There is, therefore, no fear of the new Reptile House lacking inhabitants, when ready to receive them next year.

DIFFICULT CASES OF MIMICRY

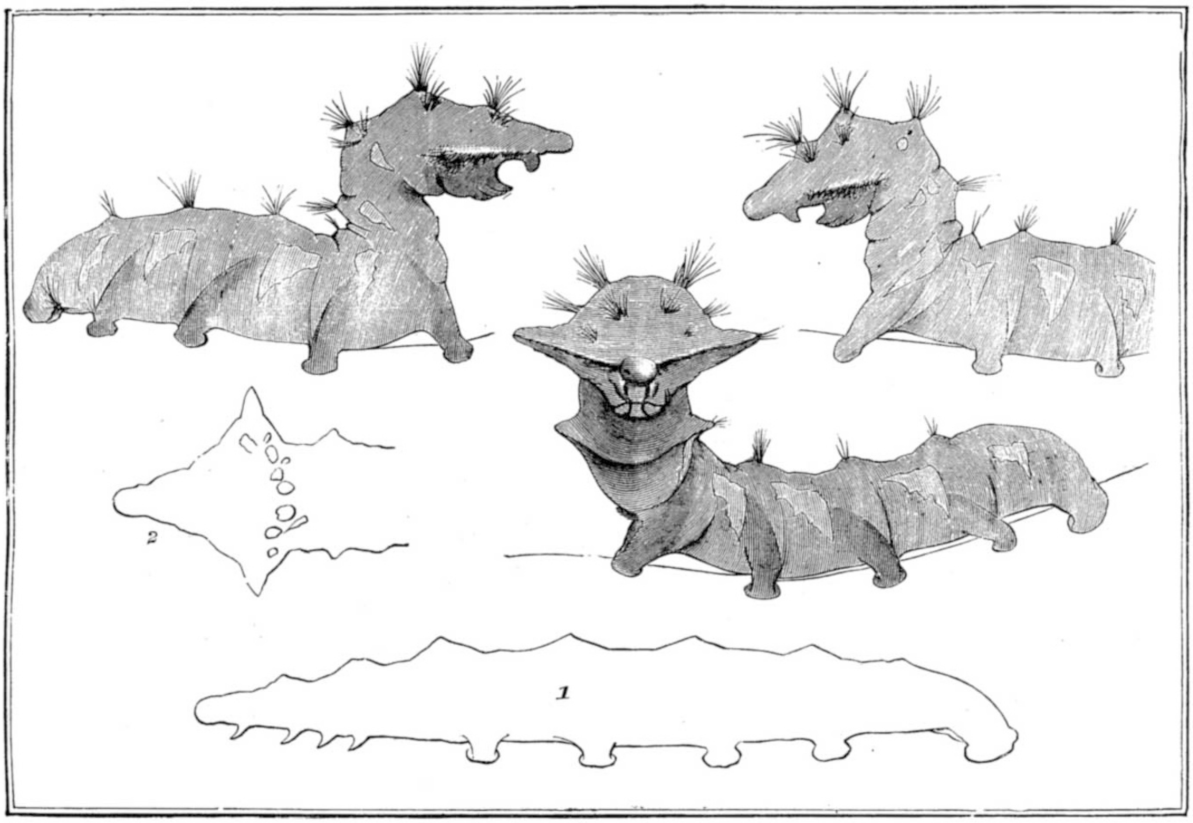
I SEE a notice regarding mimicry and simulation, by Mr. A. R. Wallace, in NATURE, vol. xxvi. p. 86, and beg to forward the case of a caterpillar mimicking a shrew, as a peculiar instance of this curious law.

Here we see the insect unconsciously simulating the very animal that most likely feeds on itself, or at least an insectivorous mammal. Passing through a dense forest near a path, I suddenly came on the caterpillar, at about five feet from the ground, on a stout creeper, and of course mistook it for a shrew. Its remaining, and not running off, induced me to look closer, when I saw the green markings, and at once secured the prize, and, after making a sketch or two, put it in my "hatching" cage; unfortunately, I could not find what it fed on, and after spinning a pale greenish cocoon, it died. The natives did not seem to know it. When moving along, it does so as other caterpillars, as seen in the outline 1, of which 2 is plan of the head. If suddenly disturbed, it at once strikes the peculiar pose, as seen in the sketches, and retains it for some time.

