the individual. We can accurately compare the rise and fall of the individual and its whole cycle of transformations with that of any of the single series or branches of the same stock which become highly specialized and then degenerated; but, when we attempt to go farther, we meet with similar difficulties to those encountered in tracing the progress of types and orders. The radical and persistent types are still present, and teach us, that, as long as they exist sufficiently unchanged, new types are a possibility. We have traced many of these in the two orders, and have found that they change and become more complicated, and that probably a purely persistent or entirely unprogressive type does not exist among the fossil Cephalopoda. The most celebrated example of unchanging persistency has been, and is now supposed to be, the modern Nautilus. We think, however, that when our observations are fully published, it will become evident that the similarities of this shell to some of the Cambrian coiled forms — which have caused Barrande and others to suppose that it might be transferred to the Cambrian fauna without creating confusion — belong to the category known to the naturalist as representation; that is, similarities of form, and even of structure, in the adults, but with young having entirely distinct earlier stages of development, and belonging to distinct genetic series. Still, comparative unprogression or persistency is common in all radicals; and they force us to recognize the fact, that the orders could have produced new series, perhaps even in the cretaceous, if it had not been for the direct unfavorable action of the physical changes which then took place, so far as we now know, over the whole earth.

Thus, in making our comparisons between the life of the individual and the life of the group, we cannot say that the causes which produced old age and those which in time produced retrogressive types were identical: we can only say, that they produced similar effects in changing the structures of the individual and of the progressive types, and were therefore unfavorable to the farther development and complication of these types. In their effects they were certainly similar; but in themselves they might have been, and probably were, quite different, agreeing only in belonging to that class of causes which we distinguish as pathological, or those whose nature can be generally summed up as essentially unfavorable to the progress, and even to the existence, of the organization.

In order to understand the meaning of these evidently degraded structures, we must turn back to our first remarks upon the order. The apertures and forms of the retrogressive shells all show that they were exceptional, that they had neither well-developed arms for crawling nor powerful pipes for swimming; that, in other words, they could not have carried their spires in any of the ordinary ways. Their habitats, therefore, must have been more or less sedentary; and like the sedentary Gastropoda, as compared with the locomotive forms, they presented degeneration of the form and structure of their higher and more complicated ancestors. Their habitats did not require the progressive grades of structure, and they dispensed with or lost them; and in many cases this took place very rapidly. This retrogression was in itself unfavorable to a prolonged existence; and the geratologous nature of the changes tells the same story, so that we can attribute their extinction to the unfavorable nature of their new habitats, and also call them pathological types without fear of misrepresenting their true relations to other forms.

We have necessarily avoided even allusions to some of the most important confirmatory facts; but we hope our effort will at least show that the theory advanced is a reasonable one, and that the fossil Cephalopoda are worthy of the attention of even the most enthusiastic of the young disciples of the modern school of embryology. The theories of this school will have to stand tests of which they have now not even a faint idea, and it is to be hoped they will not long neglect the precaution of knowing also the past history of the types they often so incautiously and confidently handle.

Alpheus Hyatt.

THE MOTION OF WAVES OF COLD IN THE UNITED STATES.

The chief signal-officer of the army desiring to learn the progress of waves of cold across the United States, an investigation has been undertaken in order to determine the appearance of such waves, their approximate velocity, and general line of advance. It would seem, at first sight, as though the problem might be solved by drawing isotherms (i.e., lines through points at the same temperature) on consecutive days, from simultaneous observations over the whole country. If, then, there were a progressive motion, the study of these lines would show it. It has been found, however, that a cold wave does not travel in a well-defined closed curve; and, more than that, the gradual increase of temperature, as the curves approach the south, masks and often obliterates the motion we seek to find. Again: such waves are frequently divided, then united, thus by the loss of their identity making it impossible to trace them for a long period. One of the simplest methods of procedure in an investigation of this nature would be the projection of the observations of temperature in curves, one for each station, and then studying the fluctuations from station to station. This was done by Professor Elias Loomis, in his ninth paper, in which he investigated the motion of waves of high and low pressure.

An investigation of this kind, a short time since, gave 19.8 days for the mean interval of time of sixteen waves, moving from St. Michael's, Alaska, to Turuchansk, Siberia, along the sixty-fifth parallel, or an approximate mean velocity of 15.8 miles per hour. Such a determination, however, cannot be regarded as entirely satisfactory, because it simply takes into account a series of stations lying in an east and west direction.

