merly Dr. Halberstaedter's assistant, as his assistant in the new department; Dr. H. A. Krebs, formerly of Berlin and now at the University of Cambridge, England, as head of the department of physiologic chemistry, and Dr. Leonid Doljansky, formerly of the Institute of Pathology, of the University of Berlin, and now at the University of Copenhagen, as head of the new department to be devoted to tissue culture research and morbid anatomy.

According to *Nature*, in the House of Commons on June 29, Mr. W. Ormsby-Gore, first commissioner of works, moved the second reading of the bill for the setting up of a National Maritime Museum in the buildings recently occupied by the Greenwich Hospital School. The cost of adapting the vacant school buildings is estimated at £29,000 and Sir James Caird has generously offered to defray this sum. Sir James has already given large sums towards the restoration of H.M.SS. *Victory* and *Implacable* and presented the museum with the Macpherson Collection of naval prints. There is nowhere, said Mr. Ormsby-Gore, where one can study the history of our maritime adventure and development, and no attempt has yet been made to illustrate conveniently for the general public the immense field of British maritime endeavor, historical, technical, geographical and commercial, including not only the exploits of the Royal Navy but also of the mercantile marine. A Board of Trustees with the Earl of Stanhope as chairman has been appointed and the post of director has been offered to Professor G. A. R. Callender, of the Royal Naval College, Greenwich.

DISCUSSION

THE PLEISTOCENE LONG VALLEY LAKE IN EASTERN CALIFORNIA[1]

The object of this notice is to place on record some observations concerning part of the Pleistocene and Recent history of a basin that is soon to become a reservoir site for the City of Los Angeles. If present plans are completed, a portion of the basin floor will be flooded and thus concealed from further investigation.

Long Valley, situated in southern Mono County, California, about 15 miles southeast of Lake Mono, occupies the lower part of a wide reentrant in the eastern front of the Sierra Nevada. This mountain-circled embayment, in which are located the headwaters of Owens River, appears on the topographic map[2] to be a northwestward extension of Owens Valley, that deep, narrow graben between the Inyo Range and the Sierra Nevada.[3] Structurally, however, the two basins are distinctly separate units. At present, the floor of Long Valley is at an elevation of about 6,900 feet above sea level, and "hangs" more than 2,400 feet above the bottom of the Owens graben, from which it is separated by an extensive, uplifted and tilted fault block, known as the Volcanic Tableland. Across the tableland, Owens River has cut an imposing gorge. Headward erosion in this canyon, and consequent lowering of the outlet of Long Valley, has brought an end to the existence of an ancient lake that once occupied the valley floor. By constructing a dam across the upper entrance to the Owens River canyon, the engineers of the City of Los Angeles plan to restore in part the original conditions and create a reservoir on the site deserted by the Pleistocene waters.

Professor C. F. Tolman has noted the former existence of a lake in Long Valley.[4] He was probably the first to report the presence of wave-cut terraces at about the 7,100 foot level along the valley sides. Since Tolman's observations were made, some interesting evidence concerning the existence and age of the extinct lake has accumulated. Although the investigation has not been completed in the desired detail, it is proposed to present briefly the evidence and some conclusions.

The former existence of the lake is established beyond doubt by the presence of lacustrine deposits, at least 100 feet in maximum thickness, on the floor of Long Valley. The significance of these sediments was probably first appreciated by Professor Blackwelder.[5] The lowest exposed lacustrine beds, consisting of clay, silt and marl, with some diatomite, have an exposed thickness of about 50 feet, but they have not been completely dissected, because the outlet of the valley has not yet been sufficiently lowered. These materials are so easily eroded that Owens River has been able to establish a broad, meadow-carpeted valley in them since the disappearance of the lake.

Overlying the finer, weakly consolidated sediments, is from 5 to 50 feet of coarse, cross-bedded, tuffaceous sandstone, usually with opaline cement. This rock has been deposited in deltas, built out into the lake by tributary streams that were fed, in part, by copious thermal springs, a few of which are still extant. The formation is quite resistant to erosion, but since it probably never completely covered the valley floor, it may not have been a serious obstacle to the removal

[1] Published by permission of the California State Division of Mines.

[2] Mt. Goddard, Mt. Morrison and Bishop Sheets, U. S. Geol. Survey.

[3] Adolph Knopf, "Geologic Reconnaissance of the Inyo Range and Eastern Slope of the Southern Sierra Nevada, California," U. S. Geol. Surv., Prof. Paper 110, pp. 90–91, 1918.

[4] C. F. Tolman, unpublished manuscript.

[5] Eliot Blackwelder, personal communication.

of the softer materials, except along some of the tributary streams, where it slowly yields to undermining.

