THE GREEN RIVER FORMATION

AMONG the continental formations of North America commonly described as lacustrine is the Green River (Eocene), which covers large areas of northwestern Colorado, southwestern Wyoming and northeastern Utah. Since the formation is one of the principal sources of oil shale in the western United States, geologists have studied various sections of it more or less intensively during the past decade and have obtained a large amount of information regarding the sedimentology and the fossil content. In a paper published under the above title, in the *Bulletin* of the American Association of Petroleum Geologists,[1] Professor Henderson has briefly reviewed this evidence to ascertain whether it accords with the view of the lacustrine origin of the formation, and, if so, whether the body or bodies of water in which the sediments were laid down were fresh or saline or alternately fresh and saline.

The formation, which is very generally considered a fresh-water lake deposit, is composed chiefly of fine-grained, even-bedded sediments, which, if not deposited in a lake, must have been laid down by streams meandering in broad valleys where shallow, temporary lakes were present. However, comparatively few strata showing cross-bedding, ripple-marks or mud-cracks, which would characterize this type of deposition, have been observed.

Fossils are numerous and are mainly of non-aquatic forms. Fresh-water fishes have been obtained principally from a single, thin stratum at two localities in Wyoming. The presence of so many skeletons in a thin layer of a lacustrine formation is difficult to explain, unless an arm of the lake were cut off and speedily desiccated. If the sediments are partly fluviatile, this accumulation could easily have taken place in isolated ox-bow lakes which were rapidly filled with sediments.

Well-preserved leaves of upland and lowland plants are abundant in the upper part of the formation far from any possible shore line. The aquatic plants are chiefly algae. The microscopic flora consists of conifer pollen, moss spores, annuli from fern sporangia and molds, all of which must have been carried from land; bacteria and blue-green algae, which can grow in both fresh and saline waters; Spirogyra and Protococcus, which are fresh-water types.

Insects are principally flying forms, whose wide distribution in the strata can be easily accounted for.

The most abundant and widespread fossils have been identified as the larvae of botflies or forms related to them. These larvae to-day infest land animals, and are not aquatic at any stage of their existence. The explanation of their distribution, if the Green River be lacustrine, is difficult.

It is evident from Professor Henderson's discussion that further intensive field work is necessary to determine the origin of certain parts of the formation. While probably most of the beds are fresh-water lake deposits, certain strata doubtless have been deposited by other agencies. The sedimentology of the formation should be thoroughly investigated, and more information secured regarding the paleontology. The identification of the botfly larvae needs confirmation. If these by chance should be some other form, the explanation of their distribution might be more easily made. In any event, it does not seem likely that these larvae had the habits of the modern types.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF MEASURING THE WATER TEMPERATURES OF LAKES AT DIFFERENT DEPTHS

THE measuring of the temperature of lake waters at various depths in connection with the study of the development of the thermocline, the percentage of saturation of oxygen and carbon dioxide and the distribution of life is a problem in which every limnologist is actively interested. The usual method of using the Negretti-Zambri reversing thermometer, while quite accurate after certain corrections have been made, is a rather slow and tedious procedure, even though several thermometers and lines are used at the same time. It is apparent that much time and labor would be eliminated by the use of some electrical indicating thermometer. The thermophone, described by Whipple, has not proven entirely satisfactory. The apparatus here to be described has been used successfully by the writer for three summers at the Iowa Lakeside Laboratory in taking daily temperature readings on Lake Okoboji with what seems to be accurate results. Feeling that other limnologists have felt the need for such apparatus the following brief description is given.

The indicator used is the Charles Engelhard type P–1 indicator provided with two centigrade scales of fifteen degrees each, divided into tenths of a degree. One scale reads from zero to fifteen degrees, the other from twelve to twenty-seven degrees centigrade, allowing an overlap on the two scales for checking purposes. While these scales are sufficient in range for ordinary work on the main lake, for ponds or shallow water which will give higher readings in mid-