The general colour is a neutral to brown-grey, beautifully marked, and which I have not attempted to imitate; the general appearance is dark, except where the greenish-yellow spots occur. It is the first case I know where a caterpillar mimics a vertebrate animal. The cases are almost innumerable out here, where insects mimic each other and similar or different kinds, or leaves, seeds, flowers, sticks, pieces of grass or clay, &c., &c.; but we see it also in many other cases, not always protective, though invaluable to the animal or the insect. The tiger has one call, when hunting, so like the loud whistle of the Samber (deer) that only an expert and old resident can tell the difference. The deer, if within range, *run to it*, and I have myself shot a Samber at twenty yards that dashed up on my whistling loudly, with a leaf; unfortunately, native shikaries are only too expert at this. Again, the eye and nose lumps of a crocodile are so like lumps of foam that I have often drifted past close to one in my *Rob Roy*, and only found it out by the lump of foam quietly and suddenly *sinking* below the surface of the muddy water. In the case of the tiger the simulation was by sound, to enable it to get food; in that of the crocodile the same end is gained by simulation of appearance, enabling the animal to drift close to prey without alarming it.

S. E. PEAL

Asam, June 25



Caterpillar that simulates a Shrew (full size).

THE WASHBURN CHRONOGRAPH

THE article on the Brussels Chronograph (NATURE, vol. xxvi. p. 107) induces me to send a brief description of the chronograph of this observatory, which may be taken as representing the form usually adopted by the best American makers, Alvan Clark and Sons, Fauth and Co., Stackpole and Brothers, &c. The accompanying engraving gives a good general idea of it. The scale may be obtained by remembering that the iron base plate is 21½ inches by 11½ inches. The barrel is 14 inches long by 7 inches in diameter. The paper used is 23⅛ inches by 13 inches which provides for a lap at the line of junction. There is room for the observations of two hours and forty minutes. The weight employed is fifteen pounds, and usually a double pulley is used to diminish the fall.

The chronograph can be wound while it is going, without affecting its rate. The barrel can be taken out of its Ys if desired, or one end of the barrel can be lifted by a small lever, so that it can be turned around to put on or take off a fresh sheet of paper. In practice several sheets of paper are put on at a time, so that the last one has simply to be removed when it is filled, and the pen-carriage moved back (to the right) to continue the record. This can be done without stopping the chronograph.

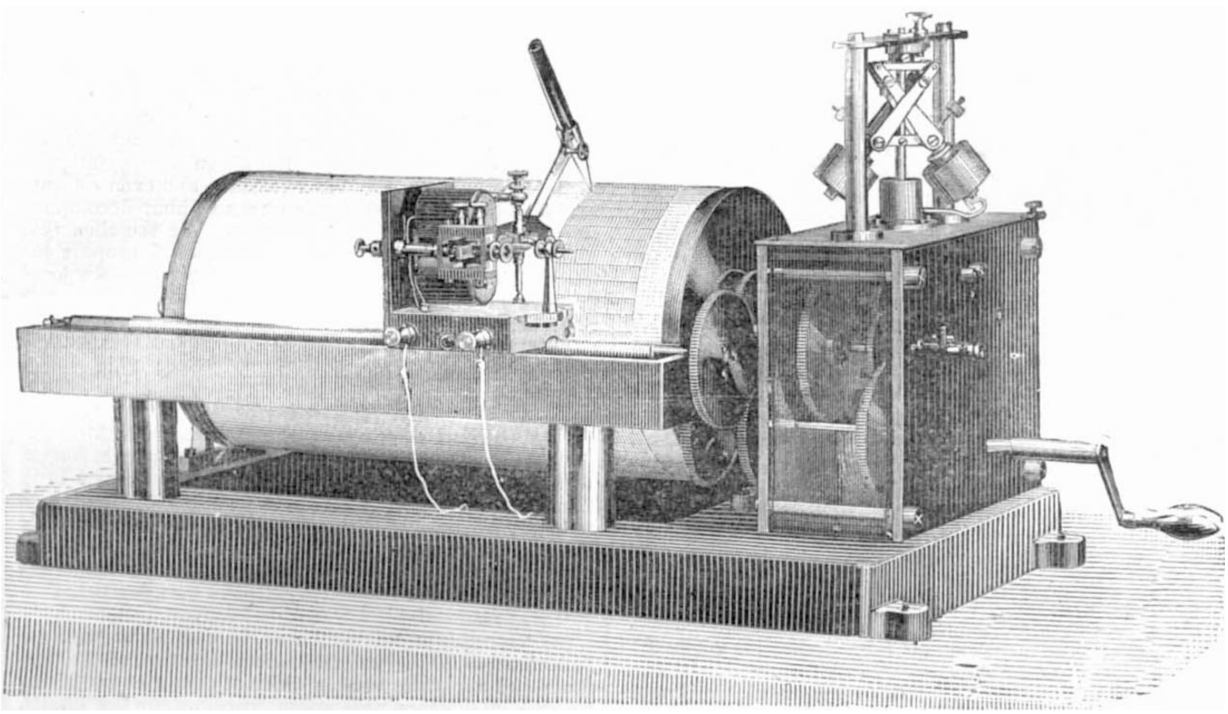
A second of time is 0·36 inches in length, in the usual adjustment. The governor is a double conical pendulum, acted on directly by the weight. It thus tends always to run too fast, as it runs faster and faster, the pendulum bobs fly out, and finally strike the point of a horizontal hook shown in the drawing. This hook is attached to a little cylinder of brass embracing the vertical axis (also shown), and when the hook is touched by the pendulum bob (as it is shown in the cut), the hook and the brass cylinder are carried about the axis through a certain angle. The work thus done diminishes the speed of the pendulum, which falls in towards the axis slightly. In this way the governor and also the barrel rotate alternately a little faster and a little slower than the desired mean rate, but these variations are vanishingly small and of no account whatever in astronomical work. The pendulums strike the hook on the average from sixty to ninety times per minute.

