has asked the High Commissioner for the Malay States to appoint Mr. Theodore Hubback, lately honorary Game Warden in Pahang, to report on the whole question of the wild fauna of Malaya. It is contemplated that a high official of the Federated Malay States government should be associated with him as assessor. In general the object of the appointment is to make regulations for the preservation of wild life, including the administration of national parks, wild life refuges and game reserves, and to suggest methods for dealing with any damage to agriculture done by wild animals.

# DISCUSSION

## THE "GIBBS PHENOMENON"—A MISNOMER

A FOURIER series corresponding to a function, $f(x)$ of period $2\pi$, and convergent over an interval on the X-axis over which $f(x)$ is continuous, under very general conditions converges uniformly over any closed subinterval. If, however, $f(x)$ has a discontinuity of the kind sometimes called a "finite jump" in an interval over which it is otherwise continuous, convergence is not uniform over any neighborhood of this point. The approximation curves, $y = s_n(x)$, have maxima and minima whose distances from the limit curve, $y = f(x)$, do not approach zero when n becomes infinite, although the abscissa of each such extreme value identified by counting from the discontinuity approaches the abscissa of the discontinuity. Briefly, this is what is known as the "Gibbs phenomenon." It seems to have been first noticed by Gibbs and was briefly described by him in a note in *Nature*[1] published in 1899. The name was applied by Bôcher in his widely read paper[2] on Fourier series. The approach by Gibbs and Bôcher and generally by subsequent writers was graphical, and the "phenomenon" should be thought of as a graphical one.

However, this "phenomenon" is in no way limited to Fourier series but is characteristic of the approximation curves of many non-uniformly convergent series. In two papers[3] now classical in the theory of uniform convergence Osgood treats with exhaustive care the behavior of "peaks" in the neighborhood of points of non-uniform convergence. He does not explicitly study Fourier series. But the behavior of approximation curves is a general problem and it is treated by Osgood in a general way. There is nothing essential to the so-called "Gibbs phenomenon" which he does not study and illustrate by examples. His approach is primarily graphical and his papers antedate the note of Gibbs by three years. His treatment is careful and thorough as against the somewhat casual character of Gibbs's note.

If the name of any individual is to be applied to the behavior of "peaks" in the neighborhood of points of non-uniform convergence it should be the name of Osgood. The term Gibbs phenomenon has been applied to such behavior in the study of series of Bessel's[4] functions. Even if the name is retained for Fourier series, I do not see that it is justified for other series. Its only justification is that Gibbs remarked for Fourier series a situation the essentials of which were already widely known for other series.

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JANUARY, 1930

[1] Josiah Willard Gibbs, *Nature*, 59: 606.

[2] Maxime Bôcher, *Annals of Mathematics*, 7: 129, 1906.

[3] William Fogg Osgood, "Non-uniform Convergence and the Integration of Series Term by Term," *Amer. Jour. of Math.*, 19 (1897), read August 31, 1896; "A Geometrical Method for the Treatment of Uniform Convergence and Certain Double Limits," *Bull. Amer. Math. Soc.*, 3: 59, November, 1896, read August 31, 1896.

[4] For example, C. N. Moore, *Bull. Amer. Math. Soc.*, 34: 414, 1928.

## THE PROBLEM OF SALINE DRINKING WATERS

IN the February 21, 1930, issue of SCIENCE, V. G. Heller and C. H. Larwood reported experiments on the deleterious effects of certain saline drinking waters. In the course of a ground-water survey of northwestern Minnesota a few years ago, the writer had opportunity to observe in the field similar effects from waters of moderate concentrations, mostly lower than those reported by Heller and Larwood. The worst waters appeared to be those rich in sulphates. The waters are commonly (though often incorrectly) referred to as "alkali" waters. The sulphates in some waters are accompanied by true alkali, *i.e.*, soda or potash, but lime and magnesia generally are more abundant. Some are associated with high chlorides and others are not.

These high sulphate waters in Minnesota are common in the till-plain just east of the glacial Lake Agassiz basin and in the lake-bed itself (now the Red River Valley). Thus nine representative samples taken from various depths and localities in Stevens County range in salinity from 664 to 2,800 p.p.m., and the average of the nine is 1,575 p.p.m. anhydrous salts. The minimum sulphate is 29 per cent., the maximum 58 per cent. and the average 49 per cent., or approximately 770 p.p.m. The averages of the other main constituents are: Ca 14 per cent., Mg 5 per cent., Na 11 per cent., K 2 per cent., $CO_3$ (including $HCO_3$, recalculated) 16 per cent., Cl 1 per cent. In four of the nine samples, Na is more abundant than Ca. The low amount of chloride is noteworthy.

