ployment list will be retained on the new list to be established as a result of the examinations just announced. An open continuous examination for inspectors of naval ordnance materials is also announced. No written examinations are being given, but applicants are being rated on the basis of education, training and experience as shown on the applications. Any one under 65 years of age qualified in any of the several fields connected with the work is eligible for positions, which carry salaries ranging from $1,620 to $2,600 a year for the various grades. To qualify for either of two higher grades, considerable experience must be shown in one of the four specific branches of naval ordnance: optical and fire control instruments, naval guns and accessories, munitions or ordnance units. In the lower grades an applicant may qualify on education alone or by showing the proper amount of experience in varied fields.

FIVE members of the faculty of the University of Chicago have been appointed by President Robert Maynard Hutchins as a Committee on Biology and Medicine to further the publication through the University Press of books in the field of medicine and the biological sciences. Members of the committee are: Dr. William H. Taliaferro, dean of the Division of the Biological Sciences, chairman of the department of bacteriology and parasitology; Dr. Franklin C. McLean, professor of pathological physiology; Dr. C. Phillip Miller, associate professor of medicine; Thomas Park, assistant professor of zoology, and Dr. Lester R. Dragstedt, professor of surgery. The committee will advise the University of Chicago Press of research suitable for publication, will plan needed texts, and act as a possible outlet for valuable work now being done throughout the country in the biological and medical fields. In the matter of securing manuscripts, the committee will be assisted by an advisory group, one man from each department of the biological sciences at the University of Chicago.

THE American Standards Association has announced the publication of a new list of American Standards for 1941. It is pointed out that in view of the importance of standards and specifications not only for every-day work but to speed up production to meet defense requirements, this particular list of standards will be of unusual interest to industry. More than four hundred American Standards are listed, covering definitions, technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, safety provisions for use of machinery and methods of work. They reach into every important engineering field and serve as a basis for many municipal, state and federal regulations. Six hundred manufacturing, government and user groups have shared in their development. The list will be sent free of charge to any one interested in the work. Requests should be addressed to the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y.

DISCUSSION

EVIDENCE OF UNDERTOW FROM ENGINEERING PRACTICE

DOUBTS as to the existence of the undertow were raised some years ago by Professor W. M. Davis.[1] Some years later Shepard[2] described river-like movements of water that here and there flow outward nearly perpendicular to the shoreline, and supported Davis in his suggestion that the undertow is non-existent.

The presence of outward moving surface currents does not, of itself, disprove the existence of undertow, since it is conceivable that water forced on a lee shore by the wind might escape in either or both ways. Investigations by Evans[3] have proved the existence in lakes and ponds of fairly strong subsurface currents which move outward from shore during on-shore winds and are reversed in direction during off-shore winds. This suggests that similar movements may take place in larger bodies of water but does not prove it.

It is evident that both Davis and Shepard in their discussions have used the word "undertow" in the popular sense of strong subsurface currents moving outward in the comparatively shallow water near shore and have left out of consideration those subsurface movements that occur farther off-shore and which Davis[4] mentioned but seemed to dismiss as of little importance. As originally used, the word "undertow" was intended to apply to subsurface currents extending entirely to the outer edge of the subaqueous terrace and even beyond. Russell says:[5]

> The finest of the waste from the land is carried lakeward by the undertow and finally deposited as lacustral beds; portions less finely comminuted fall on the outer slopes of the terrace and serve to broaden it.

Also Gilbert[6] uses the term in the same way when he says:

> The finer portion (of the detritus) being lifted up by

[1] SCIENCE, 61: 206–208, 1925.
[2] SCIENCE, 84: 181–182, 1936.
[3] SCIENCE, 88: 279–281, 1938.
[4] *Op. cit.*, 207, 1925.
[5] I. C. Russell, "Geological History of Lake Lahontan," pp. 88–89, U.S.G.S., Mono. 11, 1885.
[6] G. K. Gilbert, "Lake Bonneville," p. 33, U.S.G.S., Mono. 1, 1890.

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