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Contents.

(Illustrated articles are marked with an asterisk.)

NEW DISCOVERIES CONCERNING TERRESTRIAL HEAT.

The older treatises and text books on physical geography state that the temperature of the earth's crust, at the limit where the yearly oscillations of summer heat and winter cold are no more perceptible, is everywhere equal to the mean temperature of the locality. This statement is only approximate to the truth, and sufficed as long as the investigations were made in the rough manner which distinguished many of the experiments and observations of the beginning of this century. The example, however, of several conscientious observers of that time who applied the most scrutinous criticism in regard to the results obtained, has later influenced the great majority of the investigators of the present day. No longer content with approximations, they wish to come to positive numerical data; and among other corrections which were the result of the modern refined methods of experimenting, are those in regard to the relation of the temperature of the earth's crust to the mean temperature of the spot.

Considering the matter *a priori*, from a theoretical point of view, it is evident that if the interior of the earth has a temperature of its own far above that of the surrounding space, which is a fact beyond dispute, this heat must influence its surface, and raise its temperature beyond that produced by the solar radiation alone; in fact, the heat of the earth's surface must be equal to the sum of the terrestrial and solar thermic intensities; and if this be so, the temperature of all portions below its surface, beyond solar influence, must be somewhat higher than the mean temperature of the localities.

This is now found to be actually the case where the observations have been made with proper scrutiny and care. Alexander von Humboldt was, in 1817, the first who gave a clear and comprehensive view of the distribution of solar heat on the surface of the earth, by his ingenious method of drawing lines of equal mean temperature over the terrestrial maps; these are called isothermic lines, and they were founded on long continued observations in sixty different localities. It is to the great credit of that glorious investigator that, after all the later labors and corrections attempted during the last half century, no essential change has been made in these curves as first laid down by him. The latest isothermic maps, published by Dove in 1865, were founded on the observations made on 900 different localities.

Quite recently such lines have been drawn representing the distribution of terrestrial heat under the earth's surface, beyond the solar influence; these are called isogeothermic lines, and, of course, cannot be drawn across oceans, but only on the land. When drawing both the isothermic and isogeothermic lines on the same map, considerable deviations are perceived, contrary to the thus far established ideas of their coincidence. So it is found that, near the tropics, or where the yearly mean temperature is from 60° to 70°, or in other words, between the isothermic lines of 60° and 70°, the isogeothermic lines coincide nearly with the isothermic lines, having only slight local deviations; that between the tropics where the mean temperature is from 75° to 80°, the temperature of the corresponding isogeothermic lines is slightly lower; but that beyond the Tropic of Cancer in the northern hemisphere, the isogeothermic lines of the same temperature lay considerably north of the isothermic lines, or in other words that the temperature of the isogeotherm is considerably above that of the isotherm for the same spot. So in the United States, the yearly isothermic line of 50° runs through Philadelphia due west, and, after crossing the Rocky Mountains, continues in a northwestern course through Salem, Oregon, to our Pacific coast, while the isogeothermic line of the same temperature runs through Boston and Chicago, where the isotherm is only about 45°. In Europe and Northern Asia, the difference is still more striking; however, around the Mediterranean sea, there is only a slight difference, while in Ireland a perfect coincidence of the isothermic and isogeothermic lines takes place, undoubtedly due to the Gulf stream, raising the temperature of the air to that of the terrestrial heat. In Germany, on the contrary, and especially in Russia, the differences are very great, being as much as 9° or 10°; that is, while the yearly mean temperature of the air is, for instance, in Moscow, 38°, the temperature of the earth is 46°, while in Tobolsk, Siberia, where the mean temperature of the air is 29°, the temperature of the soil, at a depth whereto the winter frosts and summer heat do not penetrate, is 41°.

It is scarcely necessary to mention that these data constitute a most important contribution to the right understanding of many otherwise obscure facts. Our elevated mountain tops have a low temperature, not because they reflect solar rays to all sides, but because they have lost terrestrial heat by radiation long ago; and their interior temperature has descended so low that the solar rays cannot impart heat sufficient to reach the melting point of the snow. So Schlagintweit found that the mean temperature at a hight of 10,400 feet on the side of one of the peaks of the Great Glockner in the Alps was 20° Fahr.; but the temperature of the ground below the influence of solar heat was 32°. Lower down along those same mountains, where the temperature of the ground is 20° higher, the mean temperature of the air is also 20° higher, and is, in this way, raised above the freezing point by the addition of terrestrial heat. This is in fact the case everywhere on our earth's surface; and, if this internal heat were withdrawn, the whole terrestrial surface would be changed to the same condition as the lunar surface, on which the intense cold is simply a result of the absence of internal heat, lost by radiation ages ago in the same way as our mountain tops have lost it, even between the tropics, and are covered with perpetual snow. Our highly elevated plateaux have not suffered such a loss, being less exposed to loss by radiation than the more isolated mountain peaks and ranges, while the moon, by being 50 times smaller than the earth and not protected by a non-conducting atmosphere, has lost the greater portion of its own internal heat long ago.

