

EVOLUTION OF MATTER

by Gustav LeBon

Chapter 12 - Experiments on the Variability of Chemical Species

This document is a chapter from Gustav LeBon's book Evolution of Matter, which details a simple and practical demonstration of real alchemy.

This will be discussed in Eric Dollard's presentation The Power of the Aether as Related to Music and Electricity at the 2015 Energy Science & Technology Conference.

<http://energyscienceconference.com>

CHAPTER XII.

EXPERIMENTS ON THE VARIABILITY OF CHEMICAL SPECIES.

THE simple bodies chosen for experiment are mercury, magnesium, and aluminium, elements which in a normal state can form no combinations among themselves. By subjecting them to certain conditions of shock or pressure, we shall compel them to form admixtures in which one of the elements shall be infinitesimally small compared with the other. This is all that is required for these metals to acquire entirely new chemical properties.

Here is a table of the principal properties of these bodies in their ordinary state, and of these same bodies transformed:—

CLASSIC PROPERTIES OF METALS IN THEIR NATURAL STATE.	NEW PROPERTIES OF THE SAME METALS TRANSFORMED.
<i>Mercury.</i> —Does not decompose water when cold, and does not oxidize in air.	<i>Mercury containing traces of Magnesium.</i> —Decomposes water when cold, and is instantly transformed, when exposed to the air, into a voluminous dark powder.
<i>Magnesium.</i> —Does not decompose water when cold, and does not oxidize in air.	<i>Transformed Magnesium.</i> —Decomposes water when cold, but does not oxidize when dry.

 CLASSIC PROPERTIES OF METALS
IN THEIR NATURAL STATE.

Aluminium.—Does not decompose water when cold, and does not oxidize. Cannot be affected by sulphuric, nitric, or acetic acids.

 NEW PROPERTIES OF THE SAME
METALS TRANSFORMED.

Transformed Aluminium.—Oxidizes instantaneously, if dry, and becomes covered with thick white tufts of alumina. Rapidly decomposes water until the metal completely disappears and transforms itself into alumina. Is violently affected by sulphuric, nitric, and acetic acids. Possesses an electromotive force double that of ordinary aluminium.

We will now examine in detail the transformations we have just briefly indicated. I give first the *modus operandi* of these transformations :—

Transformation of the Properties of Mercury.—If a fragment of magnesium be placed in a bath of mercury the contact of the two metals may be maintained for any lapse of time without their combining. If roughly shaken in a bottle the magnesium is still unattacked. In their ordinary state, then, these metals refuse to combine, but we shall see that we have only to modify their usual physical conditions very slightly to enable them to join in very unequal proportions.

To compel the mercury to dissolve a small quantity of magnesium, the intervention of a slight pressure alone is needed. This pressure constitutes one of those causes peculiar to the effect required, one of those appropriate reagents, of which I have several times pointed out the importance in this work.

This pressure may be light but it must be continuous. To obtain it we have only to fill a tube with mercury and to close it with a cork having a strip of magnesium, carefully cleaned with emery-paper, passed through it (Fig. 54). By thus stopping the tube with the cork, the magnesium remains dipped in the mercury



FIG. 54.—*Arrangement by which the transformation of the properties of mercury is obtained by combination, under the influence of slight pressure, with traces of magnesium.*

without being able to float on its surface. Subjected to this feeble pressure it is slightly attacked in a length of time varying from a few minutes to a few hours, according to the quality of the metal and the perfection of the cleaning. The properties of the mercury then become profoundly modified. It acquires the property, as curious as it was unexpected, of appearing to oxidize rapidly in dry air, and it vigorously decomposes water so soon as it is immersed in it (Fig. 55).

To verify the apparent dry oxidation of the mercury it only has to be poured into a recently cleaned glass. Its surface is then instantaneously covered with a black powder which forms again every time it is wiped away. If not removed, the coating of oxide soon reaches the thickness of a centimètre. This permanent oxidation continues for an hour.

The oxidation of the mercury is, however, only apparent. It is not in reality the mercury which oxidizes, but the traces of magnesium contained in it.



FIG. 55.—*Decomposition of water by mercury containing a trace of magnesium. (Instantaneous photograph.)*

By oxidizing, the magnesium transforms the mercury into an impalpable black powder of considerable volume.

To verify the decomposition of water by the mercury, it is poured into a glassful of this liquid as soon as the magnesium is taken out of it. The decomposition of the water is immediate. It becomes slower at the end of fifteen minutes, but lasts over an hour.

The modified mercury rapidly loses its properties when exposed to the air, but it may be kept indefinitely and retains its new properties by covering it with a thin layer of oil of vaseline.

Transformation of the Properties of Magnesium.—If, in the last experiment, instead of a thin fragment of magnesium being placed in the mercury under pressure, a strip of a certain thickness—one millimètre, for instance—be introduced, it will be found, by taking out this strip at the expiration of two or three hours and plunging it into water, that the liquid is rapidly decomposed (Fig. 56). The hydrogen of the water is disengaged, and the oxygen combines with the metal to form magnesia.

