tion of reading the account of work which it is impossible for the student to repeat for himself, the methods adopted are quickly understood and easily remembered, because the general methods of analysis and synthesis have, in an easy form, not only been used, but discovered by the student himself.

This method of course breaks down where an elaborate examination syllabus is imposed upon the beginner from the outset, and even where this is not the case, every teacher must adapt the method to his own conditions, only and always keeping the fundamental principle in view.

For the beginner in Chemistry whether he is later to specialise in this subject or not, experience has convinced me that the teaching of facts must give way to the teaching of method if a sound basis is to be laid in chemical science, whilst the subject opens the whole question of the value of Chemistry teaching from the educational point of view. GRACE HEATH.

The Temperature of the Human Body.

THERE is a problem partly physiological and partly physical which I shall be grateful if any reader of NATURE can throw light upon.

1. *The physiological.*—I am assured by medical opinion in which I have confidence that the temperature of the human body is invariable from pole to equator of the earth. The question I want to ask, assuming this to be true, is this: What is the action in the body which exactly and everywhere counterbalances the radiation and conduction of heat in the one case from the body and in the other to the body? I thought at first that perspiration might have something to do with it, but my medical authority assures me that at the equator a man who perspires freely has exactly the same temperature as one that perspires little, although the former will be in good and the latter in bad health.

2. *The physical.*—Treating the animal as a heat engine, one is apt to think of the source of heat as the animal heat engendered by the combustion going on in his frame, and the refrigerator as the surrounding air at lower temperature—in the experience of most of us. The animal then does work at the expense of this heat during its transfer from source to refrigerator, as in an ordinary engine. On the other hand, the animal in equatorial regions must, if the physiological statement above be a fact, be often the coldest of surrounding bodies. Does he also do work at the expense of the heat of combustion in his body, and if so is this vital action an exception to the second law of thermodynamics? If not, does he do work at the expense of the heat which is conducted into his body from hotter surrounding bodies, which heat, when he is doing no external work, still does not raise the temperature of his body?

Rugby. L. CUMMING.

Comet II. 1892 (Denning, March 18).

THIS comet is still a tolerably easy object in my 10-inch reflector and will doubtless continue to be visible during the greater part of the ensuing winter. It is now approaching the earth, and its brightness is increasing slightly. During the next two months it will traverse Orion.

I observed the comet on September 30, when it was in the same field as the 6th mag. star Piazzi VI. 144 (Lalande, 12546). By differential observations with that star I found the place of the comet to be

	G.M.T.	α.	δ.
	h. m.	h. m. s.	° ′
1892, Sept. 30 ...	12 50 ...	6 25 51 ...	+14 11.

The theoretical brightness, as given in Schorr's ephemeris, was 0·62, but to my eye the comet seemed quite as plain as in March last. The nucleus was, perhaps, not so distinct, but the surrounding nebulosity appeared to be more extended than on previous occasions.

The comet will be close to ζ Orionis (the southernmost star in the belt) about November 14, and passes very near β Orionis (Rigel) on November 30. W. F. DENNING.

Bristol, October 2.

Cirro-stratus.

A RATHER perfect example of one variety of this cloud was seen here in the afternoon of September 27. A rapid fall of the barometer until 5 A.M., accompanied by a high wind, had been followed by a steady rise, the wind moderating some hours later. At 2 p.m., with a westerly light air, the sheet of cirro-stratus which overspread the sky appeared in the form of a series of very perfect undulations, stretching nearly north and south. These were about fourteen in number, crowded together towards the east. The lower surface of the sheet was sharply defined, and could be followed with ease in its successive rise and fall. The cloud-filaments could be also traced, preserving their perpendicularity to the wave-fronts and conforming to the undulations of the lower surface with a closeness which I had not before observed, although sheets of cirro-stratus are common here. The whole system was drifting slowly to the east.

J. PORTER.

Crawford Observatory, Queen's College, Cork.

A New Habitat for Cladonema.

WILL you kindly allow me through your columns to note a habitat for this genus not given in Allman or Hincks. Several weeks ago I received some sponge from Mr. Sinel, of Jersey, and on examining it with a hand-lens detected four polypites of Cladonema, one, at least, of which is still alive.