DRAWINGS FOR THE PATENT OFFICE.

The rules of the Patent Office are now very strict in regard to the character of drawings furnished for patents. They are required to be done on "Bristol board," in India ink, size of sheet 10×15 inches, one inch margin, as few lines as possible. All lines must be clean, sharp and solid, not too fine nor crowded. Every line and letter must be absolutely black. Shading to be very sparingly used, and line shading alone permitted, brush shading and colors being wholly excluded. The light is always supposed to come from the upper left hand corner. There are a variety of other regulations about the lettering and placing on of titles, all of which are strictly enforced. The reason why the Patent Office is so very particular, as to the mode in which drawings are presented, is to secure facility and legibility in their publication. The drawings are now reproduced and printed by the photo-lithograph process. This involves, in the first place, the production of a perfect photographic glass negative from the drawing, and the clearer, blacker the lines of the drawing, of course the better will be the negative and the resulting prints. From the negative a print in chromatized gelatin, on paper, is made, which print is transferred to stone, then inked and printed in the press like all lithographs.

At present the Patent Office produces three negatives, of different sizes, from each drawing, and three different editions of the prints are issued, one of very small size for the *Official Gazette*, one of medium size for bound volumes of patents, and one of large size for attachment to the patents when issued.

LACK OF INTEREST IN ENGLAND FOR THE VIENNA EXPOSITION.

It seems that Americans are by no means the only people who are lacking in interest as participators in the Vienna Exposition. The *London Standard*, of a recent date, contains quite a lengthy communication from a correspondent, in which we find the following:

"Not one inventor or owner of special goods has ever patented his goods in Austria. When his patents are infringed by their being copied, the Austrian Courts invariably decide so as to cancel the patent, and always favor piracy. * * * The experience of the Paris Exposition to inventors was one of universal disaster, on account of the very unjust French laws on patents and trade marks, with which it is impossible for exhibitors to comply. In the windows of thousands of shops in Paris and Vienna you see both English and American inventions that were copied at the Exposition in Paris, and the inventors and manufacturers have been astonished to find their inventions patented by Frenchmen and other continental people before the inventors took their patents. The inventors rested under their exposition protection certificates, and just at the close of the Paris Exposition they took their patents. Many of them, soon after the Exposition was closed, found their goods being manufactured by the French, and when the real inventor came to demand his rights, the Frenchman showed his patent to be several months the oldest."

The letter then goes on to say that the Austrians are pursuing a similar course, and the law of the country, as now enacted, "is only an entanglement and deception, for under it no foreigner has ever succeeded, no matter how valuable his invention or how simple his case. * * Under the Austria patent law there is no provision by which a case can be completed, and the infringer can keep the case open during the entire life of the patent."

The writer states that but a short time since an attempt was made in Vienna to palm off inferior cutlery upon him as the manufacture of the Sheffield "Rodgers," which, on close examination, he found to be marked "Rodger" with the "s" left out. Owners of military goods are specially cautioned not to exhibit, as neither Austrian, German nor Russian laws afford the least protection, while it is a fact that the Austrian Minister of War has declined to exhibit Austrian war material.

A strong protest against the course of officials of the English Government, in advising inventors and manufacturers to contribute to the Vienna Exhibition, concludes the letter.

