of which were coated with soap solution, a disk of mica resting on a soap film serving to mark the changes in volume. Ether gave results varying from Graham's law. Chloroform yielded numbers closely coinciding with those reckoned from the theoretical specific density. Experiments conducted at various temperatures, when the air in the interior of the apparatus was saturated with aqueous vapor, showed that the velocity of diffusion of aqueous vapor is dependent on the temperature in the same degree as the maximum of tension. After determining the constant of an apparatus in dry air, an observation made in ordinary air would serve to determine the relative amount of moisture present.

A. V. Obermayer, "*Friction on Viscous Bodies.*" The inner friction of pitch is shown to be subject to the same laws as the friction of liquids. The inner friction of merely soft bodies varies notably from these laws.

P. C. Puschl, "*Latent Heat of Vapors.*" The author finds that if a mixture of vapor and liquid passes through the following series of changes—viz., expansion by constant temperature, elevation of the temperature by constant volume, compression to the original volume by this elevated temperature, and cooling to the original temperature—the external labor required is greater than the equivalent of heat so won. An inner labor is thus produced, which in some unknown manner escapes as the evolved heat.

Z. H. Skraup, "*On Super-ferricyanide of Potassium.*" This body, already described by Städeler and Bong, but not analyzed, on account of its unstable properties, was obtained by the action of HCl and $KClO_3$ on red prussiate of potassium. It is black, amorphous, easily soluble in water, insoluble in alcohol, and possesses the composition K_2FeCy_6. Fe must be regarded as tetravalent in this case.

R. Maly, "*A New Derivative of Sulpho-carbamid.*" This consists of sulpho-carbamid-acetic acid—

$$CS.(NH_2)(NH.CH_2.COOH),$$

which can be regarded as a sulpho-hydantoic acid.

RUSSIAN CHEMICAL SOCIETY.

P. LATSCHINOFF, "*Oxidation of Cholesterin.*" By the action of $KMnO_4$ on this substance the author obtains two monobasic acids, cholestenic acid, $C_{26}H_{40}O_4$, and oxycholestenic acid, $C_{26}H_{40}O_5$, and the dibasic dioxycholestenic acid, $C_{26}H_{40}O_6$. They are all soluble in ammonia, and yield amorphous salts with all metals except the alkalies. The author is led to adopt for cholesterin the formula $C_{26}H_{42}O$ $[(C_6H_9)_5H_2O]$.

F. Beilstein and A. Kurbatoff, "*Substitution Derivatives of Benzine.*" These chloro- and nitro-derivatives have been already described (*Chemical News*, vol. xxxv., page 105.)

G. Krestownikoff, "*On Iso-succinic Acid.*" In opposition to the statement of Byk, it is found that this acid is not produced by the action of potassium cyanide on chloro-propionic ether in alcohol. The reaction yields instead lactic acid and a new polymer of acrylic acid. The silver salt of iso-succinic acid is precipitated from the concentrated solution of the ammonium salt as a heavy granular mass. On the addition of water it is suddenly dissolved, and then immediately re-precipitated in the form of needle-like crystals. An attempt to obtain methyl-ethyl-acetic acid by the decomposition of ethyl-iso-succinate at a high temperature failed the ether remaining unchanged at the boiling-point of mercury.

H. Kanetnikoff, "*Action of Oxalate of Silver on the Bromides of the Olefines.*" The bromides of ethylen and propylen act in a similar manner to their homologues, the reaction producing instead of oxalic ethers, silver, bromine, carbonic acid, and ethylen or propylen.

C. Cech and P. Schwebel, "*New Formation of Iso-cyan-phenyl.*" The action of a dilute solution of a caustic soda on dichloro acetate of aniline yields hydrochloric acid, formic acid, and iso-cyan-phenyl.

THE ALKALINE AND BORACIC LAKES OF CALIFORNIA.

By J. ARTHUR PHILLIPS, F.G.S.

IMMEDIATELY east of the range of the Sierra Nevada is an extensive region of alkaline lakes and hot springs, of which very large areas are almost totally barren, the only vegetation consisting of wild sage, yucca, a few cacti, and scanty tufts of bunch-grass.

This district affords, in its many extensive craters and in its lavas, basalts, and obsidians, the most conclusive evidence of its volcanic origin, while its solfataras and boiling springs may be regarded as the last representatives of active volcanicity.