In order to extend the investigation to a large number of stations, we may take daily 'departures' from the monthly mean, and, projecting these upon charts, determine the character of the fluctuations over a large area. In practice, however, this method fails, for the reason that the fluctuations diminish toward southerly latitudes, thus masking the progressive motion.

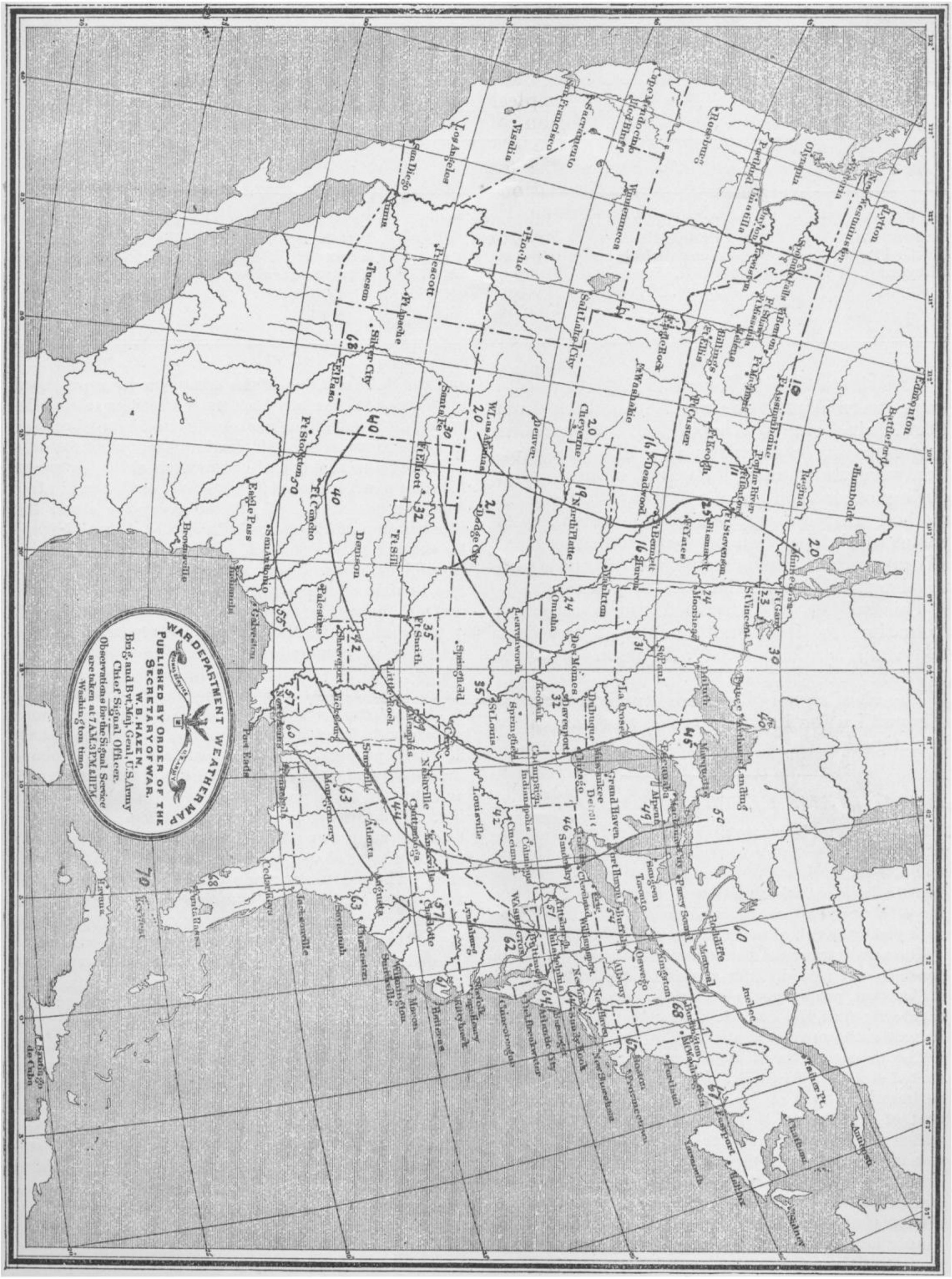
The following method has been adopted for obviating the latter difficulty. We may consider, that if a cold wave advance in any direction, without disturbance from dense clouds or mountain ridges, it will carry minimum temperatures to successive stations in its path; the intervals of time between the passage of such a minimum over any one station taken as a starting-point, and others in the line of progress, gradually increasing. By determining, then, the time of passage of a minimum across each station in a country, and charting these times, we can ascertain both the line of advance and the velocity of the wave.

