chloride of methylene or ether. In the narcotized condition, the vessels do not contract, but under the influence of ether, in the later stages, before death occurs, dilation and regurgitation are observed. The latter is noticed also when chloride of methylene is used. With both reagents breathing and vessel circulation ceasebefore the heart's action. The lecturer concluded that anæsthetic vapors act directly upon nerve matter either by preventing the developement of force or by stopping conduction. The latterhypothesis is supported by the fact, proved by experiment, that these vapors obstruct the conduction of heat and electricity.—*Med. Times and Gaz.*

ALLOYS--REVIEW OF A LECTURE BY DR. A. MATTHIESEN, F. R. S.

Up to a very recent period the knowledge of alloys was confined to the physical characters of a very few of the possible combinations of different metals, and the chief contributions to the general stock of information in relation to the subject were the result of unsystematic and desultory experiment. Nothing like generalization was reached, and it was impossible, from the knowledge of the properties of an alloy containing definite proportions of two or more elements, to predict, even approximately, the properties of a combination of the same elements in varied proportions. The great importance of the subject, has, however, stimulated investigation, until at last something definite has been reached; and although as yet the smallest possible portion of the field has been worked over, an approach has been made to the proper method of working, and as a consequence we shall no doubt witness results equal in importance to other modern chemical discoveries which have created new branches of art and manufacture and revolutionized many of the old.

The researches of Dr. Matthiesen, the results of which he submitted to the Royal Society, in a lecture delivered at the Royal Institution, on the evening of March 20, are of great interest. The lecture was illustrated by many beautiful and ingenious experiments, and undoubtedly ranks among the most valuable recent contributions to science.

Dr. Matthiesen's definition of the term alloy is, *a solidified solution of one metal in another*. By solidified solution is meant a solution of substances which have become solid, *e. g.*, glass obtained by fusing together different silicates, and allowing the homogeneous liquid to solidify. The most important characteristic of a solidified solution is its homogeneousness. The most powerful microscope should not reveal its components.

As an illustration of the difference between chemical combination and the solution of metal in metal, the lecturer plunged a rod of gold and another of copper into separate portions of molten tin. The gold dissolved rapidly in the tin, but the copper rod, though previously tinned to insure perfect contact between the two metals, remained undissolved. To properly appreciate this experiment it should be borne in mind that the fusing points of gold and copper are nearly the same (gold 2,016° F., copper 1,990° F.), and much higher than the fusing point of tin, which is 442° F.

This experiment was followed by others equally instructive and interesting, calculated to show the solvent power of fused substances.

Dr. Matthiesen proceeded to classify the phenomena attending the solution of metals in metals, as follows:

I. The solid metal dissolves quickly in the melted one with evolution of heat. Examples: gold in tin just melted; sodium in mercury.

II. The solid metal dissolves quickly without evolution of heat. Example: lead in tin just melted.

III. The solid metal dissolves slowly. Example: copper in tin just melted.

IV. Only a partial alloy is formed, or in other words, each metal dissolves to only a limited extent in the other. Examples: lead and zinc, lead dissolving only 1·6 per cent zinc, and zinc only 1·2 per cent lead; bismuth and zinc, bismuth dissolving only 8·14 per cent zinc, and zinc only 2·4 per cent bismuth.

He also divided metals considered as components of alloys into two classes:

Class A.—Those metals which impart to their alloys certain physical properties (such as conducting power for electricity) in the proportion in which they themselves exist in the alloys. The metals belonging to this class are lead, tin, zinc, and cadmium.

Class B.—Those metals which do not impart to their alloys such physical properties in the proportion in which they themselves exist in the alloys. All the metals, except the four named as belonging to class A, probably come under this head.

He further separated alloys into three groups:

a. Those made of the metals belonging to class A with one another.

b. Those made of the metals belonging to class A with those of class B.

c. Those made of the metals belonging to class B with one another.

The Doctor showed by a series of conclusive and remarkably ingenious experiments that in alloys specific gravity, specific heat, and expansion due to heat, are in all cases approximately equivalent to those possessed by the component metals; and that fusibility and some other properties are never equivalent.

Another class of physical properties are those which in some cases are, and in others are not, imparted to alloys in the ratio in which they are possessed by the component metals. This class of properties includes conducting power for heat and electricity,sonorousness, elasticity, and tenacity. The separation of metals into two classes (A and B) is founded on a consideration of the latter class of properties.