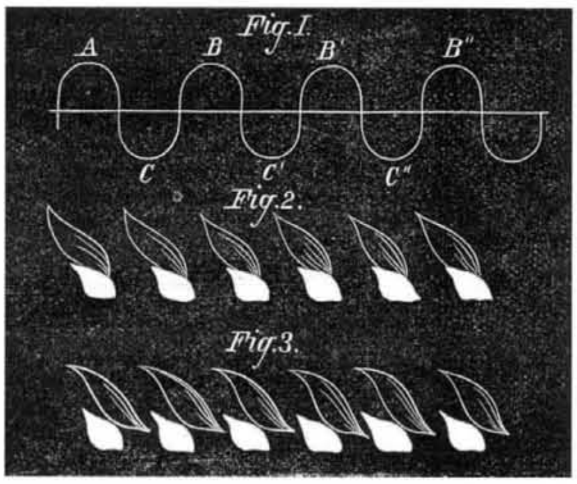
Our readers will recognize the above as confirming the views heretofore expressed by us on the subject. England, we learn, has appropriated but 6,000 pounds sterling to meet the expenses of adequate representation, but some of the papers are calling for a larger sum. It is not likely that a further amount will be forthcoming when the true state of the case is fully brought to the notice of the English people and Government. We trust that our next Congress will follow a similar course, and withhold all appropriations for the Exposition until the oppressive laws of Austria are modified or repealed.

THE DETERMINATION OF HIGH TEMPERATURES BY SOUND.

At a recent meeting of the Lyceum of Natural History in this city, Professor Mayer, of the Stevens Institute of Technology, delivered an interesting discourse upon the determination of high temperatures in furnaces by sounds; describing some original researches of his own, and illustrating his remarks by several effective experiments. In order to understand Professor Mayer's conclusions it is necessary to briefly review the laws of vibrations in elastic media. If a tuning fork be set in motion, its vibrations are transmitted to the air, and the latter vibrates in unison, making the same number of movements per second, whether 500 or 50,000. To comprehend the reason, said the speaker, imagine a sphere of delicate membrane containing air of the same elasticity as that which surrounds it. Suppose this sphere to contract and expand, say one hundred times per second; for each expansion there will be a corresponding condensation of the shell of air next to the surface of the globe; the air being elastic, this condensation is transmitted to the shell of air which envelopes the first shell, thence to another beyond, and so on. Conversely, if the sphere contract, a rarefaction of its immediate envelope of air takes place, which rarefaction is also transmitted outwards, each succeeding shell diminishing in density in turn. These motions, of course, are mere undulations, similar to waves of water, or of light in its passage through ether, the air taking up the form of the vibrations, transmitting it to the ear, whence it passes to the brain and is perceived.

A tuning fork, when vibrated in regular motion, leaves, when its point is drawn over the surface of a piece of smoked glass, a sinuous curve. This curve is a symbol of the condition of the air, and from it, if highly magnified and suitably divided, formulæ can be deduced. Suppose this sinuous line to be as represented in Fig. 1, and bisected by the horizontal line. Then the curves A, B, B', etc., above the line, are those of condensation, while those C, C', C'' are curves of rarefaction. Now, if we could physically see the particles at the points A and B, in the air, we should see them swing as it were together, while, if we compared those at A and C, we should see them move in opposite directions to each other. We thus might detect the particular phase of vibration surrounding sounding bodies. A wave length is that length of air which embraces all phases of vibration when a sound traverses it. To prove the above experimentally, two tuning forks of precisely the same note may be used. If one fork be sounded and then stopped, the other will continue its vibrations, being set in motion by the air. If now fork 1 be placed at any point to represent A in our Fig. 1, and fork 2 at a point corresponding to B, and if we vibrate fork 1, we shall find that similar prongs in both forks vibrate together. That is, while the right hand prong of fork 1, moves to right, the same prong in fork 1 will move in the same direction. But if we place fork 2 at C in the opposite phase of the wave, then opposite prongs will vibrate, or the right hand prong of fork 2 will move in unison with that on the left of fork 1, and *vice versâ*. If we could arrange a revolving mirror to reflect beams of light thrown from small mirrors on the prongs, we should find in the first case two curves side by side, like rails on a track; but in the second instance, the curves would be directly opposite to each other.

Professor Mayer then proceeded to explain the apparatus which he had provided for actually observing the above motions in the air. It consisted of an organ pipe, in the center of which was a hole closed by a membrane. Over the latter a small box was placed, into which gas entered through a pipe and leading out of the box was another tube terminating in a small flame. The air in the organ pipe, the medium in the tube, the lecturer stated, and the membrane will vibrate together, and the flame will be caused to jump up and down at the rate of 256 vibrations per second. If while the flame is at rest, we look at its reflection in a revolving mirror, it will appear as a band of light. But if the note of the organ pipe be sounded, the air in the same will cause the membrane to vibrate, this motion will be transmitted to the flame, the image of which will now not be a band, but a series of serrations like saw teeth. The Professor then showed the experiment very clearly and satisfactorily. Now, he continued, let us bear in mind that these teeth in the mirror are the vibrations of the point A in Fig. 1. Here is a resonator, a metal globe with a large opening at one pole and a smaller one at the other. It was invented by Professor Helmholtz, of Germany, and will resound to but a single note. Suppose this resonator to be connected with a separate flame by means of a tube containing a membrane, and that this second flame be placed directly beside that first described. If the resonator be held at a distance of a wave length from the organ or the vibrations of A—if, for instance, we hold the resonator at the point B—the two flames will vibrate together, and their reflections in the mirror will be coincident; but if the resonator be placed at point C', moving it further from



