

less important factor than wind-friction. Those interested in the subject will do well to read the chapters on ocean-currents in Croll's 'Climate and time,' and the papers by Croll and Carpenter in the London and Edinburgh *Philosophical journal*, and the Proceedings of the Royal society.

J. S. NEWBERRY.

Columbia college, July 1.

### Private research and government science.

Since the promulgation and discussion of the bill to curtail the work of the scientific bureaux at Washington, and Mr. Herbert's appeal "to the best literary and scientific thought of the country to come to our aid and join us in the effort to effect a reform and arrest this pernicious tendency," much has been written and said upon this subject.

One of the chief arguments brought to bear by those opposed to the extraordinary scientific progress being made, and the vast amount of scientific work being done by this country at the seat of its government, is, that this work is proving detrimental to private research in similar channels.

Further, it has been said by the opposition that these scientific publications of the U. S. geological survey are valueless in the book-markets of the world; and Mr. Herbert points to that law in the organization of the survey which specifies that it shall sell all its publications not exchanged at cost, and that during the past six years this sale has realized an amount but slightly exceeding fifteen hundred dollars.

Now, one of the best proofs that this scientific activity on the part of the government is in no way checking private research, has been recently brought forward by Professor Agassiz, who laid before this commission of investigation the titles of forty-eight publications of the Museum of comparative zoölogy at Cambridge, alone.

But perhaps a still better light is thrown upon these two latter questions by an unprejudiced examination of such a catalogue as is published by Dulau & Co. of 37 Soho Square, London. Here we find five of Mr. O. G. Elliot's zoölogical monographs on sale for five hundred and forty-five dollars, and other evidences of the very highest activity in private research in America on every page. Moreover, to prove that the government publications of this country are not held as being valueless in the book markets of the world, we see any number of the publications of the geological survey, and other scientific bureaux of Washington, on sale in the above catalogue, and being sold at prices fully equalling those of private publications. That more money has not been realized at the survey for the sale of its works, simply speaks in favor of how eagerly they are sought in exchange, leaving but a few copies each year on hand for sale.

The excellent handbooks of geology of this country by Dana and LeConte do not seem to have been suppressed by government interest in this highly important work; and if we run our eyes over the bibliography and illustrations of this science, as set forth in these two volumes, I defy any one to say that the government work is not appreciated, or that private researches in this field are checked. The same holds good for all the other sciences.

I think when the sense of the vote of the "best literary and scientific thought of this country" is taken upon Mr. Herbert's appeal to suppress such works as the paleontological monographs of Marsh,

Ward, White, and others, and the magnificent publications in the bibliography of science undertaken and accurately carried through by our government, there will be an enormous zero on his side of the ticket. Government moneys can be squandered on far worse things in the times of peace, than such schemes as powerfully aid the progress of knowledge, culture, science, and learning. Be it said to the credit of this country that she sees fit to invest her surplus means to the advancement of such ends.

R. W. SHUFELDT.

Fort Wingate, N. Mex., June 29.

### Expulsion theory of comets.

Mr. Proctor's article in a recent number of the *Nineteenth century*, on the expulsion theory of comets, leads one to believe that the solution of this problem is not only as far off as ever, but that little headway is being made for a general clearing-up of the 'mystery.' There are many serious objections to this particular theory of the origin of comets. We admit, of course, that the earth and Mars, for instance, or even the moon, may have been at one time scenes of vast fiery eruptions, etc. But that this cast-off matter should go out into space in a burning state, and continue to go out, probably, for a great number of years, then return, still in a burning state (the alleged comet),—while the body from which it was expelled, and a much greater size as a matter of course, always remaining in close proximity to the sun, and drawing closer all the time, should cool down and become solid and non-luminous, such as the earth, Mars, or the moon is at the present time,—is certainly something on which Mr. Proctor's theory throws little light. The expelled matter must naturally cool down the same as the body from which it was expelled, and except by accident, considering the distance it would have to travel to meet another source of heat (a sun), we can only come to one conclusion in regard to the expulsion theory, it won't do.

G.

Brooklyn, June 29.

### Flooding the Sahara.

Mr. G. W. Plympton's very interesting and suggestive article on the flooding of the Sahara (*Science*, vol. vii. pp. 542-544) induced me to make some numerical estimates, based upon the data furnished by him, which may be of some interest to readers of *Science*. He shows that "the area, which, lying below the Mediterranean, can possibly be flooded by it" (the united areas of the depressed portions), is, by M. Roudaire's measurements, about 3,100 square miles; and the average depth, if flooded, would be 78 feet. Now, assuming the area of the cross-section of the water of the Inlet Canal to be 2,000 square feet, and the average velocity of the inflowing water during the whole time of flooding to be 2 feet per second (not a low estimate), it follows that the average inflow would be 4,000 cubic feet per second =  $3,456 \times 10^6$  cubic feet per day =  $1,262,277 \times 10^6$  cubic feet per year.

Again: 3,100 square miles =  $864,230 \times 10^6$  square feet; and, the average depth being 78 feet, the amount of water required to flood it to this depth =  $67,409,971 \times 10^6$  cubic feet. Consequently such a canal would require 53.4 years to flood the comparatively small and shallow Saharian lake, under the assumption that during the inflow no water was lost by evaporation or by absorption into the porous bed.

