The consequences of this change are somewhat momentous. The main mouth of the river was formerly twenty or thirty miles farther north of the new débouchure, and with the converging shores of the gulf, gave conditions which with the spring tides at thirty to forty feet, produced a marked bore, being felt many miles upstream, both in the Colorado and Hardy. The new channel reaches sea-level by a much more gradual descent and hence without the strong current favorable to developing the bore.

The new mouth will become the center of a new series of mud flats which fringe the shores already for a distance of fifty miles. The deposition of silt will operate to close the eastern channel between Montague Island and the mainland, which has long since ceased to be navigable and will soon afford material which will be piled by the tides in the deeper channel to the westward with the final result of filling it more or less completely.

The new eastern channel is one probably not previously occupied by the river in its present condition, and the change adds to the delta the triangular area enclosed by the old channel below the "Colony mesa" to the gulf, and the new channel, inclusive of expanses of mud flats and a range of gravel dunes or hillocks which find their culmination at the extreme northern end of the triangle immediately below where the new channel takes off from the old one.

In addition to increasing the area of the delta, serious disturbance of the plants and animals over an area of several hundred square miles may ensue. In a large part of it the composition of the flora will be totally altered.

M. C. MARSH,
Recording Secretary

THE TORREY BOTANICAL CLUB

THE first stated meeting for 1908 was held on January 14, 1908, at the American Museum of Natural History at 8:15 P.M. Vice-president Edward S. Burgess presided. The attendance was fourteen.

This being the annual business meeting of the club, the chairman called for the reports of officers for 1907. Reports of the secretary, treasurer, editor and corresponding secretary were read, accepted and placed on file.

The secretary reported that fourteen regular meetings had been held during the year, with a total attendance of 306, as against 219 in 1906, and an average attendance of 21.8, as against 16.8 last year. A total of 37 formal papers was presented before the club, distributed according to subject-matter as follows: taxonomy, 5; physiology, 6; morphology, 4; ecology, 7; regional botany, 5; exploration, 2; lantern lectures, 4; miscellaneous, 4. In addition to these were numerous informal notes and exhibitions of specimens.

The editor reported the publication of one number of the *Memoirs,* of 47 pages, and the issuance of the *Bulletin* and of *Torreya* as usual. The need of an adequate index to the *Bulletin* from volume one to thirty, inclusive, was strongly emphasized.

On behalf of the committee on the local flora, the chairman, Dr. Britton, urged the need of increased activity, and emphasized the desirability of preparing a special work on the flora of New York City and vicinity. At present no such work exists.

Election of officers for the year 1908 resulted in the election of the following ticket:

President—Henry Hurd Rusby.

Vice-presidents—Edward Sandford Burgess and John Hendley Barnhart.

Secretary—C. Stuart Gager.

Treasurer—William Mansfield.

Editor—Marshall Avery Howe.

Associate Editors—John Hendley Barnhart, Jean Broadhurst, Philip Dowell, Alexander William Evans, Tracy Eliot Hazen, William Alphonso Murrill, Charles Louis Pollard and Herbert Maule Richards.

C. STUART GAGER,
Secretary

DISCUSSION AND CORRESPONDENCE

THE TEMPERATURE OF THE SUN

PROFESSOR SCHAEBERLE'S measurement of the effect of concentrated solar radiation in the melting of platinum and other metals[1] is a valuable addition to previous experiments of this sort. Indeed, it may be doubted whether the measurement has ever been made before

[1] SCIENCE, December 20, 1907, p. 877.

with a mirror of so great concentrating power, which at the same time has possessed so perfect a figure.

The energy received from the sun can not be determined from the data given without further addition of a time-factor, and estimates of the mass of material heated, and of the accompanying losses of heat. As a simple experiment in static equilibrium of temperature, however, this knowledge is not necessary.

It is doubtful whether radiation formulæ obtained from measures through a limited range of temperature for solid bodies, composed of complex molecules, are applicable to solar conditions at the photospheric level, where it is improbable that any molecules remain undissociated. Extrapolations from Stefan's law of the proportionality of total radiation from a black body to the fourth power of the absolute temperature, are therefore not certainly applicable to the problem, even though the law has been verified through a range of some hundreds of degrees. But, on the other hand, Newton's law, which is only an approximation for a very limited range of temperature, and which becomes entirely erroneous when we pass to wider variations, is even less trustworthy.

If the exposed body were at the center of a perfectly reflecting, hemispherical mirror, it would receive as much heat as if it were transported to the sun's surface, neglecting the loss by atmospheric absorption. At the focus of such a mirror, since the radiation received or lost is proportional to the solid angle filled by the mirror, or by the portion of the sphere outside the mirror, respectively, the body would receive more solar radiation than from the actual mirror, subtending 29°, in the proportion, versin 90°: versin 14°.5 = 31.3 : 1.

