examined by Mr. R. Ellsworth Call, who reports the following species: Aphaerium dentalum Haldeman, Pisidium ultramontanum Prime, Helisoma trivolvis Say, Granulus vermicularis Gould, Limnophysa bulimoides Lea, Carnifex Newberryi Lea, Valvata virens Tryon.

The mingling of the blackened and mineralized bones of horses, camels, elephants, edentates, etc., with the shells enumerated above, presents a puzzling association of extinct tertiary(?) mammals with quantities of shells of living species, which we had hoped Professor Cope's studies would elucidate.

The presence of 'worked flints,' mingled with the fossil bones, is a matter of but little significance; as the bones occur on the surface, and might have had arrow-heads, etc., scattered among them at a very recent date. There is no evidence that the fossil animals, and the people who chipped the flints, were contemporaneous.

The valley of the Warner Lakes is referred to as a 'fractured anticlinal.' Again, the same expression is used in describing Silver Lake. We believe, however, that geologists familiar with the progress of exploration in the Far West during the past ten years would class these basins as monoclinal valleys, of the Great Basin type.[1] The Warner valley has a profound fault along both the eastern and western borders, and is enclosed to a great extent by lofty fault-scarps.

The Abert Lake basin also owes its formation to displacements. The lake occurs at the base of a great fault-scarp, forming a cliff two thousand feet high, and covers the depressed edge of a thrown block.

In the passage relating to Abert Lake (p. 138), the reader is left in doubt as to whether the lake, or the Chewaucan River, abounds in trout. Later, however, three species of fish are credited to Abert Lake. My own experience has been, that trout are abundant in the river, and absent from the lake; although they perhaps could exist in the latter in the immediate vicinity of the mouth of the Chewaucan River (frontiersmen who are familiar with the lake say that it is uninhabited by fish). During my own examination I found its waters swarming with 'brine shrimps' and the larvae of insects, but never saw a trace of piscine life. Its waters are strongly alkaline, and utterly unfit for culinary purposes. In its physical properties the water of Abert Lake resembles the brines of Sumner Lake (Oregon), Moro Lake (California), and the soda-ponds (near Ragtown, Nev.), all of which are too strongly alkaline to be inhabited by fishes. It is not evident on what authority Professor Cope ascribes a fish fauna to this lake, as on p. 138 it is stated distinctly that he did not get a near view of it.

From a study of the geographical distribution of the fishes in the lakes of the Great Basin, Professor Cope has found that the larger fishes inhabiting the lakes in northern Nevada and south-eastern Oregon are different from those of the lakes of the Bonneville basin. This is an interesting determination; as the former basins were mostly without outlets during the quaternary, while the latter became tributary to the Columbia.

The effect of alkalinity on the growth of fishes has been noted by Professor Cope to some extent, and is evidently a study that might lead to interesting geological conclusions. The comparison of the faunas of Pyramid and Tahoe lakes would perhaps show the effect of salinity and alkalinity on the species of fishes which probably inhabit both lakes. Pyramid Lake, it will be remembered, is supplied almost wholly by the Truckee River, the outlet of Lake Tahoe.

Before concluding that "all the species of Pyramid Lake are peculiar to it, excepting Catostomus tahoensis," it would be desirable to compare its fishes with those of Walker Lake. As these two lakes are quite similar in chemical composition, and both occur in the Lahontan basin, it seems probable that their abundant faunas would be found nearly identical. One species of trout, at least, seems to the writer, from superficial examination, to be common to the two.

The second part of Professor Cope's paper is devoted to the description of the fossil fauna of 'Idaho Lake.' This lake existed in eastern Oregon and western and southern Idaho during pliocene time. No body of water represents it at present; and the fish-remains found in its sediments differ from those of the Oregon basin, both recent and fossil. The extent of this ancient lake is not known. Its sediments are named the 'Idaho formation,' but no typical exposure is described or in any way indicated. Even the locality at which the fossil bones were collected is, for some unstated reason, withheld. This method is to be regretted; as Professor Cope does not stand alone in making geological divisions on purely paleontological grounds, without attempting to describe or locate the formations named. If this practice is persisted in, it can only lead to confusion.

Of the twenty-two species of fossil fishes described, eight are new. Besides these, the sediments of the Idaho Lake have furnished three species of crawfish which were reported by Professor Cope some years since. The mollusks, it appears, have already been described by F. B. Meek. Both the vertebrate and invertebrate fossils of the formation determine it to be lacustrine and fresh.

Although we have ventured to take exception to a number of statements in the paper under review, yet we welcome it as adding materially to our knowledge in a field that had previously been but little studied.

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[1] See 'Basin Range structure,' Geol. of the Uintah Mountains, Powell, p. 16.

