the agitation of the waves, is held in suspension until carried outward to deep water by the undertow.

Several studies relating to problems of water supply and sewerage disposal have been made by engineers in the Great Lakes region for the purpose of determining the movement of sewerage, the spread of turbidity and the bacterial count. In discussing such studies Townsend[7] says:

> With the wind blowing from the shore, this sewerage flows on the water surface and the pure lake waters flow along the lake bed. When the direction of the wind is reversed, the sewerage flows along the bed and pure water on the surface. The intake gates to the water supply tunnels can be manipulated accordingly.

Burdick,[8] in discussing the conditions at Chicago and Gary, states that with on-shore winds the travel of the surface water is shoreward, that there is an undertow outward, and that the turbidity developed in the shallow water is carried out to the deeper water in this way. He says this turbidity is noticeable at the water intake at Gary with a north (on-shore) wind and that with a south (off-shore) wind the bacterial count is least.

Investigations of methods of protecting the water supply of Milwaukee gave further evidence of subsurface currents.[9] It was found that with an on-shore wind there is an undertow, and that with an off-shore wind there is a subsurface current in the other direction. This wind-induced circulation reached a depth of 65 feet. A somewhat similar study by Whipple[10] regarding sewerage disposal in Lake Erie indicated similar current conditions there. With an on-shore wind the sewage moved off-shore on the lake bottom and with an off-shore wind it moved off-shore at the surface while on the bottom it moved somewhat inshore.

In describing current studies at Squam Lake, New Hampshire, Whipple[11] states:

> Floats near the surface drifted with the wind, while the deeper floats moved in the opposite direction. It was found that the greater part of the return circulation was above the transition zone, but that even below the transition zone there was some movement of the water. . . . In summer, when the lake is vertically stratified, these currents remain largely confined to the circulation zone.

According to the studies cited above, wind-induced currents are common and are confined, in summer, mostly to that part of the water body above the thermocline. On the Great Lakes this is from about 50 to 100 feet below the surface. On Squam Lake, at the time the studies were made, the lower part of the thermocline was at a depth of about 48 feet. According to Whipple's diagram, the surface current extended down to a depth of about one third of the distance from the water surface to the bottom of the thermocline, and Metcalf and Eddy's diagrams showing conditions at Milwaukee and at Rochester suggest about the same relation.

On the east shore of Lake Michigan the bottom slope is so gradual that a depth of 15 to 20 feet is not usually reached until 800 to 1,200 feet from shore. Under these conditions it is probable that a definite surface and subsurface circulation is not present near shore during heavy storms and that where the water has less depth than that to which the surface current penetrates, the water movements are uneven and disorganized and the water driven on-shore by the wind escapes outward in localized currents either on the surface or below. It may even move parallel with the shore for some distance before reaching a place where the shoreline and conditions of bottom topography are favorable for off-shore movement. Thus the "rip currents" described by Shepard are a part of this outward movement, but there is sometimes also a subsurface escape in favorable localities, as was observed by Evans[12] on the east shore of Lake Michigan.

The above observations seem to indicate that if we mean by "undertow" an outward moving subsurface sheet of water beneath the layer that is being driven shoreward by on-shore winds, such a current does not exist closer to shore than where the depth of water is about equal to the thickness of the shoreward drifting sheet but that it does exist in the greater depths offshore. In the zone nearer shore the water movements are localized and may be in any direction and either at the surface or below.

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[7] Curtis McD. Townsend, "River and Harbor Construction," p. 83, The Macmillan Company, 1922.

[8] C. B. Burdick, "The Relation of the Intake to Pure Water from the Great Lakes," p. 40, Illinois Water Supply Association Proceedings, 1911.

[9] Metcalf and Eddy, "American Sewerage Practice," pp. 201–204. McGraw-Hill Book Co., Inc., 1935.

[10] *Ibid.*, pp. 197–200.

[11] G. C. Whipple, "The Microscopy of Drinking Water," 4th Edition, pp. 161–162. John Wiley and Sons, Inc., 1927.

[12] O. F. Evans, *Jour. Geol.*, Vol. XLVII, No. 3, 1939.

A BACTERIAL PATHOGEN OF THE CITRUS RED SCALE

ADULT females and crawlers of the red scale on field lemons can be infected and destroyed, under laboratory conditions, by a spore-forming, nitrate-reducing motile bacterium isolated from a certain soil, in connection with denitrification studies. A similar, if not identical, microorganism was later found in the dead red scale in some lemon orchards.

