

motion, these currents cannot be maintained in a radial direction. A rotary motion, rapidly augmenting, will take place, producing a vortex more powerful than any imagined by Descartes. The radial currents of the vaporous column having assumed a spiral course, will rapidly acquire a velocity exceed that of a cyclone. The practical effect of the powerful movement of the vortex, it is reasonable to suppose, will resemble that of a gigantic carving-tool whose thorough efficiency in removing irregularities has been proved by the exact circular outline presented by thousands of lunar formations. The terraces within the "ring mountains" indicated on Beer and Mädler's chart, it may be shown, were produced by evaporation resulting from low temperature and reduced energy after the formation of the main glacier.

There is another feature in the lunar landscape scarcely less remarkable than its circular walls and depressions. In the centre of nearly all of the latter one or more conical hills rise, in some cases several thousand feet high. Has the rotary motion of the boiling vortex any connection with these central cones? A brief explanation will show that the connection is quite intimate. The under-rated estimate that 10 square feet of surface under the action of slow fire is capable of developing one horse-power proves the presence of a dynamic energy exceeding 5,000,000,000 of horse-power at the base of the vaporous column resting on the boiling water of a pond as large as that of Tycho. No part of this power can be exerted vertically, as already explained, on the ground that the weight of the vapour restrains such movement. The great velocity of the vortex resulting from the expenditure of the stated amount of dynamic energy will of course produce corresponding centrifugal force; hence a maelström will be formed capable of draining the central part of the pond, leaving the same dry, unless the water be very deep, in which case the appearance of a dry bottom will be postponed until a certain quantity of water has been transferred to the glacier. It should be observed that the central part of the bottom, freed from water, will also be freed from the surrounding cold by the protection afforded by the vaporous mass. The quantity of snow formed above the centre, at great altitude, will be small, and of course diverged during the fall. Evidently the dry central part, prevented, as shown, from cooling, will soon acquire a high temperature, admitting the formation of a vent for the expulsion of lava, called for as the moon, whose entire dry surface is radiating against space, shrinks rapidly under the forced refrigeration attending glacier-formation. Lavas cones similar to those of terrestrial volcanoes, and central to the circular walls, may thus be formed, the process being favoured by the feebleness of the moon's attraction. The existence of warm springs on the protected central plains is very probable; hence the formation of cones of ice might take place during the last stages of glacier-formation, when those plains no longer receive adequate protection against cold.

In accordance with the views expressed in the monograph read before the American Academy of Science, continued research has confirmed my supposition that the water on the moon bears the same proportion to its mass as the water of the oceans to the terrestrial mass. I have consequently calculated the contents of the circular walls of the "ring mountains" measured and delineated by Beer and Mädler, and find that these walls contain 630,000 cubic miles. The opposite hemisphere of the moon being subjected to similar vicissitudes of heat and cold as the one presented to the earth, the contents of the circular walls not seen cannot vary very much from those recorded in "Der Mond"; hence the total will amount to 1,260,000 cubic miles. Allowing for the difference of specific gravity of ice, the stated amount represents 1,159,000 cubic miles of water. But "Der Mond" does not record any of the minor circular walls which, as shown by the large photograph before referred to, cover the entire surface of some parts of the moon. On careful comparison it will be found that the contents of the omitted circular formations is so great that an addition of 50 per cent. to the before-stated amount is called for. An addition of 25 per cent. for the ice-fields, whose extent is indicated by cracks and optical phenomena, is likewise proper. The sum total of water on the moon, therefore, amounts to 2,028,600 cubic miles.

Adopting Herschel's estimate of the moon's comparative mass, viz. 0.011364, and assuming that the oceans of the earth cover 130,000,000 square miles, it will be seen that the estimated quantity of water on the moon corresponds with a mean depth of 7250 feet of the terrestrial oceans.<sup>1</sup> This depth agrees very

$\frac{2028600 \times 5280}{130000000 \times 0.011364} = 7250$  feet mean depth of terrestrial oceans corresponding with water on the moon.

nearly with the oceanic mean depth established by the soundings for the original Atlantic cable, viz. 7500 feet; but the result of the *Challenger* Expedition points to a much greater depth. This circumstance is by no means conclusive against the supposition that the satellite and the primary are covered with water in relatively equal quantities. The correctness of Sir John Herschel's demonstration proving the tendency of the water on the lunar surface to flow to the hemisphere furthest from the earth must be disproved before we reject the assumption that the quantity of water on the surface of the moon bears the same proportion to its mass as the quantity of water on the earth to the terrestrial mass.

JOHN ERICSSON

SCIENTIFIC SERIALS

*Rendiconti del Reale Istituto Lombardo*, May 27.—Determination of the heat of fusion in the alloys of lead, tin, bismuth, and zinc, by Prof. D. Mazzotto. By the cooling process usually adopted for determining the specific heat of liquids, the author finds the point of fusion and the heat of fusion for these various chemical alloys as under:—

	Point of fusion	Heat of fusion
Tin and lead ... ..	181	10.29
Tin and zinc ... ..	196	16.20
Tin and bismuth ... ..	138	11.065
Bismuth and lead ... ..	126	4.744

Two of these coincide and two others differ little from the composition of the chemical alloys as given by Rudberg.—Education and crime in Italy, by S. Amato Amati. In order to ascertain the influence of public instruction on the criminal classes in the Peninsula, the author has compiled a number of comparative tables based on official returns ranging from the year 1871 to 1883 inclusive. For the last three years of this period the results are as under:—

	Criminals	Unlettered	Could read and write	Educated
1881 ...	8693	5511	3031	151
1882 ...	7009	4139	2671	199
1883 ...	6490	3741	2596	153

According to the three last census returns the total percentage of unlettered was as under:—

	Males	Females	Total
1861 ...	65.47	81.52	73.50
1871 ...	60.16	77.18	68.64
1881 ...	53.89	72.93	63.45

—Meteorological observations made at the Brera Observatory, Milan, during the month of May.

SOCIETIES AND ACADEMIES

LONDON

**Royal Society**, May 6.—"Further Discussion of the Sunspot Spectra Observations made at Kensington." By J. Norman Lockyer. Communicated to the Royal Society by the Solar Physics Committee.

I have recently discussed, in a preliminary manner, the lines of several of the chemical elements most widened in the 700 spots observed at Kensington.

The period of observation commences November 1879, and extends to August 1885. It includes, therefore, the sunspot curve from a minimum to a maximum and some distance beyond.

It is perhaps desirable that I should here state the way in which the observations have been made. The work, which has been chiefly done by Messrs. Lawrance and Greening, simply consists of a survey of the two regions F—b and b—D.

The most widened line in each region—not the widest line, but the *most widened*, is first noted; its wave-length being given in the observation books from Ångström's map. Next, the lines which most nearly approach the first one in widening are recorded, and so on till the positions of six lines have been noted, the wave-lengths being given from Ångström's map, for each region.

It is to be observed that these observations are made without any reference whatever to the origin of the lines; that is to say it is no part of the observer's work to see whether there are metallic coincidences or not; this point has only been inquired into in the present reductions, that is, seven months after the