The terraces noted by Tolman have, in many places, been eroded into soft, unconsolidated materials, with the result that they are now very indistinct,[6] but nevertheless real. Several levels can be made out in some places. On the eastern, or tableland side of the valley, there are many faint terraces, the highest of which is several hundred feet above the highest similar feature yet found on the western side. This seems to indicate that during the life of the ancient lake, there was a slow, probably intermittent, uplift of the volcanic tableland, or a sinking of the valley floor.

Well-rounded pebbles, usually of dense, flow-banded rhyolite, but occasionally of obsidian, are scattered along the eastern terraces, and are regarded as additional evidence of wave action at these sites in the past. The rounding of the pebbles is farthest advanced on the lower terraces.

There are two lines of evidence regarding the time at which the lake existed. When light conditions are most favorable, terraces can be seen etched into some of the glacial moraines that project from the mouths of canyons in the Sierra Nevada. These moraines were formed during the Blackwelder's Tahoe age;[7] hence the valley floor was deeply covered with water during or subsequent to Tahoe (Iowan) time. Whether or not the same condition existed before the Tahoe epoch, the writer can not say. The closing stages of lacustral history are recorded by domes of lithoid and dendritic tufa[8] along the lowest terraces on the southeastern side of the valley. At one place, the tufa deposit crosses a short, dry wash, some 30 feet deep, evidently eroded during a temporary lowering of the lake level. The tufa in the bottom of the gully shows such slight evidence of corrasion that it is tempting to regard this level as having been finally abandoned by the lake only a few hundred years ago. Under the present climatic conditions, however, water very seldom flows in this wash, and the slight corrasion of the tufa may therefore represent all the time since the Tioga (Wisconsin) epoch.[9] For this reason, the closing stages in the history of Long Valley Lake are tentatively placed in, or shortly after, Tioga time, perhaps 10,000 or 20,000 years ago.

Besides giving evidence concerning the approximate time at which the lake disappeared the tufa domes are of interest because they indicate that such deposits can be formed, at least locally, along the shores of a water body that has an outlet.

Although more details are desired, the existence and approximate age of Long Valley Lake are proved. At the highest stage it may have been about 17 miles in length and 8 miles across at the widest place. The greatest depth attained could not have been less than 250 feet.

EVANS B. MAYO

CORNELL UNIVERSITY

[6] One sharp, distinct terrace in unconsolidated material does exist on the southwestern side of the valley, but it is thought that this has been caused, or at least greatly accentuated, by recent movement along one of the bounding faults of the Sierra Nevada.

[7] Eliot Blackwelder, "Pleistocene Glaciation in the Sierra Nevada and Basin Ranges," *Bull. Geol. Soc. Amer.*, 42: 865–922, 1931.

[8] I. C. Russell, "Quaternary History of Mono Valley, California," U. S. Geol. Surv., 8th An. Rept., Pt. 1, pp. 310–315, 1886–87.

[9] Eliot Blackwelder, *loc. cit.*, p. 881.

DO CHROMATOPHORE WALLS CAUSE MOVEMENT OF PIGMENT GRANULES?

IN a recent reply to Sumner by Mast,[1] there is expressed an opinion that " . . . a chromatophore is somewhat like a branched, heavy-walled rubber tube closed at the distal ends of the branches and at the other end joined to a heavy-walled rubber bulb filled with pigment granules suspended in a fluid, and that movement of the granules in the chromatophore is due to action in the heavy walls which surround the cavity containing the granules." A further statement is, " . . . the distribution of the granules in a chromatophore is due to action in the wall which surrounds the cavity containing the granules . . ." With this conception of the method of bringing about changes in the amount of pigment exposed to view in chromatophores, reasons are given why one should or should not use certain terms relative to these changes.

I have not been particularly concerned in this controversy over terminology; but if the use of terms is to be determined on the basis of the functioning of the chromatophore or parts of these cells, I believe there should first be fairly common agreement among investigators as to what actually takes place during "distribution" and "congregation" of the granules of pigment.

In my study of chromatophores, I have been impressed by the unusual thinness of the walls. Although the terms "thick" and "thin" are only relative and the actual measurement of the thickness of the walls of chromatophores has not been done, as far as I know, I see no reason for calling the walls thick. Furthermore, I have found no reason for believing that the walls of the chromatophore cause the pigment granules to move. In my study of the epidermal melanophores of frog tadpoles in living, uninjured tissue, in which observations were made continuously over periods of hours and with magnifications up to 1,000 diameters, the employment of an ocular micrometer did not reveal the slightest change in diameter

[1] SCIENCE, March 16, 1934.