Although this region is one of great scientific interest, and may eventually become industrially important, it appears to be but little known in this country, and it has therefore been thought that a brief description of the district, as well as that of the borax lakes, lying on the western side of the Sierra, might not be without interest to English readers.

The most remarkable of the alkaline lakes of this portion of California are Mono and Owen's Lakes. The former lies in a depression occupying a portion of an elevated plateau of desert land, situated at the eastern base of the Sierra Nevada, between the head waters of Owen's and Walker's Rivers. The distance from the summit of the range to the lake shore is about six miles, and the difference of elevation is about 6,000 feet. On all sides, excepting towards the Sierra, this lake is surrounded by a wide belt of desert, the total area of which is from 400 to 500 square miles.

Mono Lake is about fourteen miles long from east to west, and nine wide from north to south; but it was formerly much larger than it is at present; this is indicated by numerous terraces, by means of which the lines of its ancient shores may be readily traced.

The water of this lake, which has a high specific gravity, and is alkaline and extensively saline, is not easily thrown into waves, but is generally smooth and glassy. Near its north shore there are springs which have produced extensive deposits of tufa, some of which rise several feet above the surface in forms resembling gigantic fungi.

There are numerous islands in this lake, two of which are of considerable size, the largest being two and a half miles long from north to south, and the other about half a mile in length from east to west. These, as well as a group of smaller islets lying to the north, are entirely composed of volcanic materials.

On the northeastern corner of the larger island are extensive hot springs and steam-jets, covering an area of some thirty acres, and extending into the lake. The escape of steam and hot gases from so many hundreds of vents is attended with much noise, and the sides of the orifices of many of the fumaroles are incrusted with a reddish-brown substance, which is probably chloride of iron. In the neighborhood of these springs there is a slight smell of sulphurous acid, but no free sulphur is deposited. Some of them furnish a copious supply of boiling water, large quantities of which enter the lake, and so perceptibly raise its temperature for a considerable distance around. Much gas and steam escape from a fissure caused by the sinking of a portion of the crust, while on the eastern part of the island are two well-defined craters, now filled with water.

Mono Lake is, during the summer, the resort of myriads of gulls and other aquatic birds, which are most numerous during the breeding season, but the water is believed to be entirely destitute of life, with the exception of a small crustacean, *Artemia fertilis*, nearly related to the so-called brine shrimp (*Artemia Salina*) found in the strong brine of the salt pans on European coasts, and the *Koo-cha-bee* of the Indians, a whitish larva, occurring in immense quantities, and which is much esteemed by them as an article of food.

Stretching south of the lake is a chain of extinct volcanoes, presenting the form of truncated cones, of which the generally steep sides are covered with ashes and other loose materials. Obsidian and pumice are abundant on the surface of these cones, and also cover the plains at their base.

Owen's Valley is a narrow basin lying south of Mono Lake, and running nearly north and south for a distance of about 140 miles. Its average width may be taken at ten miles. It is bounded along its western edge by the Sierra Nevada, which in this portion of its course presents an almost unbroken wall, of which the highest peak, opposite Owen's Lake, reaches an elevation of 15,000 feet. No pass crosses it at a less height than 11,000 feet, and near the lake shore the descent from the summit to the valley beneath must have an average inclination of at least 1,000 feet per mile, the distance being from ten to eleven miles, and the difference of level between the highest point of the pass and the valley being from 10,500 to 11,000 feet.

On the eastern side of this valley are the Inyo Mountains, towards its southern end, and the white Mountains further north. This range is dry and desert-like, and not a single stream of any size flows from it into Owen's Valley, which is exclusively watered by the melting of the snows accumulated during the winter months on the eastern slope of the Sierra. Owen's River rises a short distance from the source of the San Joaquin, and, after flowing for a distance of 120 miles, falls into Owen's Lake in lat. 36° 20′ N., long. 118° W. from Greenwich. This lake, of which the water is exceedingly saline and strongly alkaline, is twenty miles long and eight wide. It has no visible outlet, and its shores are often thickly coated with a snow-like alkaline incrustation.

