. Thus, then, the Cretaceous was before, the Tertiary after, and the Laramie [in which he includes the Lance, Fort

Union, etc.] during, the Rocky Mountain revolution (''Elements of Geology'').

The reviewer therefore does not hesitate to state that to him the evidence relating to the field relations and stratigraphy, the orogeny and paleogeography, and the invertebrate and vertebrate fossils of the Montana series and the Fox Hills and Lance formations is now well enough in hand to conclude that all are unmistakably of Mesozoic time. Furthermore, as the Lance and Fort Union are continuous formations, have wholly archaic mammal faunas, and are broken by a period of orogeny and lack of deposition from the succeeding Eocene deposits with their wholly different and modernized mammal faunas, the line separating the Mesozoic from the Cenozoic apparently lies between the Fort Union and the Wasatch, and not between the Fox Hills and the Lance. From this conclusion the paleobotanists will of course dissent, but we have now come to the parting of the ways. Our floral brethren will continue to say that the Cenozoic begins with the Lance, but the dominating faunal evidence of the invertebrates and vertebrates, backed as it is by the field relations and the two movements of the Laramide revolution, binds invertebrate paleontologists and geologists together in the conviction that the Lance and the Fort Union are of Mesozoic time. The U. S. Geological Survey should now reverse its former conclusion and adapt itself to the fuller evidence.

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SPECIAL ARTICLES

AN ADJUSTABLE EMBOUCHUER

THE device shown in Fig. 1 was designed to evoke a definite note, fundamental or overtone, from cylindrical tubes, closed at one end or open at both. It consists of a brass tube P, pinched down at cc', so as to form a crevice 2 or 3 cm. long and not much more than $\frac{1}{2}$ mm. broad. From this issues a lamina of air striking the strip of thin brass ss' about 5 mm. broad. The strip ss' which is always to lie in plane of the lamina, is on guides gg' of thick copper wire, bent at right angles, as shown, and soldered to the ears of the crevice cc'. In proportion as a higher or lower note is to be evoked, ss' is placed nearer cc' or removed from it; for the nearer ss' is to cc' the higher the mean pitch of the siffling. For high overtones the adjustment is rather delicate and should be made (preferably) with a micrometer. In Fig. 1, ss' slides with slight friction and is moved by the fingers. In use, the apparatus is placed across the end of the pipe with the plane $gcc'g'$ normal to the axis. The particular note wanted is obtained by correctly setting ss', which operation sometimes requires patience. The best results are obtained with pipes of the one-foot octave, and of a diameter less than twice the width cc', pipes of about equal width with cc' being most satisfactory. From inch gas pipe, two feet long, a whole series of overtones may be evoked in succession. With a less exacting demand for an immediate response, clear notes may be obtained from a great variety of vessels. Thus bottles, deep tumblers and beakers, flat jars (like sardine boxes), truncated cones, thistle tubes and even thimbles respond, often very loudly.

Very disconcerting sounds are often obtained. Thus, for a wide-mouthed cylindrical jar, 3″ in diameter and 6″ high, tapering