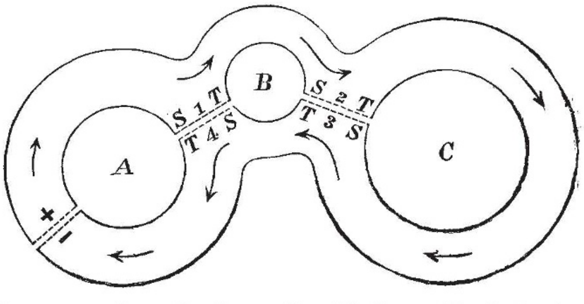
HENRY SCHERREN.

5 Osborne Road, Stroud Green, N.

TO DRAW A MERCATOR CHART ON ONE SHEET REPRESENTING THE WHOLE OF ANY COMPLEXLY CONTINUOUS CLOSED SURFACE.

IF a solid is not pierced by any perforation, its surface is called simply continuous, however complicated its shape may be. If a solid has one or more perforations, or tunnels,[1] its whole bounding surface is called "complexly continuous"; duplexly when these is only one perforation; $(n+1)$-plexly when there are n perforations. The whole surface of a group of n anchor-rings (or "toroids") cemented together in any relative positions is a convenient and easily understood type of an $(n+1)$-plexly continuous closed surface.

Let the diagram represent a quadruplexly continuous closed surface made of very thin sheet metal, uniform as to thickness and homogeneous as to quality throughout. To prepare for making a Mercator chart of it, cut it open between perforations C and B, B and A, A and outer space, in the manner indicated at $\overset{2}{\underset{3}{=}}$, $\overset{1}{\underset{4}{=}}$, and ±. Apply infinitely conductive borders to the two lips separated by the cut at ±, and apply the electrodes of a voltaic battery to these borders. By aid of movable electrodes of a voltmeter trace, on the metallic surface, and a very large number ($n-1$, of equidifferent equipotential closed curves between the + and − borders. Divide any one of these equipotentials[2] into parts each equal to the



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[1] A "hole" may mean a deep hollow, *not* through with two open ends. The word "tunnel" is inappropriate for the aperture of an anchor ring. Neither "hole" nor "tunnel" being unexceptionally available, I am compelled to use the longer word "perforation."

[2] Two sentences of my previous article ("Generalisation of Mercator's Projection") in § 3, and in last paragraph but one, are manifestly wrong, and must be corrected to agree with the rule given for dividing into infinitesimal squares, in the present text.

infinitesimal distance perpendicularly across it to the next equipotential on either side of it; and through the divisional points draw curves, cutting the equipotentials at right angles. These curves are the stream lines. They and the $(n+1)$ closed equipotentials (including the infinitely conductive borders) divide the whole surface into $n\,m$ infinitesimal squares, if m be the number of divisions which we found in the equipotential. The arrows on the diagram show the general direction of the electric current in different parts of the complex circuit; each arrow representing it for the thin metal shell on either far or near side of the ideal section by the paper.

Considering carefully the stream-lines in the neighbourhoods of the four open lips marked in order of the stream 1, 2, 3, 4, we see that for each of these lips there is one stream-line which strikes it perpendicularly on one side and leaves it perpendicularly on the other, and which I call the flux-shed-line (or, for brevity, the flux-shed) for the lip to which it belongs. The stream-lines infinitely near to the flux-shed, on its two sides, pass infinitely close round the two sides of the lip, and come in infinitely near to the continuation of the flux-shed on its two sides. Let F_1, F_2, F_3, F_4 (not shown on the diagram) be the points on the $+$ terminal lip from which the flux-sheds of the lips 1, 2, 3, 4 proceed; and let G_1, G_2, G_3, G_4, be the points at which they fall on the $-$ lip. Let S_1, T_1, S_2, T_2, &c., denote the points on the four lips at which they are struck and left by their flux-shed-lines.

Let p_1, l_1, p_2, l_2, p_3, l_3, p_4, l_4, p_5 be the differences of potential from the $+$ lip to S_1, from S_1 to T_1, T_1 to S_2, ... S_4 to T_4, and T_4 to the $-$ lip. Measure these nine differences of potential. We are now ready to make the Mercator chart. We might indeed have done so without these elaborate considerations and measurements, simply by following the rule of my previous article; but the chart so obtained would have infinite contraction at eight points, the points corresponding to S_1, T_1, ... S_4, T_4. This fault is avoided, and a finite chart showing the whole surface on a finite scale in every part is obtained by the following process.

Take a long cylindric tube of thin sheet metal, of the same thickness and conductivity as that of our original surface; and on any circle H round it, mark four points, h_1, h_2, h_3, h_4, at consecutive distances along its circumference proportional respectively to the numbers of the m stream-lines which we find between F_1 and F_2, F_2 and F_3, F_3 and F_4, F_4 and F_1 on the $+$ lip of our original surface. Through h_1, h_2, h_3, h_4 draw lines parallel to the axis of the cylinder.