A and beyond B, the serrations of its flame will lie between those of the flame from the organ. Moving the resonator still further along to B', the flames will again coincide. Consequently, if we place the resonator as near the organ as possible, and then obtain a coincidence of flames, we shall have determined a wave length which we can actually measure; taking the distance between the organ or point A to resonator or point B for one wave, B' for two waves, and so on. Again, if we carry the resonator one half the distance between A and B, or to C, we shall have the flames intersecting, and the space between organ and resonator will be one half a wave length. To show this fact experimentally, Professor Mayer attached a tube to the small opening in the resonator, and arranged it in connection with a box, in which was a membrane to make a second flame beside the organ flame. The tube measured one meter and a fraction, that being the wave length of the organ as previously determined by the lecturer. The organ being sounded, the flames appeared coincident, as in Fig. 2. The resonator tube was then lengthened half a wave's length, and the flames appeared as in Fig. 3. This was explained very clearly by the fact that, the resonator pipe being the longer of the two, vibrations passing through it would be retarded, and therefore take more time to meet the flame. Professor Mayer went into the elucidation of this phenomenon at some length, so that we are obliged through want of space to omit the process of reasoning by which the above conclusion was attained. Having discovered how to measure a wave length, it is easy to determine a wave surface. A wave surface covers those points around a surrounding body where the air has the same phase of vibration. Now, if instead of holding the resonator still, it be moved around the organ, always keeping the reflected flames in the same relative position, it is evident that all the points through which the resonator passes are positions of the wave surface, which will be found to be an ellipsoid, of which the ends (top and bottom) of the organ pipe are foci. If air is heated, the velocity of sound transmitted therein is increased, its wave length is lengthened. The velocity of sound is determined by the formula:

v (velocity of sound) = 333 (meters at zero C.) $\sqrt{1 + \cdot 00367t}$, t being the temperature.

The decimal ·00367 is the coefficient of the expansion of air under a constant pressure.

The Professor then proceeded to explain the practical application of his discovery. He placed in the furnace a platinum tube, say thirteen meters in length, connected with a resonator. The tube is coiled in convenient form, and is arranged so that the heated air within it does not leave the furnace. Outside an organ pipe is placed, sounding the note UT_4 of 512 vibrations per second. Now if the temperature of the air in the furnace, and also of that around the organ be 0° C., it is plain that the flames acted upon by vibrations from organ and resonator will coincide and the wave lengths are equal. But the temperature in the furnace is becoming increased, and the wave lengths in the metal tube are lengthening, consequently the flames no longer coincide—one set is slowly moving. The furnace is heated a certain number of degrees; another coincidence takes place. Then, if the heat be still increased to 820°, the air in the tube will be expanded to four times its first volume (at 0° C.), and the wave lengths will be doubled. That is, if twenty wave lengths were first contained in the furnace-tube, now but ten will be found; or in other words, ten successive coincidences of flames will have been noted. Therefore, if we count the coincidences and measure the fractions, by the aid of a micrometer, until the flames become stationary, we have exactly the quantity of heat in the furnace which we may determine to 10 degrees Cent.

Professor Mayer concluded his lecture by giving the following formula, in which t = temperature outside the furnace; t' = temperature of air in furnace; v' = velocity of sound corresponding to temperature t'; l = number of wave engths at temperature t; d = displacement at $t'-t$, $l-d$ = wave lengths in tubes at t'. From (1) and the formula $v' = 333\sqrt{1 + \cdot 00367t'}$, the formula

$$t' = \left(\frac{v\,l}{20\cdot 16\,(l-d)}\right)^2 - 272\cdot 48 \qquad (2)$$

which gives the temperature. Professor Mayer proposes to develop the theory to its fullest extent, and also to experiment as to the best modes of applying it, in order to render it useful in many industrial pursuits.

CHOOSING AN OCCUPATION FOR A YOUNG MAN.