In order to obtain the time of passage of a minimum temperature over a station, where a series of observations has been made each day, it is essential first to eliminate the effect of diurnal range. This may be done by obtaining the residuals for each observation of a month, taken at any hour; then, determining the approximate time of passage, we can, by examining the successive residuals near that time, obtain the time sought. An effort has been made to apply the above principles to the observations of the U. S. signal-service, taken five times each day during November, 1881, at forty-two selected stations. In this month there were four prominent cold waves; and the following table gives the interval of time which elapsed between the passage of each of these over Fort Dunvegan, North-west territory, and each of the forty-two stations. These figures are inserted exactly as determined from the observations. It was found, however, that many of the apparent discrepancies in a progressive law of motion were due to the appearance of clouds at the time of an observation, thus throwing the minimum forward or back four and even eight hours. Blanks indicate that the minimum could not be determined satisfactorily.

Cold waves, I., II., III., and IV., of November, 1881.

Station.	Hours between Fort Dunvegan and stations in U. S.				
	I.	II.	III.	IV.	Mean.
Alpena, Mich.	48	32	52	64	49
Bismarck, Dak.	24	12	16	48	25
Boston, Mass.	64	52	60	72	62
Brownsville, Tex.	48	64	32	64	52
Buffalo, N.Y.	36	56	48	76	54
Burlington, Vt.	64	–	–	72	68
Cape May, N.J.	48	72	64	72	64
Charlotte, N.C.	56	48	52	72	57
Chattanooga, Tenn.	32	48	40	56	44
Cheyenne, Wyo.	–	–	12	28	20
Cincinnati, O.	32	28	52	56	42
Concho, Tex.	–	–	32	48	40
Davenport, Io.	24	24	32	48	32
Deadwood, Dak.	–	0	8	40	16
Dodge City, Kan.	32	8	12	32	21
Eastport, Me.	72	56	64	76	67
El Paso, Tex.	80	72	56	64	68
Fort Assinaboine, Mont.	24	0	— 8	24	10
Fort Buford, Mont.	20	0	—16	40	11
Fort Elliott, Tex.	32	16	32	48	32
Fort Gibson, Ind. Ter.	32	24	28	56	35
Galveston, Tex.	72	48	48	52	55
Huron, Dak.	–	8	8	32	16
Key West, Fla.	64	–	–	76	70
Kitty Hawk, N.C.	56	56	56	76	61
Marquette, Mich.	40	48	40	52	45
Memphis, Tenn.	32	24	48	52	39
Montgomery, Ala.	56	–	56	76	63
Moorhead, Minn.	24	24	0	48	24
New Orleans, La.	–	48	52	72	57
North Platte, Neb.	–	8	16	32	19
New York, N.Y.	48	72	56	80	64
Omaha, Neb.	–	8	24	40	24
Pittsburg, Penn.	52	56	48	48	51
Punta Rassa, Fla.	48	–	84	72	68
St. Louis, Mo.	32	24	32	52	35
St. Paul, Minn.	24	24	36	40	31
St. Vincent, Minn.	24	16	24	28	23
Savannah, Ga.	52	72	56	72	63
Shreveport, La.	–	–	32	52	42
Toledo, O.	28	30	52	76	46
Washington, D.C.	56	48	72	72	62

Projecting the mean interval for the four waves upon a chart (see accompanying plate).



MOTION OF WAVES OF COLD, NOVEMBER, 1881. THE RATE OF MOTION IS GIVEN IN HOURS FROM FT. DUNVEGAN, B.C.

and taking Fort Assinaboine as a starting-point, we obtain the following lines of advance: —

HOURS FROM FORT ASSINABOINE.