The operation lasts about an hour, and as in the case of mercury, at last stops. If, after having immersed the magnesium in water, it is withdrawn, its temperature rises considerably and it oxidizes in the air.

This oxidation of magnesium in the air is—contrary to what was observed with mercury, and contrary to what will be observed in aluminium—very slight and only shows itself when the metal is wet. Withdrawn from the mercury and dried at once with a dry cloth,



FIG. 56. — *Decomposition of water by magnesium containing traces of mercury. (Instantaneous photograph.)*

it does not oxidize, but retains indefinitely, if kept in a very dry place, the property of decomposing water.

In the preceding experiments I have worked without the intervention of any reagent, simply by putting in presence of each other two metals which will not combine in the ordinary way, but which I have compelled to interpenetrate by the action of slight pressure. The operation requires several hours. It will only require a few seconds if I call in a reagent which by the sole fact that it attacks magnesium will diminish its resistance to the action of mercury.

I now introduce into a large bottle a few centimètres cube of mercury, a strip of magnesium, and water containing 1% of hydrochloric acid, and roughly shake the bottle for 10 seconds. I now withdraw the magnesium, wash it to quickly remove all traces of hydrochloric acid, dry it and throw it into a precipitating glass full of water. It will at once decompose this liquid. Taken from the bottle and poured into a glass full of water the mercury will likewise decompose that.

Transformation of the Properties of Aluminium.—The experiments with aluminium are much more striking than those effected with magnesium.

To generate immediately on the polished surface of an aluminium mirror a vegetation in thick tufts as white as snow, constitutes one of the most curious experiments in chemistry, and one of those which has most struck the learned persons to whom I have shown it. Its realization is very simple.

It is possible, as with magnesium, to compel the mercury to act under pressure, but the action of impact is much more rapid.

It is sufficient to introduce into a bottle containing a few centimètres cube of mercury some strips of aluminium polished with rouge or simply cleaned with

emery, and then to roughly shake the bottle for two minutes.¹ If one of the strips then be taken out, carefully wiped, and vertically placed on a support, it will be seen to be almost instantaneously covered with white tufts of alumina, which in a few minutes grow to a height of 1 centimètre from the surface (Figs. 57 to 60). At the commencement of the experiment the temperature of the strip rises to 102° C.

The above oxidation does not manifest itself if the aluminium be introduced into air or oxygen completely dry. The presence of a small quantity of water vapour is therefore indispensable for the production of the phenomenon. The alumina formed is, besides, always hydrated.



FIGS. 57 to 60.—Formation of tufts of alumina on strips of aluminium covered with invisible traces of mercury. (Instantaneous photograph.)

¹ All the figures given by me in this book must be very exactly followed by any one wishing to repeat my experiments. The repeated shocks produced by the shaking tend to generate combinations which do not occur otherwise. It was by shaking a bottle containing ethylene and sulphuric acid some 3000 times that M. Berthelot, as is well known, obtained the synthesis of alcohol.

If, instead of placing the aluminium on a support, it is thrown into a vessel full of water immediately after taking it out of the mercury, it energetically decomposes the liquid and transforms itself into alumina. This operation only ceases when the aluminium is entirely destroyed, a complete destruction which never occurs with magnesium. A strip of aluminium 1 millimètre in thickness, 1 centimètre in width, and 10 centimètres in length is entirely destroyed by oxidation in less than forty-eight hours.

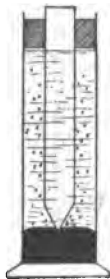


FIG. 61.—
Arrangement of the experiment which allows us to give to a strip of aluminium, after its extremity has touched mercury, the property of decomposing water, and of transforming itself entirely into alumina, even when the mercury is withdrawn after the decomposition of the water has commenced.

As with the transformed mercury, it is easy to preserve indefinitely in the modified aluminium all its properties by simply immersing it in a bottle of oil of vaseline.

An idea of the minute quantity of mercury necessary to transform in so great a degree the properties of aluminium may be gathered by putting into a precipitating glass filled with distilled water, but containing a small quantity of mercury, a strip of aluminium cleaned with emery and fixed in a cork, so that it can only touch the mercury with its lower extremity (Fig. 61). After a few hours the water begins to decompose, and this decomposition, even after the mercury has been taken away, continues till the strip has been eaten away for a length of 5 to 6 centimètres above the point in contact with the mercury.

In this experiment the action of the mercury has thus extended far beyond the part in contact with it. It may therefore be supposed that the mercury has travelled along the strip of aluminium by an electro-capillary phenomenon. The

following experiment is free from this objection, and shows even more clearly the slight quantity of mercury necessary to transform the properties of aluminium.