Alloys made of the metals belonging to class A only (lead, tin, zinc, and cadmium) conduct electricity in the ratio of the relative volumes of the component metals. The conducting powers of a series of such alloys, say those of tin with zinc, may therefore be represented graphically by straight lines.

In alloys made of the metals belonging to class A with those of class B, the conducting power of the B metal undergoes a marked change, while that of the A metal remains unaltered. The conducting powers of a series of such alloys, say those of copper with tin, is represented graphically by a bent line approximating to the form of the letter L. There is a rapid decrement on the side beginning with the metal belonging to class B (copper in the case referred to) until a certain point is reached, when the line turns and goes straight to the metal belonging to class A (tin in the case cited).

In alloys made of the metals belonging to class B only, the conducting power of each component undergoes a marked change, hence such alloys do not conduct electricity or heat in the ratio of the relative volumes of their component metals. The curve which represents graphically the conducting powers of a series of such alloys, say those of silver with gold, has approximately the form of the letter U. There is a rapid decrement on each side of the curve, and the turning points are connected by a line nearly straight.

The turning points of the curves representing the conducting powers of series of alloys of the second and third groups, necessarily correspond to certain alloys in which the alteration of the physical properties of the components is most strikingly exemplified. It is a fact of no small importance, therefore, that these turning points represent approximately the composition of some of the most valuable alloys which are employed for technical purposes. Thus, gun metal, containing 10 per cent tin, is marked on the copper-tin curve, the turning point of which corresponds to 12·5 per cent tin. Brass, containing 28 per cent zinc, is marked on the copper-zinc curve, the turning point of which corresponds to 25 per cent zinc. Twenty-two carat gold, alloyed with silver, is marked on the silver-gold curve, close to one of its turning points, and the same alloyed with copper, on a corresponding portion of the copper-gold curve. Again, a silver-platinum alloy, containing 33 per cent of platinum, employed by the electrical standard committee for their unit-coil, and largely used by dentists for making springs for artificial teeth, is the alloy which forms the turning point of the silver-platinum curve.

Further experiments demonstrated the fact that alloys of class B with those of class A give a great increase of sonorousness.

The following experiments were made to test the tenacity of metals and alloys. with the annexed results. The tension was made by the use of a winch, and measured by a spring balance. The wires used were double, gage No. 23:

	Breaking strain for double wire.
Tin	under 7 lbs.
Lead	" 7 lbs.
Gold	about 25 lbs.
Copper	" 30 lbs.
Silver	" 50 lbs.
Platinum	" 50 lbs.
Iron	" 90 lbs.
Tin-lead alloy	under 7 lbs.
Tin-copper alloy (12 per cent copper)	about 7 lbs.
Copper-tin alloy (12 per cent tin)	" 90 lbs.
Gold-copper alloy	" 75 lbs.
Silver-platinum alloy	" 80 lbs.
Steel	above 200 lbs.

These results show that the tenacity of metals belonging to class B is greatly increased by alloying them with metals of the same class. By experiments with spirals of hard drawn wire of the same gage it was shown that elasticity follows the same law as tenacity.

The practical conclusion drawn from the facts illustrated by these experiments was, that when a new alloy is desired which shall posses some special physical property, an examination should first be made of the alloy indicated by the turning point of the curve which represents the conducting power of the two metals.

We consider these conclusions to be of the greatest importance, and venture to predict that through their application during the next decade many valuable discoveries will be made, and a new impulse given to the art of metallurgy.

THE WATCH---ITS HISTORY AND MANUFACTURE.

BY H. F. PIAGET.

No. 3.

THE SELECTION OF WATCHES.

Were it possible to give rules for the selection of watches, society might be benefited, as the young man who has a bad watch is less likely to obtain habits of punctuality than he who has a good one. I once heard an anecdote of two young persons who were allowed to select watches for themselves. One chose a plain watch, from being told that its performance could be depended upon. The other, attracted by the elegance of the case, decided upon one of inferior construction. The possessor of the good watch became remarkable for punctuality, while the other, although always in a hurry, was never in time, and discovered, as a celebrated writer justly observes, "that next to being too late, there is nothing worse than being too early." Unfortunately, no efficient instruction can be given, as none but a workman possessing the highest knowledge of his art is capable of forming a correct opinion, and a watch must be bad indeed for an inexperienced eye to detect the defects, either in its principle or its construction. Even a trial of a year or two is no proof, for wear seldom takes place within that time; and while a good watch, if in order, can but go well, a bad one may by chance occasionally do so.