10.	20.	30.	40.	50.
St. Vincent, Minn.	Duluth, Minn.	Marquette, Mich.	Erie, Penn.	Rochester, N.Y.
Huron, Dak.	St. Paul, Minn.	Milwaukee, Wis.	Pittsburg, Penn.	Washington, D.C.
North Platte, Neb.	Leavenworth, Kan.	Chicago, Ill.	Knoxville, Tenn.	Charlotte, N.C.
Cheyenne, Wyo.	Fort Sill, Tex.	Memphis, Tenn.	Vicksburg, Miss.	Augusta, Ga.
	Santa Fé, New Mex.	Denison, Tex.	Brackettville, Tex.	Mobile, Ala.
		Concho, Tex.		

This shows that in November, 1881, the cold waves were about two days in travelling from Fort Assinaboine to Washington. It would be an interesting comparison if a like investigation were undertaken for waves of heat, also, during other months of the year. A similar method may be applied to the advance of waves of high and low pressure, with the great advantage that clouds would not interfere with the determination of the time of passage.

This subject has attracted much attention from time to time, and recently it has been taken up by Mr. A. N. Pearson of India (*Nature*, Aug. 9, 1883).

The chief signal-officer has kindly permitted this publication in advance of a more extended investigation. H. A. HAZEN.

TISSANDIER'S ELECTRIC BALLOON.[1] — I.

IN describing recently the new hydrogen-gas apparatus which we had constructed in our workrooms at Paris-Auteuil, we mentioned that the governable electric balloon, which has been in preparation since the electrical exposition, was ready for trial. This took place the 8th of last October.

The arrangement of the controllable electric balloon consists of three distinct pieces of apparatus, — the air-balloon, properly so called; the gas apparatus to inflate it; and the electric motor to supply freedom of motion by means of a screw.

The construction of an elongated aerial ship presented serious difficulties. We were aided by two experiments, — that of Mr. Henri Giffard in 1852, and that of Mr. Dupuy de Lôme in 1872. In the model which we tried at the time of the electrical exposition, we arranged for the suspension of the little boat a low rod, running longitudina similar to that of the air steamship of Mr. Giffard. We afterward concluded that it would be better to place the screw behind a large parallelopiped-shaped boat, high enough to protect the propeller against the danger of a shock on descent. The boat, in this case, is connected to the balloon by suspension-cords running obliquely; and the deformations of the arrangement are escaped by means of a flexible shaft fixed at either side of the balloon. The balloon was constructed by my brother, in the rooms of Mr. H. Lachambre, to whom was intrusted the making of the new air-ship. A model 15 cubic metres in capacity was first made; and, after studying the action of this in a captive state, the construction of the large balloon (fig. 1) was begun. Its shape was like that of Mr. Giffard's and Mr. De Lôme's balloons: it was 28 metres long, and 9.2 metres in diameter through the middle. On its lower surface, there is a cone with an automatic valve: it is made of a thin cloth, rendered impermeable by a new varnish prepared by Mr. Arnoul of Saint-Ouen-l'Anmône. The capacity of the balloon is 1,060 cubic metres.

The netting over the balloon is formed of ribbons woven with longitudinal spindles, which keep them in their proper geometric positions. The ribbons thus easily adapt themselves to the inflated material, and do not form projections, as do the meshes of a net. The netting is connected on the sides of the balloon with two flexible shafts, which perfectly conform to its shape, passing along the centre of each side. The shafts are made of thin walnut laths fitted with bamboo: they are connected by silk belts. At the lower end of the netting are intersecting rods, at the ends of which are twenty suspension-ropes connected in groups of five to the four upper corners of the car. This latter is in the form of a cage made of bundles of bamboo rods, strengthened by cords and threads of copper covered with gutta-percha. The lower part is made of walnut cross-pieces, which support the willow basket. The suspension-ropes entirely cover the boat: they are woven into the basket, being previously sheathed in caoutchouc, which, in case of accident, protects them from the acid liquid centained in the boat to feed the batteries. The suspension-ropes are connected horizontally by rigging about two metres above the boat. The guide and anchor ropes are attached to this rigging, which also serves to equally distribute the traction during the descent. The rudder, a broad surface of unvarnished silk supported by bamboo, is also arranged behind. The weights of the different parts are as follows: —

[1] Translated from *La Nature*.