splendid series—as representative of his general mode of working; and, in fact, he himself states that there are objections to it in its present form, to eliminate which he points out the way: but, nevertheless, the apparatus may stand as a model of ingenious contrivance, showing how fertile is the mind of the investigator in devising means, and how thorough and refined these last, when placed in tangible form.

The object of the apparatus, as already noted, is to obtain the co-efficient of expansion of metals and alloys. By co-efficient is meant a factor, which serves as a multiplier; and the co-efficient of expansion of any metal is that fraction of its length which the metal elongates or shortens by the addition or subtraction of one degree of temperature. This fraction of the length of a given metal bar is expressed decimally, and hence to ascertain the absolute amount of the expansion of any given length of the metal, we multiply the given length by the co-efficient.

In order to measure the minute differences in length of the bars, Professor Mayer desired to use Saxton's comparator, on account of various advantages which that device offered. A complete description of that instrument, as well as a very interesting biographical sketch of its inventor, Mr. Joseph Saxton, will be found in No. XI of Professor Mayers' series of articles above referred to, in the SUPPLEMENT. It will suffice here to say that it consists essentially of a mirror, which reflects a beam of light over double the angle through which the mirror is revolved, and this beam acts as an index by being caused to sweep over a graduated scale, having for its center the center of the axis of the mirror. It will be obvious how measurements may be made by this arrangement.

We can do no more here than present a very brief account of how Professor Mayer solved the problem we have stated, as our readers will find all the details in No. XII of Professor Mayer's SUPPLEMENT series, which will shortly be published. The bar, whose co-efficient of expansion is to be determined, is supported on standards in a brass tube, which is made about ½ inch shorter than the bar. Against the ends of the bar are placed rubber washers, which are perforated so as to allow the ends of an abutting screw and a rod connecting with the moving mirror of the comparator to come in contact with the ends of the bar. Arrangements are provided which hold the washers perfectly water and steam tight against the ends, while the bar is perfectly free to expand or contract in the tube. Inside the tube are supporting springs, which relieve the standards in some degree from the weight of the bar.

In our engraving Fig. 1, T T' is the tube, supported on V's, V V'. Its weight is relieved by the spring balances shown. At p and p' are pins, to which springs (one of which is shown at S) are attached to pull the end of the bar against the abutting micrometer screw. A screw, E, serves to rotate the tube slowly in its V's, so that the bubble of the level, L, can be brought to the middle of the scale. Through the tube, D, water or steam is passed which, after circulating around the bar, escapes by the pipe, C. Thermometers may be introduced into the main tube through the tubulures, B B' B''; and these last also serve as openings for the introduction of hot water to melt ice around the bar. Fig. 1 represents the machine complete, and Fig. 2 is a sectional view of the tube T T.

In beginning the experiment, ice is packed around the bar, and the tube adjusted in the balances. The head of the abutting screw is adjusted to a known reading, and the end of the bar is pulled against said screw. The tube, T T', is then made level. The mirror rod, r r', Fig. 1, attached to the mirror, M, is next allowed to abut against the bar, when the reading of the index beam on the scale is at once noted. This is repeated three times. The tube is now removed from its V's, and hot water poured in until all the ice is melted. Steam at known temperature is then passed through the tube for thirty minutes, and the same operation for measuring above described is repeated.

Subtracting the scale reading obtained from the bar when it was in the comparator surrounded by melting ice, from the scale reading obtained when the bar was enveloped with steam, we have for remainder the amount of scale deflection produced by the bar in expanding from the length it has at 0° C. to that which it assumes at the temperature of the steam. This scale length, converted into linear motion of the mirror rod, gives the actual expansion of the bar in fractions of an inch or of a millimeter.

A Porcelain Fiddle.

Venice is considerably excited at present over a very unusual sort of a fiddle, the only one of its kind, probably, ever made. The manufacturer of this porcelain fiddle was formerly a workman in a Saxon porcelain manufactory. After his return, old and feeble, to his old home, he attempted to carry out a long cherished project for making a fiddle, the box of which should be of china. With the aid of a boy, it is stated, he has in fact succeeded in producing a fiddle of this kind, which has a tone of rare purity and astonishing richness, combined with charming harmony and extraordinary power. The box part, or resonator, is exceedingly light, and the strings are made of metallic wires, while the bow, departing from the usual form, is curved, making almost a semicircle. The success of this clever Venetian, who had enjoyed the advantages of the skill acquired in a German porcelain factory, may be the means of directing musicians to the advantages of the clear, ringing, but fragile china and glass, for various similar uses in acoustics.