THE DEFINITION OF MEAN SOLAR TIME.[1]

THE proper definition of mean solar time appears to me a very simple matter, and to have nothing arbitrary about it. The mean sun is merely an imaginary body which is supposed to move uniformly

[1] Paper by Prof. J. C. Adams of Cambridge, at the December meeting of the Royal astronomical society. From *The observatory*, February.

in the equator at such a rate that the difference between its right ascension at any time, and that of the true sun, consists entirely of periodic terms. This difference is called the equation of time, which, therefore, by its very nature, cannot contain any term increasing indefinitely with the time. Mean noon at any place is determined by the transit of this imaginary body over the meridian of the place, just as apparent noon is determined by the transit of the true sun.

Thus mean time is defined with reference to a natural phenomenon; viz., the transit of the real sun over a given meridian: and we cannot have one length of a mean solar day according to Bessel, and another length according to LeVerrier, any more than we can have different lengths of the apparent solar day.

A mean solar day, according to Mr. Stone's theory, is something totally different from that above defined. It has no reference to the average length of the apparent solar day, but is purely artificial or conventional in character. Practically, Mr. Stone's mean solar day is the time during which the mean *longitude* of the sun increases by some definite amount. Bessel gives one determination of this amount, and LeVerrier a different one: hence Mr. Stone is obliged to employ two mean solar days, which are of different lengths, according as Bessel's or LeVerrier's mean motion of the sun is used. On this principle, every fresh investigator of the sun's motion would require a mean solar day peculiar to himself. We are tempted to ask, What was the meaning of the mean solar day before Bessel's time?

The origin of Mr. Stone's misapprehension on this point seems to be the following. In the ordinary practice of an observatory it is usual and convenient to deduce the mean solar time from the sidereal time supposed to be known, instead of finding it by direct observation of the sun. In order that this conversion of sidereal into mean solar time, however, may be correctly performed, it is necessary to employ the correct mean longitude of the sun at the given instant. Any error in the assumed mean longitude will produce an equivalent error in the mean time deduced; and, if the sun's mean motion be incorrectly assumed, the error of time thus produced will gradually accumulate.

Thus the error of mean solar time as deduced from sidereal time by means of Bessel's formula, which amounted in the year 1864 to a little more than half a second, has increased to a little more than six-tenths of a second at the present time. The increase of the error of mean solar time in nineteen years is in reality rather less than eight-hundredths of a second, whereas Mr. Stone's theory makes it amount to twenty-seven seconds! In fact, the error, according to Mr. Stone's theory, is about three hundred and sixty-five times as great as it should be. The reason is, that mean time is measured, *not* by the sun's mean motion in *longitude*, as Mr. Stone's theory supposes, but by its mean motion in *hour-angle*, which is about three hundred and sixty-five times as great; so that the error in time produced by a small error in the mean motion in longitude is only about $\frac{1}{365}$ of that which would be produced if the error in time bore the same proportion to the time that the error in the mean motion in longitude bears to this mean motion itself.

If n denote the sun's mean motion in longitude in a mean solar day, then the ratio of the length of a mean solar to that of a sidereal day is

$$360° + n : 360°.$$

And if $n + dn$ denote a slightly different determination of the mean motion in longitude, this ratio will be altered to

$$360° + n + dn : 360°.$$

Hence the measure of the sidereal interval corresponding to any given number of mean solar days will be altered in the ratio of

$$360° + n + dn : 360° + n,$$

or

$$1 + \frac{dn}{360° + n} : 1;$$

that is, since 360° is nearly equal to $365\,n$, the sidereal measure of the interval will be altered nearly in the ratio of

$$1 + \frac{1\,dn}{366\,n} : 1$$

instead of in the ratio of

$$1 + \frac{dn}{n} : 1,$$

as it should be by Mr. Stone's theory.

In conclusion, we will test Mr. Stone's theory of mean solar time by supposing an extreme case. Let us imagine that the sun had *no motion* in longitude, but, like a fixed star, retained a constant position in the heavens. On this supposition, mean solar time would be just as intelligible as it is at present, and it is evident that the mean solar day and the sidereal day would become identical with each other; but what would become of mean solar time according to Mr. Stone's idea of it?

MORPHOLOGY OF THE PELVIS AND LEG.

MISS ALICE JOHNSON, at the suggestion of the late F. M. Balfour, has investigated the development of the pelvic girdle and hind-limb of the chick (*Quart. journ. micr. sc.*, xxiii. 399). On the fourth day of incubation the limb is merely a local exaggeration of the Wolffian ridge, consisting, like it, of a mass of rounded mesoblastic cells crowded together. The first trace of the skeletal parts appears on the fifth day; the mesoblastic tissue of the axis of the limb becoming more condensed, and, by the seventh day, converted into recognizable cartilage. Ossification begins very late. The entire skeletal *anlage* of the girdle and limb is at first continuous, making a T, of which the stem represents the limb, and the cross the girdle running dorsoventrally. The pelvic *anlage* soon expands, above the centrally placed acetabular region, into a broad plate, the ileum; below, and in front, into the narrow pubis. A little later the pectineal process grows out in front from the upper part