Let now an electric current equal to the total current which we had from the $+$ lip to the $-$ lip through the original surface be maintained through our present cylinder by a voltaic battery with electrodes applied to places on the cylinder very far distant on the two sides of the circle H. Mark on the cylinder eight circles, K_1, K_2... K_8, at distances consecutively proportional to l_1, p_2, l_2, p_3, l_3, p_4, l_4, and absolutely such that l_1, p_1, &c., are equal to the differences of their potentials from one another in order.

Bore four small holes in the metal between the circles K_1 and K_2, K_3 and K_4, K_5 and K_6, K_7 and K_8 on the parallel straight lines through h_1, h_2, h_3, h_4, respectively. Enlarge these holes and alter their positions, so that the altered stream-lines through h_1, h_2, h_3, h_4 (these points supposed fixed and very distant) shall still be their flux-sheds. While always maintaining this condition, enlarge the holes and alter their positions until the extreme differences of potential in their lips become l_1, l_2, l_3, l_4, and the differences of potential between the lips in succession become p_2, p_3, p_4. In thus continuously changing the holes we might change their shapes arbitrarily; but to fix our ideas, we may suppose them to be always made circular. This makes the problem determinate, except the distance from the circle H of the hole nearest to it, which may be anything we pleased, provided it is very large in proportion to the diameter of the cylinder.

The determinate problem thus proposed is clearly possible, and the solution is clearly unique. It is of a highly transcendental character, viewed as a problem for mathemetical analysis; but an obvious method of "trial and error" gives its solution by electric measurement, with quite a moderate amount of labour if moderate accuracy suffices.

When the holes have been finally adjusted to fulfil our conditions, draw by aid of the voltmeter and movable electrodes, the equipotentials, for p_1 above the greatest potential of lip 1, and for p_5 below the least potential of lip 4; and between these equipotentials, which we shall call f and g, draw n-1 equidifferent equipotentials. Draw the stream-lines, making infinitesimal squares with these according to the rule given above in the present article. It will be found that the number of the stream-lines is m, the same as on our original surface, and the whole number of infinitesimal squares on the cylinder between f and g is $m\ n$. Cut the cylinder through at f and g; cut it open by any stream-line from f to g, and open it out flat. We thus have a Mercator chart bounded by four curves cutting one another at right angles, and divided into $m\ n$ infinitesimal squares, corresponding individually to the $m\ n$ squares into which we divided the original surface by our first electric process. In this chart there are four circular blanks corresponding to the lips 1, 2, 3, 4 of our diagram; and there is exact correspondence of their flux-sheds and neighbouring stream-lines, and of the disturbances, which they produce in the equipotentials, with the analogous features at the lips of the original surface as cut for our process. The solution of this geometrical problem was a necessity for the dynamical problem with which I have been occupied, and this is my excuse for working it out; though it might be considered as devoid of interest in itself.

KELVIN.

THE RECENT ERUPTION OF ETNA.[1]

THE southern flank of Etna has been the site of three consecutive eruptions, remarkable for the diversity of the phenomena they presented.

On March 22, 1883, after several violent shocks of earthquake, the ground was rent open in a N.E. and S.W. direction, almost on the continuation of the big rift formed in the eruption of 1879, and near Monte Concilio a most interesting eruptive apparatus was formed. Very quickly, however, the eruption was arrested, but the eruptive energy had not had sufficient vent, as evidence of which were the frequent shocks which followed it and persisted, until on March 18, 1886, the ground was again split open as a prolongation of the rift of 1883, giving rise to an imposing eruption, during which an enormous quantity of lava was poured forth. This eruption from the very beginning manifested a great explosive force. The fragmentary materials were projected to an extraordinary height from several craterets formed along the rift, most of which, however, soon became quiet and were buried by the ejectamenta of the others, remaining alone the one twin crater now called Monte Gemmellaro. After this eruption the geodynamic phenomena and the volcanic activity at the central crater remained exceedingly feeble up to the last few days, so that this actual eruption did not present any grand display of premonitory phenomena.

On the evening of July 8, at about 10.30, the central crater of Etna began to send up a dense column of vapour, charged with dust, lapilli, and large rock fragments, which rose as an imposing mass with the

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[1] This paper was written in Italian, and sent as a letter to Dr. H. J. Johnston-Lavis, who has kindly translated it for NATURE, as requested by the author.