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IS THERE A LAW OF INVENTION?

Whether we are to conclude with Buckle that there are laws governing human action which exist unknown and which only future and wiser generations will discover; or whether we adopt the theory of epidemic thought and assume that there is a bond of unconscious ideation forming some subtle link between minds pursuing like objects, the fact remains that no one can study the progress of invention without becoming impressed with a definite notion that there is some extraneous cause which impels inventors to reach similar conclusions and make like discoveries at about the same time. Of course this cause must be dependent upon antecedents, and these last are the steps which go to make up scientific progress, with which all may by study render themselves familiar, and thus may as it were place themselves under like influences. The question for speculation however is whether there even can be proved to exist a law which taking into account certain circumstances will enable us to recognize conditions when the production of a certain new and original conception is predicable.

Analogies in this regard are by no means wanting. In the case of artificial selection, horticulturists, agriculturists and stock breeders the world over are constantly engaged in experimenting under every imaginable combination of circumstances and conditions with the object of reaching new results which it is hoped may be superior to any hitherto obtained. The constant study of mankind has been to discover those circumstances under which the human race enjoys the highest point of mental and physical culture; and with such success has this been attended that it is quite possible to conceive of an ideal man, the product of present attainable conditions, who in all his attributes, certainly physical and probably mental, would be a far superior being to modern men. There are many instances which can be cited showing that occurrences seemingly of the most fortuitous character are subject to definite fixed laws. The number of suicides, of murders, of marriages, of letters posted unstamped, and so on through almost every imaginable event in a large community, is nearly invariable; the great business of life insurance rests upon the law of probabilities, and finds its stability in the hypothesis that out of a given number of policy holders the ratio of deaths may be definitely forecast. The entire onward march of scientific investigation is toward the formulation of these laws. The highest effort of original investigation is the grand general deduction, the establishment of a theory on the basis of a multitude of observed facts.

It may not therefore be unreasonable to suppose that, some day, laws governing invention will be revealed. No great or striking invention, not even one moderately out of the common run, appears, but that others similar to it at once come to light, not as improvements on the first announced but as the outcome of independent thought. Take the telephones as an instance. Bell's telephone is not an improvement on Gray's, nor is Edison's on that of either of the other inventors, yet all were produced, as is well known, within a few months of each other. Note the number of entirely original inventions which followed rapidly upon each other within a very few years and which together resulted in the sewing machine as now perfected. There are abundant records where in purely scientific investigations independent students find themselves pursuing exactly similar objects. The case of the magnificent discovery of Neptune by both Leverrier and Adams is a most striking example of an instance where two investigators each reached his aim in a manner original with each yet common to both.

The recently invented phonograph is proving no exception to the general rule. A preliminary notice in these columns of the Marey and Rosapelly phonograph lately devised in France elicited the announcement of Mr. Edison's remarkable invention. Two inventors have written us, since the publication of the latter device to the effect that they also have invented phonographs of substantially similar construction, which antedate (they say) Mr. Edison's device by a considerable period. It will be interesting to watch the progress of the phonograph if only to note how many other inventors have been simultaneously engaged in its investigation or have independently discovered it in various forms. Statistics based on data of this kind and kept over a reasonable period would probably lead to some remarkable conclusions relative to the conditions of invention, and possibly, as we have intimated, to the discernment of some general laws.

UNITED STATES COINAGE AND THE GREAT PYRAMID.

Some one who fails to see wherein the benefit of importing obelisks from Egypt exists sarcastically proposed not long ago that Yankee ingenuity should astonish the world by floating, not an obelisk but a pyramid across the Atlantic, and erecting the structure in some city park. The satirical proponent might have strengthened his scheme if he had added that while this nation has no bond of connection with obelisks, it actually has something in common with the Great Pyramid—and that we have a direct national interest in that mass of stone, inasmuch as a most curious analogy exists between its measurements and in the weights of our several coins. We are indebted to Dr. Watson F. Quimby for the following letter, wherein he ingeniously points out this remarkable linkage, and suggests the very plausible idea that the weights of our coins owe their origin to no fortuitous circumstance, but rather to customs established at a period dating back beyond history. Dr. Watson says:

"In the admirable work of Professor Piazzi Smith, entitled