In such an arid and hot climate, evaporation alone would probably prolong the time of flooding for hundreds of years: indeed, the time might be prolonged indefinitely, for the loss by evaporation might ultimately be equal to the supply by inflow. We have a case in point in Pyramid Lake, in Nevada, into which the bold and rapid outlet of Lake Tahoe (Truckee River) perpetually flows without flooding it. Of course, by increasing the dimensions of the Inlet Canal, or augmenting the velocity of the inflowing water, the computed time of flooding might be proportionately shortened; but, after all, the feeble efforts of man are insignificant in relation to the great hydraulic systems of nature.

JOHN LECONTE.

Berkeley, Cal., June 29.

### A dissolving smoke-ring.

The remarkable breaking-up of a smoke-ring from a locomotive in Chicago was observed by me, a few days since, in company with a mechanical engineer of New York, whose estimate of size and height I adopt. The ring rose to an elevation of about one hundred and fifty feet, and attained a diameter of twenty or twenty-five feet, as nearly as could be estimated. It broke up suddenly with a rush of the smoke *along the line of the ring* toward two centres; namely, the smoke of the south half coming together in the centre of that half of the line, and the smoke of the north half correspondingly to a centre in the north. After these momentary and confused aggregations, all semblance of form disappeared. A vortex ring is different from the theoretic planetary ring breaking up into satellites, but aggregation of the dissolving smoke-ring is suggestive.

H. W. PARKER.

Grinnell, Io.

### Surface tension and muscular contraction.

I would offer as an attempt to explain the nature of muscular contraction the hypothesis that the contraction is due to the phenomena of surface tension.

By surface tension of a liquid is meant a peculiarity presented by its surface, due to a difference in state between the molecules in the surface and those in the interior of the liquid. That there must be an essential difference between the surface of a mass and its interior follows from the fact that the molecular forces acting on any particle within the mass are equal in every direction, and so must balance one another; while the particles in the surface film, having no particles above them, are acted on only from below and at the sides, and so are constantly drawn down against the mass: so that the liquid must be under a definite surface tension.

This surface film behaves as a perfectly elastic membrane stretched in every direction by equal tensions, and takes the form of smallest area consistent with the conditions. This tendency of the film to become as small as possible is well illustrated by the soap-bubble, which may be considered as a layer of water with two surface films. So, when left to its own molecular forces, a drop of liquid assumes that form having the smallest superficies, with a given content, which is the sphere.

When a drop of liquid rests upon a surface which it does not wet, it assumes the form of a sphere more or less flattened out; and the greater the surface tension of the liquid forming the drop is, the more

nearly does it approach the spherical form, and whatever alters its surface tension causes a corresponding alteration in the form of the drop.

Many substances, even in small quantity, exert a considerable influence on the surface tension of liquids.

If a drop of water resting upon a greasy surface, which it does not wet, be touched with a little alcohol, its surface tension is diminished, and it immediately spreads out over a larger area; but, when the alcohol evaporates, the surface tension of the water is increased, and it again contracts into a more globular form.

Remarkable changes in form are caused when a globule of mercury is electrically polarized. In organic substances the surface tension increases with the increase of certain elements entering into their composition, and diminishes with the increase or diminution of others; e.g., in butyric acid and acetic anhydride the increase of oxygen and diminution of hydrogen increase the surface tension.

Now, to see the bearing of this upon the contraction of a muscular fibre, it is necessary to remember that the surface tension of a liquid may be changed by a change in its composition, that the contracting elements of a muscular fibre are the cells, and that the composition of the cells is changed at the time of a contraction.

The cells are of an oblong shape extended in the axis of contraction; and when contraction occurs the cells grow shorter and thicker, just as an oblong drop of water grows shorter and thicker when its surface tension is increased.

Now, a tendency to contraction must follow an increase in the surface tension of the cell; and that there probably are changes in the surface tension of the cell during contraction, follows from the fact that there are chemical changes in the cell, more rapid during contraction than rest. The changes occurring in acting muscle may be identical with those in resting muscle; but in resting muscle, restoration keeps pace with destruction, while in contraction, destruction largely exceeds restoration: so any thing hastening the decompositions within the cell may cause contraction.

Exhaustion is explained by the accumulation of products of decomposition, since fatigue in muscles in which circulation has ceased may be readily removed by renewing the current of blood.

This hypothesis may be thus summed up: the active shortening of the fibre is due to an increase in the surface tension of the substance of the cell, caused by an increase in the proportional amount of the products of decomposition. Equilibrium is restored—after the stimulus which hastened the chemical changes has ceased—by a part of the products of decomposition finding their way into the blood-current, and possibly by the remaining products helping to build up the original compound.

ELMER STARR, M.D.

Buffalo, N.Y., June 25.

### Trenton natural history society.

So far as my own communications to the Trenton natural history society are concerned, the report thereof in *Science* (viii. No. 178) is a wilful misstatement. As what I did state will soon be published, it is unnecessary to enter into explanations.

CHAS. C. ABBOTT, M.D.

Trenton, N.J., July 2.