At the same time, the angle through which loss of radiation from the heated body takes place, having been diminished in the ratio, 1.968 : 1, the total radiant effect would be altered in the ratio, $1 : 1.968 \times 31.3 = 1 : 61.6$. Accepting the estimate of losses by absorption, this ratio is to be further multiplied by 2.14, giving 1 : 131.8. With the estimated temperature of 2,000° C. from solar rays with an 18-inch aperture, we get, if the sun radiates as a full radiator and Stefan's law holds, effective solar temperature $= t_0 = (2{,}000^4 \times 131.8)^{\frac{1}{4}} = 6{,}776°$. This is a minimum value, because the sun does not radiate as a body at a single definite temperature, but as a complex radiator, since, even if the photosphere behave like an absolutely "black," or full radiator, the atmospheric layers above the photosphere, which are at a lower temperature and which add their own radiations, can not be perfect radiators, because they would then be perfect absorbers also, and would completely absorb and shut off the radiation from the photosphere itself, becoming a new photosphere in turn.

We may presume that quite a notable amount of radiation comes from these cooler and imperfectly radiating layers, enough, at any rate, to cause the maximum in the spectral energy-curve to move from the position corresponding to the photospheric temperature to one appropriate to a body of lower temperature, through the addition of a disproportionate amount of radiation of longer wave-length.

To produce a given amount of radiation from an imperfect radiator requires a higher temperature in inverse proportion to the coefficient of relative emissive power. Scheiner has noted this in his treatise on the "Radiation and Temperature of the Sun," and has estimated that it may be necessary to almost double the temperature which would be obtained on the supposition that the sun is a perfect radiator.

The complexity of the solar radiating layer prevents the strict application of Paschen's law connecting the wave-length of maximum radiation and the absolute temperature, to the problem of solar temperature; but there is now sufficient agreement in the different modes of computing the solar temperature to indicate that it is between 6,000° and 7,000°, or else that there is a marked change in the law of radiation at solar temperatures, a possibility which has been suggested by Professor Bigelow.[2]

It does not seem demonstrable that the effective solar temperature is as great as 66,-

[2] *Monthly Weather Review*, December, 1902, p. 561.

000° C., the value assigned by Professor Schaeberle; but neither is it demonstrable that the temperatures assigned by Stefan's law are correct; and nothing but the existence of certain coincidences in values given by different methods, coincidences which are possibly fallacious, can be said to favor the supposition that the effective temperature is as low as 7,000°.

Since about nineteen twentieths of photospheric radiations of wave-length $0.3\,\mu$ are absorbed by the sun's atmosphere, and of rays of wave-length $0.4\,\mu$ barely a fifth get through, the form of the spectral energy-curve is so much changed near the maximum that the position of this important point in the curve of photospheric radiation, restored by application of corrections for the absorption by the atmospheres of sun and earth, becomes uncertain; but the photosphere can not have a temperature as great as 60,000°, nor even one of 10,000°, without requiring serious changes in the constants of radiation in the formulæ accepted to-day, or in the assumptions tacitly made as to the emissive power of the solar substances. The latter may very likely be in error, and it would be interesting to have measures of the relative emissive powers at very high temperatures of all substances which can give continuous spectra at those temperatures.

FRANK W. VERY

WESTWOOD, MASS.

THE FAUNA OF RUSSIAN RIVER, CALIFORNIA, AND ITS RELATION TO THAT OF THE SACRAMENTO

FOLLOWING an article in a recent number of SCIENCE[1] on certain "Physiographic Changes bearing on the Faunal Relationships of the Russian and Sacramento Rivers, California," a note on the fish faunas of these basins may be of interest. The writer of the present paper has seen no account of the fishes of the Russian River, and therefore must rely entirely on his own observations for the following statements.

The Russian River has, so far as known, twelve species of indigenous fishes. They are: *Entosphenus tridentatus, Catostomus occidentalis, Mylopharodon conocephalus, Ptychocheilus grandis, Rutilus symmetricus, Oncorhynchus tschawytscha, Salmo irideus, Gasterosteus cataphractus, Cottus asper, Cottus gulosus, Cottus aleuticus* and *Hysterocarpus traski.* Of these, *E. tridentatus, O. tschawytscha* and *S. irideus* are anadromous forms, while *G. cataphractus, C. asper, C. gulosus* and *C. aleuticus* are able to withstand salt water and are consequently to be ignored in a study of the faunal relationships of rivers. The other species are strictly fluvial. The above-named species also occur in the Sacramento River. A large series of specimens from each basin, examined some years ago by the writer, presented no structural differences whatever. They were as near alike as fishes collected from the same stream.

It may here be noted, for those not familiar with the geography of the region, that the Russian River occupies a basin lying mostly in the mountainous region to the westward of the great valley drained by the Sacramento. Its general course is southward until it reaches a point about 35 miles to the north of San Pablo Bay, when it turns abruptly west and, flowing through a deep canyon, reaches the ocean. It is therefore completely isolated from the Sacramento. The headwaters of numerous small tributaries of both rivers rise in close proximity in the high mountains which divide their basins. It is in this mountainous divide that Holway has found evidence of a transfer of a part of a tributary from the Russian River to the Sacramento, which probably carried along with it a representation of the Russian River fauna.

That such a movement as Holway records could have any effect on the faunal relationships of the two basins seems highly improbable, as the Sacramento, a vastly larger and probably older system, not only contains all the fluvial species known from the Russian River, but also others not there represented. The zoological evidence, such as it is, indicates that the Russian River fauna was derived from the Sacramento, and not that any portion of the fauna of the latter was obtained from the Russian River.

[1] Holway, Ruliff S., SCIENCE, September 20, 1907.