The pen-carriage is nothing but an electromagnet mounted on a frame, which is driven by an endless screw from right to left in the cut. The carriage may also be lifted by the hand and moved in either direction. This is a great convenience in certain kinds of work, such as comparing a number of clocks together. The record for each clock can be separated from that of every other clock by a blank space.

The pen is of glass, filled with a thick ink made according to the following formula which is used at the Naval Observatory. This ink does not freeze in winter weather.

Water	4 fluid ounces.
Alcohol	2 ,,
Concentrated glycerine	1 fluid drachm.
Crystallised Aniline Blue	40 grains.

Filter very thoroughly and draw off for use through a stop-



cock. A common stylo-graphic pen, if held nearly vertical and weighted with a little piece of lead, is nearly as good as the glass pen, and somewhat cleaner.

The signals from the clock and observing key are received through the two flexible wires shown in the cut. These signals can be repeated, by connections to screw-posts, on the pen-carriage.

The whole machine is light and portable. It takes, say, fifteen minutes to move it from one room to another. It can be worked equally well with a break or a make-circuit. Its price is 325·00 dollars. The makers of our chronograph are Fauth and Co., Washington, D.C., but the design is that adopted by the Clarks.

The first *double* conical pendulum of this kind was made by Dr. Henry Draper, and applied to the driving-clock of his photographic telescopes. The first governor on this principle was adopted by Alvan Clark and Sons, for driving the heliostats used in the United States Transit of Venus Expedition of 1874. These governors had, however, only a single pendulum, and not two crossed pendulums, as in the cut. I am induced to send you this brief account of a simple and useful device which has had a thorough trial of 31 years (it was exhibited by G. P. Bond at the Crystal Palace in 1851), which is always satisfactory; which never gets out of order; because it is a standing wonder to us, on this side of the water, why the expensive and complicated double-pen chronographs continue to be made and used in England, and on the Continent. The inclosed sheet, which is selected absolutely at random from a pile of such records, will show the kind of work these machines will do; and all the questions which have been agitated with regard to the relative accuracy of one and two pen-chronographs, seem to me to have been practically settled by the observations made at our principal observatories for a score of years past. I need only mention the longitude campaigns of our Coast Survey, of the Naval Observatory, of the Army Engineers, and the standard work of the Transit circles of Washington and Harvard College, in this connection.

I am sure that it only needs a trial of the form indicated to prove its superiority in every respect for astronomical purposes. All objectors on the score of accuracy, &c., should refer to the *Annals* of the Harvard College Observatory, vol. i., part ii., pp. xxxiv., where they will find what seems a sufficient answer.