Spraying with active cultures, immersion and dusting with the spores of the bacterium were studied as methods of bringing about a mass infection of the scale on lemons and on a number of other hosts. Mortality

of the adult females was found to be in the vicinity of 100 per cent. under certain conditions. Immersion and dusting with the bacterial spores fruits previously sprayed with water appeared to offer more promise than spraying alone.

Within a few days after the infection the pygidia of the scale often become distorted. Evolution of gas and a more or less general browning of the insect often occur simultaneously. Vegetative cells of the bacterium, as well as its spores, can be observed in the contents of the general cavity. Saprophytic fungi frequently invade the diseased or dead insect.

A detailed article containing experimental data has been submitted to *Phytopathology*.

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PRO AND CON EVOLUTION IN CONTEMPORARY GERMANY

THE attacks on evolution, discussed under the above heading in SCIENCE, 93: 40, 41, have been also contradicted in two articles of the German monthly *Der Biologe* (year 9, fasc. 12, December, 1940, which was received here in May, 1941).

The first of those articles, by the geneticist, F. Schwanitz (*l.c.*, pp. 407–413), bearing the title "Ein Kreuzzug gegen die Abstammungslehre" ("A Crusade against Evolution"), deals with the "Sonderheft" (4/5, vol. 37, April/May 1940) of "Natur und Kultur," particularly with Otto Muck's essays, which are harshly refuted and stripped of any scientific significance.

The second article, entitled "Immer wieder: Abstammung oder Schöpfung?" ("Again and again: Evolution or Creation?"), by Chr. von Krogh (*l.c.*, pp. 414–417), who recently[1] participated in the German scientific discussion on "Menschwerdung" (origin of man), deals chiefly with an anti-evolutionary pamphlet of H. Frieling,[2] one of the contributors to the aforementioned special publication. Von Krogh rejects it for both scientific and philosophical reasons, claiming that Nordic man always believed in unity of body and soul, whereas dualism is assigned to Eastern conception of life.

OTTO HAAS

THE AMERICAN MUSEUM
OF NATURAL HISTORY

CARL FRIEDRICH GAUSS'S DESCENDANTS IN AMERICA

GAUSS, who is probably one of the four greatest mathematicians who ever lived, was twice married. By his first wife he had two sons (Joseph, 1806–73, and Louis), and by his second also two sons (Eugene, 1811–96, and Wilhelm, 1813–79). Louis died in childhood. Joseph was an engineer, and in 1836 and 1837 he was sent by his government to the United States to study railway construction in the New World. Eugene came to the United States in 1831 and enlisted as a private in the U. S. Army for five years. In 1840 he settled in St. Charles, Mo., married, and had a family of seven children. His younger brother Wilhelm came to this country in 1837, immediately after his marriage to a niece on his mother's side of the astronomer Bessel. For about a score of years he was engaged in farming in Missouri. Thereafter he entered the wholesale shoe business in St. Louis, in which he continued until his death. Of his eight children six were living in 1899. In January, 1935, one of these children, Joseph H. Gauss, was still living, and dean of the Brookes Bible Institute of St. Louis. Other descendants are in Colorado and California. Most of the information given above, and much more, may be found in *C. F. Gauss und die Seinen. Festschrift zu seinem 150. Geburtstage,* herausgegeben von H. Mack, Braunschweig, 1927, and in two articles by Professor Cajori: (a) "Carl Friedrich Gauss and His Children," SCIENCE, n.s., v. 9, 1899, pp. 697–704; and (b) "Gauss and His American Descendants," *Popular Science Monthly,* v. 81, 1912, pp. 105–114.

This supplies information requested by a correspondent, Sir Joseph Larmor, in your issue for May 30, page 523.

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SCIENTIFIC BOOKS

MATHEMATICS

Gap and Density Theorems. By NORMAN LEVINSON. American Mathematical Society Colloquium Publications. Vol. 26. New York, 1940. viii + 244 pages. $4.00.

ONE of the fundamental properties of the system of trigonometric functions (cos nx, sin nx), or of the equivalent system of exponential functions (e^{inx}), is the property of closure. It is precisely this property that makes them so important in problems of expansions of arbitrary functions in Fourier series. The natural question under what conditions this property is enjoyed by a more general system of functions ($e^{i\lambda_n x}$), has interested several earlier writers, among whom the name of G. D. Birkhoff should be mentioned. Several important problems in this direction were

[1] *Zeitschr. ges. Naturw.*, pp. 105–112, 1940.
[2] "Herkunft und Weg des Menschen. Abstammung oder Schöpfung?" Klett, Stuttgart, 1940 (113 pp.).