No fish inhabits its waters, but *Koo-cha-bee* is abundant, and at certain seasons is carried in by the waves and deposited on the shores in layers of several inches in thickness. This was formerly collected in large quantities by the Indians, and, after being dried in the sun, rubbed between the hands and roughly winnowed, was crushed in a stone mortar, and made into a sort of bread, which furnished an important article of food. This insect, which has been described as a white grub, is also found abundantly in the waters of Great Salt Lake, Utah, and those of other saline and alkaline lakes of the West, and appears to be the larva of a two-winged fly which is described by the late Professor Torrey under the name of *Ephydra californica*, and by Dr. A. S. Packard as *Ephydra gracilis*.*

A specimen of water taken from Owen's Lake in January, 1866, had a specific gravity of 1·076, and contained 7128·24 grains of solid matter per gallon. The composition of this residue was found, calculated on an imperial gallon, to be as follows:

Chloride of sodium	2942·05
Sulphate of sodium	956·80
Carbonate of sodium	2914·43
Sulphate of potassium	122·94
Phosphate of potassium	35·74
Silicate of potassium	139·34
Organic matter	16·94
	7128·24

In addition to the substances above enumerated, iodine was present, but only in such minute proportion that its amount could not be estimated. It is also to be observed that since, for convenience of carriage, the sample of this water operated on was reduced by evaporation to one fourth of its original bulk before being brought to this country for analysis, it is probable that some alkaline sesquicarbonates may have been originally present.

The incrustations, which at certain periods of the year accumulate to the extent of many hundreds of tons on the shores of this lake, mainly consist of carbonates of sodium, in which the proportion of sesquicarbonate is somewhat variable; in some specimens examined monocarbonates were alone present. Besides carbonates of sodium, these deposits contain 3 per cent. of chloride of sodium, and about 5 per cent. of sulphate of sodium, together with traces of silica.

It was proposed some years since to erect works on the eastern shore of Owen's Lake, for the purpose of refining this deposit, for the manufacture of merchantable carbonate of sodium; but whether this idea was ever carried out, I am not aware. The only serious obstacles to the success of such an enterprise would appear to arise from scarcity of fuel, and the great distance of the lake from a shipping port.

As this lake continuously receives the waters of a considerable and constantly flowing river, while it has no apparent outlet, it follows that it must act the part of a hugh evaporating basin, in which the salts introduced by the not apparently saline water of Owen's River become concentrated to an alkaline brine. The rocks on either side of the valley through which the river flows are, to a very large extent, composed of granites, lavas, and basalts, from decomposition of the felspars in which the alkaline salts of the lake have doubtless been derived. The very small proportion of potassium salts present in these waters is remarkable, for although from the circumstance of the felspars of the district being to a large extent triclinic, sodium might be expected largely to predominate, still so great a disproportion in the respective amounts of the two alkalies could scarcely have been anticipated. This circumstance may perhaps, to some extent, be accounted for by supposing the potassium salts to have been largely assimilated by plants during the percolation of the waters containing them through vegetable soil, while the salts of sodium, not having been thus arrested, have passed into the river, and thence into the lake.

Owen's, like Mono Lake, was at one time much more extensive than it is at present; this is evident from the occurrence of a series of parallel terraces, plainly traceable on each side of the valley. In addition to these lakes, numerous alkaline lagunes and boiling springs are met with throughout this region.

The *Artemia fertilis*, before referred to as being plentiful in Mono Lake, is also exceedingly abundant in Owen's Lake. A peculiarity of this crustacean is that it congregates into masses which have often a strange appearance in the water. These masses sometimes stretch out in such a way as to have the form of a serpent, while at others they represent circles or various irregular figures. A gentle breeze scarcely affects water filled by *Artemia*, so that while on all sides the water is slightly ruffled, that which is occupied by these dense aggregations remains perfectly smooth, thus indicating the figure of the mass. On placing some of these crustaceans in a bottle filled with lake water, for the purpose of preserving them for subsequent microscopical examination, it was found that those which died rapidly disappeared, and on closely examining what had taken place, it soon became evident that, as soon as vitality had ceased, chemical action was set up, and the animal gradually dissolved in the strongly alkaline brine.