EDWARD S. HOLDEN

Washburn Observatory, University of Wisconsin, Madison, June 30

THE LIMIT OF THE LIQUID STATE OF MATTER

THE conditions under which an investigation is carried out often predetermine the conclusions to be drawn from the observations made. That this has been the case with the observations made upon the upper confines of the liquid state, there is now ample evidence to show. When Cagniard de Latour, on heating liquids in sealed tubes, noticed the disappearance of the liquid surface, he came to the conclusion that the liquid state had ceased to be possible, and that the substance had passed into the gaseous state. But Latour had no means of varying the volume of his liquid to observe whether or not increase of pressure might again induce liquefaction. This defect was removed by Dr. Andrews, who constructed the well-known apparatus for varying the volume by means of a screw. And it is to the work performed with this apparatus that the above remark is applied. By two modes of observation Dr. Andrews arrived at the conclusion that the liquid and gaseous states of matter were continuous. The experiments being conducted in transparent glass tubes, the appearance of the contained fluid constituted one mode, and the registration of the pressure constituted the other. *Neither of these methods could by the necessities of the case give any aid in determining the state of matter.* Dr. Andrews's method of demonstrating the continuity, by passing from a lower to a higher temperature under a pressure which prevented the formation of vapour, ensured the homogeneity of the fluid under examination, and precluded the existence of a visible liquid surface; and as liquid and gas are equally transparent, no tidings of the state of the fluid under examination could come to him by observations of its appearance. How did Dr. Andrews tell when his tubes contained liquid? By lowering the pressure till a meniscus was seen. *Then the formation of a meniscus is the only test of the liquid state.* Dr. Andrews then obliterated the only ocular test of the fluid's condition by increasing the pressure, and raised the temperature till on again reducing the pressure no meniscus was formed, showing the fluid to be gaseous, and he then declared that no sudden change of state had occurred—that is to say, that it was impossible to say that the fluid was either liquid or gaseous, but that it had probably passed through an intermediate state. Of course a change of state had taken place, and if we only reflect that the change from cohesion to repulsion is caused by the thermal velocity of the molecules, and not by the number of them in a space, the change should depend upon temperature and not upon pressure.

The characteristic property of the liquid state is then the possession of cohesion sufficient to form a surface, or simply surface tension; and could this property be retained in a visible form at all pressures, the existence of the continuity enunciated by Andrews could be put to a crucial test. By compressing hydrogen over various liquids in which it is insoluble, I was enabled to carry the above proposition into effect, and after several hundreds of experiments, detailed in a paper read before the Royal Society, the conclusion was arrived at that the two states are not more continuous than are the solid and liquid states, but are separated by an isothermal passing through the critical point. In fact by Latour's or Andrews's method, where the liquid was in contact with its own vapour, the critical point is the only place where the direct passage from liquid to gas is visible, but the employment of hydrogen for retaining a free surface enables us to observe the passage at any pressure, and it takes place as suddenly at 200 atmospheres pressure as at the critical pressure. Thus the critical point is the termination of an isothermal line, which is the limit of the liquid state.

As to the other mode employed by Andrews—namely, pressure—continuity of pressure does not prove continuity of state. If it did the continuity of the solid and liquid states could easily be proven. In fact, the irregularities observed by Andrews in the vicinity of the critical point rather lend support to the views that a change of state takes place there.

We may state the change thus:—The cohesion of the liquid state is weakened as the thermal motion increases, till the repulsion is in excess of the attraction, and the gaseous state ensues. The evidence I have collected from capillary phenomenon in the paper above referred to proves this to be the case, and shows that pressure has no effect in altering the occurrence of the phenomenon. Thus we are led to the conclusion, that so far from the liquid and gaseous states of matter being continuous and indistinguishable, the liquid limit or "absolute boiling point" *is the only fixed point among the properties of matter.* The freezing point can be altered by pressure, and besides, many bodies like ethyl alcohol may have no freezing point, probably becoming more and more viscous till absolute zero is reached. But all substances may be made to pass into the gaseous state, and even delicate compounds may be rendered gaseous without decomposition when under sufficient pressure. We see then that this important change of state, for which I propose the name Cohesion Limit, and which till lately was supposed to have no existence, is in reality the only fixed point in the relations of the states of matter, being determined by temperature alone.

J. B. HANNAY

INTERNATIONAL METEOROLOGY

THE second meeting of the International Meteorological Committee took place at Copenhagen, August 1-5 inclusive. All the Members were present, except Prof. Cantoni, who had resigned his seat on the Committee on account of health. Prof. Tacchini was unanimously elected in his place. The following brief account of the more important of their proceedings is in the numerical order in which the respective subjects were discussed:—

It was resolved—

(*a*) To organise an exhibition, in connection with the International Fisheries Exhibition, London, of the methods and apparatus used in different countries for giving weather intelligence and storm warnings to the coasts, and of the instruments, &c., used in the study of ocean meteorology.

(*b*) To issue a circular to all existing organisations, requesting them to supply data as to their condition and operations up to the end of the current year.

(*c*) To request the several institutions to be more precise in the information published by them as to the hour of occurrence of rain and other phenomena.

(*d*) To request all institutions to append to their Daily Bulletins, Monthly Sheets giving the mean results for the month, in the same way as the London Office has done since 1880.

(*e*) To request all institutions to furnish particulars of any stations which may exist in distant localities, especially in the Torrid Zone, South America, and the Islands of the Pacific, at least during the period of the International Polar Observations, and to publish the names of such stations in the Polar Bulletin issued by Prof. Wild.

(*f*) To express approval of the plan proposed by Capt. Hoffmeyer and Dr. Neumayer to publish daily synoptic