I have myself seen some of the old rack lever watches that were more than fifty years old, and worn constantly, nearly as good as new, by having been properly attended to, and in time. It is not sufficient that a watch be well constructed, and on good principles. The brass must be hard, and the steel properly tempered. The several parts must be in exact proportion, and well finished, so as to continue in motion, with the least possible friction. It must also be made so that when taken to pieces all its parts may be replaced as firmly as before.

A watch thus constructed and properly adjusted will continue its motion and correct performance for years without trouble, and with little expense, except occasionally cleaning. A bad watch is one to which no more attention has been paid to the proportions of the parts or durability of materials than was necessary to make it perform for a time. It is either the production of inefficient workmen, or of those who, being limited in price, are unable to give sufficient time to perfect their work. There is a great fault in many watches and movements, sent both from England and Switzerland—they are not properly examined, adjusted, and regulated, before exported.

Formerly, and it is still the case in many instances, the most eminent watchmakers were all practical workmen. At present, there are but few manufacturers who work themselves, and if they do, have not time to see to every watch sent away. Those who value the reputation of their watches have a practical workman, one who understands thoroughly every branch of the business, who is called the examiner, whose duty it is to take every part and see that it is properly made, adjusted, and put together on correct principles; for where a piece of mechanism like a watch is made in so many parts or pieces, it is next to impossible but some slight oversight or imperfection may occasionally occur. The examiner or manufacturer then regulates every watch or movement (if correct) before being sold.

But latterly, the competition for cheapness has been so great that in many cases the examiner is dispensed with, as good examiners are paid very high wages—it being necessary for him to have considerable skill and experience before being entrusted with such an important position. Also, many watch manufacturers have not the opportunity of examining every watch, in order to fulfill their orders in time at the busy season, and many watches, particularly cheap ones, are merely *going machines*, and not time-keepers.

Another fault with many watches sent from Europe to this country, is that the oil has not been changed; the oil mostly used in the manufactories will not do in this climate, and but few watches will perform correctly until the oil is changed. Still, another fault, and one which often brings discredit on a good maker, particularly in cheap work, is that when the watch or the movements are cased in this country, the movements go in the hands of workmen, who merely take them down for casing, or are paid so little for the work that they cannot properly examine them, and correct any oversight or imperfections in manufacturing, and frequently have to do the work in great haste; if the balances only vibrate with a good motion, it is all that is wanted of them. Bad watches in some instances, with strong springs, will go well for a time, but as they wear from friction, they require frequent repairs, which cannot effectually be done, for in correcting one defect in a badly constructed watch. you frequently find several others, which could not be discovered before.

The principal cause of imperfect watches is the universal desire of obtaining them for as little money as possible, and to reduce the work of watchmaking to the same value, is to compel good workmen to produce bad work.

When an art is difficult to learn, requiring much knowledge and study, with years of experience, the number of really good workmen will be few, and therefore employed by those who can offer the best remuneration. Few can judge of a machine, the accuracy of which depends upon the most minute correctness of principle and execution; it is not wonderful, therefore, that there are numbers of bad watches, since a portion of the public considering them as mere ornaments, or in many instances only bought to trade, and not for use as time keepers, procure them from dealers who, however just and honest they may be, can never possess that knowledge which is only acquired by long practice in that particular art, and may therefore be themselves deceived. Those, also, who in order to meet the general desire for cheapness sell at low prices, can only do so by producing inferior watches, for a greater division of labor, or use of machinery, can scarcely be brought into operation. The workmen are therefore compelled to do the greatest quantity of work in the least possible time, and good work in watches must not be slighted. It is often supposed that the principle on which a watch is constructed must determine its quality. This is far from being the case. A duplex watch may be very bad if not well made and the escapement in its true principle. A chronometer watch with the same fault is still worse, while a common vertical watch may be good if well made. I have seen good vertical watches which had been in constant use for upwards of fifty years, with new verges put in occasionally, and kept reglarly cleaned, which were still much better than many of the full jeweled levers made at the present time. To make one watch better than another, execution must be added to principle.

It may be here mentioned, that undue importance is frequently attached to watch jeweling; many low priced and bad watches have eight or ten holes jeweled, while many that are good have but four. To state the number of holes which ought to be jeweled, would require details ill suited to a work which is merely elementary. But when it is known that in common watches the holes can be jeweled in Europe at less than fifty cents each, it will be seen that the number of holes jeweled affords no criterion by which to estimate the value of a watch. But in fine watches, which are jeweled with rubies