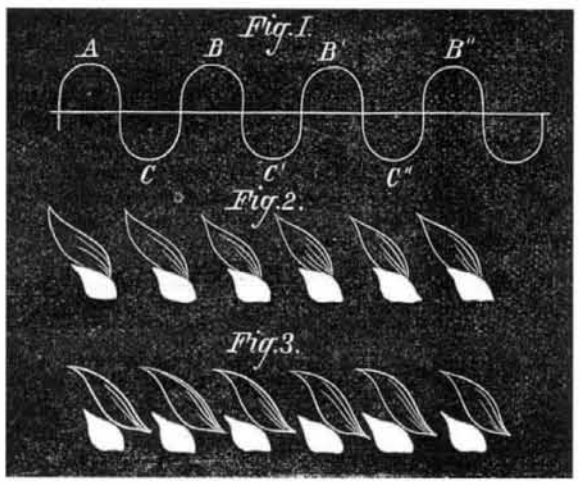
a resonator, a metal globe with a large opening at one pole and a smaller one at the other. It was invented by Professor Helmholtz, of Germany, and will resound to but a single note. Suppose this resonator to be connected with a separate flame by means of a tube containing a membrane, and that this second 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.) $\sqrt{1+\cdot00367t}$, 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 $v' = 333\sqrt{1+\cdot00367t'}$, the formula

$$(2) \qquad t' = \left(\frac{v\,l}{20\cdot16\,(l-d)}\right)^2 - 272\cdot48$$

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, *vid* 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