Into a dry and very clean bottle is put a small quantity of pure distilled mercury; the bottle is shaken for one minute, then the mercury is poured out so that there remains no visible trace of it on its sides, which, moreover, will have kept all their transparency if the metal used was perfectly pure. The bottle has, nevertheless, retained traces of metal sufficient to transform the properties of aluminium. It is only necessary to wash it with water acidulated by one-fifth part of hydrochloric acid, to place in it a strip of aluminium, and to shake the bottle for thirty seconds to cause the strip to exhibit the properties of oxidation mentioned, although it is impossible to discover on its surface any trace whatever of amalgamation.¹

The proportion of mercury necessary to produce the transformation of aluminium can be represented in figures. If, to a bottle containing water acidulated by one-fifth of hydrochloric acid is added a trace of bichloride of mercury so weak that the liquid only contains $\frac{1}{100000}$ of its weight, and a strip of aluminium be inserted, and the bottle shaken for two minutes, the aluminium will have acquired all the properties I have indicated, although, as in the preceding experiment,

¹ As the conditions in which aluminium can combine with mercury without the intervention of any reagent may be met with in any laboratory, I at first supposed that some of the facts I noted must have long been known. After fruitlessly consulting the most accredited chemical treatises without finding anything but facts relating to the amalgamation of aluminium in the presence of bases, I made inquiries of the most eminent chemists, and notably of M. Ditte, Professor of Chemistry at the Sorbonne, and author of the most complete and recent work on the properties of aluminium. One and all answered that none of the facts I pointed out, neither as regards aluminium nor mercury nor magnesium, had before been published.

there is no trace of amalgamation visible to the naked eye.

The electro-motive force of the modified aluminium is more than double that of ordinary aluminium. With a couple formed of platinum, pure water, and ordinary aluminium the electro-motive force I found was 0.75 volts. By replacing in the same couple the ordinary aluminium by the modified aluminium, the electro-motive force rose to 1.65 volts.

The hydrogen which is disengaged during the decomposition of water by the modified aluminium renders the air a conductor of electricity, as may be verified by connecting an electroscope with a metal receptacle containing water and fragments of transformed aluminium. The discharge of the electroscope is about the same whether its charge be positive or negative.

In addition to these new properties of oxidizing when cold and of decomposing water exhibited by the aluminium, it has also acquired the property of being affected by sulphuric, acetic, and nitric acids, which in general have no action upon it.

To observe this new property the following precautions should be taken:—For acetic acid, it is only necessary to use it pure and crystallizable; for nitric acid, the metal drawn from the bottle of mercury must be plunged into the nitric acid of commerce. After a few seconds the metal is very violently attacked, its temperature raised considerably, accompanied by the disengagement of heavy russet-coloured vapour. The reaction is rendered less dangerous by adding to the nitric acid half its weight of water.

If nitric acid pure at 40° were employed instead of the nitric acid of commerce, the aluminium would not be affected.

The difference of action by pure and impure nitric acid is not an isolated example. It has long been

known that there is a difference in the action exercised on lead by pure and ordinary water. Pure water attacks it, while ordinary water does not. It is sufficient to pour distilled water on recently prepared lead filings for the liquid to become tinted in a few minutes by the formation of oxide of lead. With ordinary instead of distilled water the liquid remains perfectly limpid. Ordinary water modifies the surface of the metal, and deposits on it insoluble carbonates and sulphates.

Sulphuric acid does not affect ordinary aluminium, as the chemistry books teach us; but it energetically attacks modified aluminium. Pure sulphuric acid is almost devoid of action. Sulphuric acid in twice its volume of water must be used. Once the action has commenced, enough water can be added to reduce the sulphuric acid to one-hundredth part. The reaction continues with almost the same vivacity. Sulphuric acid diluted to the one-hundredth degree, which has an action almost nil on aluminium not already attacked, has, on the contrary, a very great action as soon as the reaction has started. Consequently, it has the power of continuing but not of exciting it.

The fact that sulphuric acid pure or diluted does not attack ordinary aluminium is taught in chemistry books, but it is not quite exact. Pure sulphuric acid, it is true, has no action, but with half its measure of water added it instantaneously attacks aluminium, though less energetically than in the case of modified aluminium. The verification of so simple a fact not being open to any misconception, it must be supposed that the divergence between what is written in the books and what is shown by observation is due to the chemists, who first studied the action of sulphuric acid on aluminium, making use of a metal containing foreign bodies which modern manufacture has succeeded in

eliminating. Foreign bodies in aluminium greatly modify its properties. I have come across samples of impure aluminium with which I was unable to effect any of the preceding experiments.

In his notable memoir on the properties of aluminium, M. Ditte had already shown that this metal could be affected by acids, but only by adopting certain devices. For weak sulphuric acid to act, a little chloride of platinum has to be added; for nitric acid, a vacuum has to be made above the metal plunged into the acid. The attack, moreover, is very slow, and in no wise violent, as is the case with modified aluminium. M. Ditte has concluded, from his numerous experiments, that aluminium is a metal easily liable to attack under many conditions, several of which are still undetermined. The fact appears indisputable. The Navy has been compelled to abandon the use of aluminium, and unless means be found to associate it with a metal able to modify its properties, it will be impossible to employ it, as has been proposed, for metallic constructions.