If a boy is constantly whittling sticks, fond parents say that he has "marked constructive ability;" or if he can whistle one or two notes of an air correctly, "he will be a great musician;" or if he can draw with reasonable accuracy, "that child is a born artist." If these presumed or assumed evidences of genius are acted upon, and those in authority seize arbitrarily upon the young man and force him into a trade or art, on the ground of their being better able to judge than he is for himself, the possibility, nay, the probability is that he will turn out a Harold Skimpole, of whose class the world has far too many already. He sketches a little; tinkers a little with tools; drums a little on a piano; and in time falls into line with the rank and file of the noble army of incompetents and revilers of fate. He may protest with all his strength in his earlier years that he is not fitted for the occupation chosen for him; he may demand to be transferred into some other calling that his soul hungers after; it is all in vain if some one in authority, be the same parent or guardian, says: "Your profession has been chosen for you and you must follow it; your elders have had more experience than you and can tell better, by reason of it, what you need;" and so the young man is condemned for life. He goes moping all his days and refuses to be comforted, simply because his heart is not in what he is doing. He is out of his element; he disturbs the machinery of the world; he is as bad as a broken wheel on a train; everything with which he is connected goes halting and bumping and jumping because of him. If he does not reach the highest place in his profession, his elders, with astonishing inconsistency, upbraid him and say that he has no ambition, no energy, no desire to succeed; when the simple fact is that he has no qualification to command success.

"How *can* I know about a thing I dunno nothing about?" exclaimed an exasperated and badgered witness in the box. "How can I have inspiration to preach when I am always thinking about machinery; or paint, when I am always wishing to preach, when divine truths fire my heart to go forth and turn men from the error of their ways?" A man out of his place says these things at heart if not in actual words, and his whole life is embittered by the blindness of his elders who would not see, but claimed the right, because they had the power, to squeeze a human heart into the corner they thought it should fill. For it is crushing the heart out of the man to make the boy travel in a circuit he is unfitted for. All his energies and ambition reach forward to one goal; all his nature is bent upon that one thing, and because you cannot see as he sees, oh parent or guardian! because you are not him and do not love it as he loves it, you destroy his future power. It is a serious responsibility to assume: to direct the calling in life a young man shall follow, an action to be taken only upon great deliberation. Whatever he undertakes he must stick to. In the early years of his life, when the world expects but little of him, he must study or work hard to be qualified for the later ones, when it exacts a great deal. He cannot be always young; he cannot have two youths; he must give his young life, his bright hopes, his aspirations to the work in hand. What if his heart is far from it and he is longing with all his strength for that other calling which you have put out of his reach? You might as well go out into the world when he is of age, as some foreign parents do, and select a wife for him. With equal consistency you might say: "I have had more experience in the world than you; you can live happier with this woman than one of your own choosing," yet this is an action you would shrink from committing. Is not a man's profession the same in degree as his wife? Does he not live by it as with her? Are not all his hopes centered upon it, his happiness bound up in it? Is not the contentment which springs from a congenial occupation in some respect the same as connubial affection? It certainly is; for unless a man love the work to which he applies himself his labor is of no force, of little worth. He is half hearted, simply because he lacks the inspiration which enthusiasm lends to every occupation, even the humblest. The shoemaker who likes to make shoes makes better ones than the convict enforced to do so, and the same is true of every work under the sun.

Let every young man choose his own occupation in life. In any event, let him choose it. If he has no particular bias or bent, let him find something to do, all the same. A parent or guardian may say: "My son, it appears to me that your walk in life lies this way," and point out the advantages likely to accrue or that can be absolutely given him if he adopts the suggestion, but this is all that should be done. If he revolts, or objects and says "I cannot," do not retort with "you shall, or you are no son of mine." You will live to repent it. You will wear sackcloth and ashes for it. Humble yourself a little before you overthrow him. A boy has a right to his choice. He has an inalienable natural right—yea, a constitutional one—to "life, liberty, and the pursuit of happiness." Words mean something, and the choice of an occupation embraces all of these. How can you force a boy into a workshop to learn a trade when he has no aptness whatever for it, except that he has been seen to make boats, or kites, things that a child naturally amuses himself by? You cannot; you have no right. Consider the matter somewhat. If he is a tractable, affectionate, and docile boy, so much the worse; you use his natural affection as a vehicle to work your will with him, not seeing that in after life he will become a listless, moody, inefficient laborer in the vineyard, because you have trained him to a stake, or spread him on a wall, instead of allowing him to grow free and unfettered as he should. Consider this matter in some other light than your own inclinations. He will doubtless live many years after you are gone. How shall he best perpetuate your name and family? By following his own natural inclinations, or by trying to force his nature to run on a track too wide or too narrow gage for him? Think over it!