Burton Springs are situated at the extreme northern point of Owen's Valley. These springs rise from the earth over an area of about eighty square feet, which forms a basin or pond that pours its heated waters into a narrow creek. In this basin a vegetable growth is developed at a temperature of about 160° F., and is continued into the creek to a distance of about a hundred yards from the springs; where, at a temperature of about 120° F., the algæ grow to a length of over two feet, looking like bunches of waving hair of a beautiful green color. Below the temperature of 100° F., these plants cease to grow, and give way to a slimy fungus, which is also green in color, but finally disappears as the temperature of the water decreases. Dr. J. H. Wood, Jr., who has carefully examined this growth, makes the following observations with regard to it: "This plant certainly belongs to the *Nostechaceæ*, and seems a sort of connecting link between the genera *Hormosiphon* of Kützing and *Nostoc*.

"The best algologists now refuse to recognize the former group as generically distinct, and the characters presented by this plant seem to corroborate this view.

"The species appear to be an undescribed one, and I would propose for it the specific name *Caladarium*, which is suggested by its place of growth."*

Twenty miles south from Owen's Lake, across a sage-brush and grease-wood waste, the surface of which is plentifully strewn with fragments of lava, pumice, and basalt, is Little Lake. This sheet of water, which is of comparatively small extent, is surrounded by hugh masses of contorted vesicular lava, and evidently occupies the cavity of an ancient volcanic vent. The waters of this lake are considerably less alkaline than those of Owen's Lake, but bubbles of carbonic acid make their way to its surface in almost uninterrupted streams.

Fifteen miles east from this point are numerous hot springs; the path for the greater portion of this distance lies over lava-flows, which render traveling slow and fatiguing. At the principal group of springs the ground is covered, over a large extent, by innumerable cones of plastic mud, varying in height from a few inches to several feet; these rise above the surface of a seething swamp, and give issue to steam and jets of boiling water. In some cases the steam and gases, instead of issuing from cones as above described, are evolved under the surface water and mud contained in basin-shaped reservoirs formed in the decomposed rock. By these means are produced multitudes of boiling cauldrons in which violent ebullition keeps clay in a constant state of suspension; this clay varies in color from bluish gray to bright red. The waters of these springs are much employed by the Indians as an embrocation for the cure of diseases of the eye; on examination they were found to contain 48 grains of solid matter to the gallon, of which amount 26 grains are sulphate of aluminium; in addition they contain lime, soda, potash, and a little free sulphuric acid.

Borates of sodium and calcium occur in various localities in North America. The two borax lakes are both situated near the shores of Clear Lake in Lake County, California, seventy miles northwest of the port of Suscol, and one hundred and ten from the city of San Francisco.

The larger of these lakes is separated from Clear Lake by a low ridge of volcanic materials loosely packed together, and consisting of scoriæ, obsidian, and pumice; it has an average area of about three hundred acres. Its extent however varies considerably at different periods of the year, as its waters cover a larger area in spring than during the autumnal months. No stream flows into its basin, which derives its supply of water partly from drainage from the surrounding hills, and partly from subterranean springs discharging themselves into the bottom of the lake. In ordinary seasons its depth thus varies from five feet in the month of April to two feet at the end of October.

The borax occurs in the form of crystals of various dimensions imbedded in the mud of the bottom, which is found to be most productive to a depth of about three and a half feet, although a bore-hole which was sunk near its center to the depth of sixty feet afforded a certain amount of the salt throughout its whole extent.

The crystals thus occurring are most abundant near the center of the lake, and extend over an area equivalent to one third of its surface; they are, however, also met with in smaller quantities in the muddy deposit of other portions of the basin. The largest crystals, some of which are considerably above a pound in weight, are generally inclosed in a stiff blue clay, at a depth of between three and four feet; and a short distance above them is a nearly pure stratum, from two to three inches in thickness, of smaller ones; in addition to which crystals of various sizes are disseminated through the blue clayey deposit of which the bottom consists.

Besides the borax thus existing in a crystallized form, the mud itself is highly charged with that salt, and, according to an analysis by Dr. Oxland, affords, when dried, in those portions of the lake which have been worked (including the inclosed crystals), 17·73 per cent. Another analysis of an average sample, by Mr. G. E. Moore, of San Francisco, yielded 18·86 per cent. of crystallized borax. In addition to this, the deposit at the bottom of the other portions of the

* See Hayden, "Geological Survey of Montana, Idaho, Wyoming, and Utah, 1872," p. 744.

* Silliman's Journal," vol. xlvi., 1868, p. 33.