In the Cretaceous waters which are tapped by drilling in the Red River Valley farther west, sul-

phates and chlorides (apparently connate) are both abundant. Thus water from a city well at Wheaton, Minnesota, shows Ca and Mg 1 per cent., Na 33 per cent., K 4 per cent., $CO_3$ 4 per cent., $SO_4$ 28 per cent. and Cl 30 per cent.; total salinity, 2,794 p.p.m. This is a typical soft salty water of the region. Similar waters occur in the basal sand of the Cretaceous rock system northward to the Canadian boundary, but with a salinity as high as 10,000 p.p.m. or more. Toward the east these waters are diluted and become sodium or calcium bicarbonate waters. The waters from the glacial drift above the Cretaceous beds are bicarbonate solutions of Ca or Na, but many show high sulphates also. Waters from wells ending in the clays of glacial Lake Agassiz are notoriously high in sulphates, so that they have a bitter taste and drastic purgative effect on the drinker. In one case a 12-inch bored well 45 feet deep furnishes water containing 2,104 p.p.m. $SO_4$ in a total salinity of 3,600 p.p.m. As an extreme, another 80-foot well furnishes water with 3,590 p.p.m. $SO_4$ in a total salinity of 5,756 p.p.m.

The drastic cathartic action and the weakening effect of these natural solutions of Epsom and Glaubers salts on man and on live stock are well known in the region. Some persons believe that disorders of kidneys and bladder also result, but that effect is not established. It seems true though that no matter how well they are fed, cattle and hogs can not be fattened for market while they drink such water. Indeed, the case is even worse. The cattle develop a run-down, ragged appearance and many eventually weaken and die prematurely. The principal difficulty in such cases seems to be that a degeneration of the bones sets in, so that most of the lime is abstracted from them. These bones are reduced to gristle that can be tied in knots and easily punctured with a knife. Calves are stunted in growth and many never mature at all. The cows develop strange appetites for bones, leather, wood, etc. The condition is alleviated but perhaps not cured by feeding bone-meal or ground limestone.

Altogether about one fourth of the State of Minnesota is affected in some degree by this problem. Furthermore, the observation of cattle from Dakota and Montana, where similar waters are known, suggests that the difficulty is really wide-spread but has not been properly diagnosed. With the present trend toward "diversified farming" involving cattle-raising and dairying, a considerable territory faces a critical problem. It seems probable that people using such waters are affected in the same way as cattle, but perhaps in different degree, so that questions of human physiology and diet also are involved.

It is to be hoped that the experimental work of Heller and Larwood will be continued, and that the effect on the equilibrium of body calcium may be studied in particular, because the problem has a large economic bearing.

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## A SURVEY OF THE PHYTOPLANKTON AT ERIE, PENNSYLVANIA

IN a recent number of SCIENCE[1] Mr. Paul R. Burkholder outlined briefly the scope of the biological survey of Lake Erie which was carried out during the summers of 1928 and 1929 through the cooperation of the U. S. Bureau of Fisheries, Buffalo Society of Natural Sciences, N. Y. State Conservation Department, Buffalo Health Department and the fish and game departments of Ohio, Ontario and Pennsylvania. Attention should be called, also, to similar investigations being carried on at Erie, Pennsylvania, by graduate assistants in the University of Pittsburgh appointed for that purpose. The present note refers only to the work carried on by the assistant in the botanical department of the university.

Early in the spring of 1929, Mr. Herbert Graham began quantitative and qualitative studies of the raw Lake Erie water taken in at the large city waterworks intake crib situated out in the lake about two miles from the shore of Presque Isle and about three miles out from the main shore at Erie. The water is taken into this main at a level of about six feet above the lake-bottom and twenty-four feet below the surface of the water. Generally, two samples of this water were studied each week, the organisms identified and their abundance estimated. In the late spring Mr. Graham left to become a member of the staff of the ill-fated *Carnegie*, being succeeded by Mr. Russell Y. Gottschall, who has continued the investigation.

The notable results of this study consist mainly in that there is now a continuous record of the phytoplankton organisms throughout the whole year, based on studies of about 250 samples and including about 65 organisms determined as to species and various others as to genera. It is believed that this study will thus supplement in a very important way the more general biological survey carried on only from May to September. The Erie samples are also much more productive, as a larger number of the organisms are caught by the lake-sand filter method used than by the tow-net and bottle method.

Being an expert bacteriologist, Mr. Gottschall has extended the studies to cover the bacterial flora of Erie Bay, as well as its general phytoplankton, and

[1] SCIENCE, 75: 288, March 14, 1930.