THE LATEST DISCOVERIES IN THE POLAR REGIONS.

Although the North Pole has not yet been reached, notable progress has recently been made in the exploration of the zone of which it is the center. During the past summer several voyages have been accomplished; and of the results thereby determined, we are now beginning to learn the first particulars.

Dr. Augustus Petermann, the eminent German geographer, has received advices, *viâ* Norway, that the land at the east of the islands of Spitzbergen, of which the position has frequently changed on the charts during the past two centuries, has at last been reached, and that, during the month of August last, it was thoroughly explored by Captain Nils Johnsen, of Tromsoe. Another Norwegian captain, Altmann of Hammerfest, although reaching the same locality, failed to make observations of any importance, so that it was reserved for Captain Johnsen to complete the work. He left Tromsoe for the fisheries of Nova Zembla in the yacht Lydiana with a crew of nine men. At the beginning of June, says Dr. Petermann, he shaped his course toward the western part of the vast sea which extends between the islands of Spitzbergen and Nova Zembla. During the latter part of the same month he arrived some 80 kilometers to the south east of the Ryk Is islands (a little group off the east coast of Spitzbergen) and in the midst of a great polar current that transports enormous quantities of ice toward the eastern shores of the Spitzbergen and Bären Islands. In the following July and August, the ice current turned more to the eastward, leaving the western half of the sea comparatively clear. Captain Johnsen, who meantime was making large hauls of fish on the great Spitzbergen banks, suddenly discovered on the afternoon of the 16th of August that he had been carried to over 78° north latitude, and shortly after perceived the land which it is believed appears on the charts of 1617 under the name of Wiche or Gillis Land. Finding the sea open on the east and southeast shores of this island, Johnsen anchored his vessel near the northeast point, at latitude about 79° north, and disembarked in order to explore the surroundings, to ascend a mountain near the coast, and also to obtain a supply of the wood which he saw in enormous quantities on the beach. The main island he found to be accompanied by others smaller in extent. On no portion of the land could extended snowfields be seen. One glacier was visible on the southeast coast, while numerous streams of clear water were apparent.

The length of the island between its furthest points was determined to be 44 marine miles. The drift wood had accumulated in vast heaps, hundreds of feet from the shore and as high as twenty feet above the sea level. The principal animals inhabiting the polar regions were observed, and especially the Greenland seal, which appeared in immense numbers. The explorers evince considerable surprise at the reindeer, which they state are fatter and larger in size than any they had ever seen. On the back of one of these animals, fat was found of over three inches in thickness. Specimens of argillaceous and quartziferous rock were collected and, with some fossil vegetation, forwarded to museums in Europe for examination. On the evening of the 17th of August, Johnsen departed, following the southern and south eastern shores of the island. There was no ice except on the north coast, while in a northeasterly direction the sea was open as far as the eye could reach. Regarding the Austrian expedition of Payer and Wieprecht, we have news as late as the 16th of August. At that date the expedition was near the Isle of Barentz 70° 7' north latitude and 58° 24' longitude east of Paris. There is little of novelty communicated other than that the temperature of the sea, as taken, verifies the figures adopted by Dr. Petermann, on the charts. "Much thick ice has been encountered" says M. Payer, "but with the aid of steam we have no difficulty in penetrating it."

IMPROVEMENTS IN THE MANUFACTURE OF SILK.

In a report to the *Société d'Encouragement*, in Paris, M. Alcan lately gave an account of some recent improvements in the production and manufacture of silk. Among the various branches of this industry are the rearing of the silkworm, the collection of the cocoons, the filature or reeling of the raw silk, the spinning, the utilization of various waste products, and the dyeing and weaving of the threads in their manifold stages from the singles, trams and organzines to the finished silk tissues. Moreover, there belongs to the silk industry the obtaining of the silk substance from the body of the worms and its use for fish lines and violin strings. Recently the regaining of the silk fiber from the silken rags has been added to it; and in regard to this, we would say that it is more important than the shoddy industry, inasmuch as the silk threads regained possess a proportionally higher value than shoddy, because, when used again, they differ less from the new material which is mixed with them.

Of these various branches, we will first allude to the killing of the worms. The most preferable method would undoubtedly be that in which hot air is the means, were it not