of all things. It must not be forgotten, however, that men have really become mad after having been long confined on suspicion of pretending to be so, just as hysterical women often really fall into a state which they have long affected."

Part Second.

REVIEWS.

Traité de l'Art de Formuler, ou Notions de Pharmacologie appliquée à la Médecine. Par M. MIALHE, M.D., Pharmacien, Professeur agrégé à la Faculté de Médecine. Paris: 1845. 8vo. Pp. 518.

A Treatise on the Art of Prescribing. By M. MIALHE, M.D., &c. Paris: 1845.—(Continued from p. 43.)

IN a former article upon this treatise, after a brief survey of the author's views on the general absorption of medicines, we shortly adverted, in detail, to two important drugs which are discussed by him, namely, sulphur and iron. The subjects of antimony, silver, and mercury, will now engage our attention.

And first, as to *antimony*. As this metal undergoes oxidation when exposed to the combined influence of air and moisture, there is no difficulty in understanding its action when taken into the stomach in the metallic form. Further, as the oxide thus generated is, according to our author, in the state of hydrate, it is dissolved in a feebly acid menstruum, as the gastric juice, much more readily than the ordinary sesqui-oxide of antimony, more or less of which is probably anhydrous. Having digested equal parts of the pure metal in a state of fine division, and of the sesqui-oxide in separate portions of water very feebly acidulated, Mialhe ascertained that the quantity of antimonial salt produced with the metal was much greater than with the oxide, from which he infers that the activity of an antimonial preparation, of which the oxide forms the base, will be much increased when the latter is in the state of hydrate. It is not mentioned how the oxide used in this experiment was prepared. Gmelin (*Handbuch der Chemie*, 1844) says, that the sesqui-oxide of antimony does not appear to form a hydrate, but, as Berzelius has shown, it is to a slight extent soluble in water. The sesqui-oxide of antimony belongs to a small class of drugs which are soluble alike in the acids of the gastric juice as in the alkalis of the intestinal canal, comporting itself as a base in the one case, and as an acid in the other; but for easy solution in feebly acid or alkaline fluids like the gastric and intestinal secretions, Mialhe affirms that it must be hydrated.

Of late years in France, the kermes mineral has again come into vogue as an antimonial preparation, and, owing to the recommendations of Clusel, Trousseau, and others, has with many superseded the use of tartar-emetic. It is said that, while in its general therapeutic action it is quite equal to the double tartrate, it is much less apt to excite vomiting, local irritation, or inflammation. This compound seems worthy of a further trial in this country; but the circumstance to which we wish to direct attention here, is the great difference in its strength, according as it is obtained by the moist method of Clusel (officinal in the Parisian codex), when it is most active, or by the dry method of Thierry, when it is often nearly inert. Our author has ascertained, by experiment, that the officinal kermes contains a much larger proportion than the other of the hydrated oxide. May not the very irregular action of the sesquioxide itself, observed in the trials made with it by Professor Christison and Dr Clark, be owing to its containing a variable proportion of hydrated oxide?

The following explanation is offered by Mialhe, of the remarkable difference in the physiological effects of the same doses of tartar-emetic in health and disease. In the healthy stomach the tartrate is, in part, immediately decomposed by the free muriatic acid of the gastric juice, and a highly acrid compound, the hydro-chlorate of the chloride of antimony, is formed. Hence the nausea, vomiting, and diarrhœa. In the course of an acute disease, as pneumonia or bronchitis, in consequence of the loss of appetite and abstinence from food, the gastric juice becomes very feebly acid, and frequently indeed presents no acid reaction whatever. There is little or no formation of the acrid chloride, while the passage of all the tartrate into the circulation, fully accounts for its powerfully sedative or contro-stimulant action under these circumstances. Mialhe endeavours to account for the well-known fact, that vomiting which has been excited by small doses of tartar emetic, frequently disappears when the dose is increased, by supposing that an amount of hydro-chloric acid in the gastric juice, capable of decomposing a quarter or half a grain of the medicine, may be insufficient to displace the tartaric acid when the quantity is larger. To these views it may be objected, that as the emetic action of antimony is obtained by injecting it into the veins or rectum, the vomiting should be regarded as the effect rather of a special modification of the nervous system, than of a local irritation of the mucous membrane of the stomach; and a still stronger objection is found in the results of several experiments in which we administered, along with one grain of tartar emetic, thirty grains of calcined magnesia or prepared chalk, without interfering in any degree with its ordinary emetic action. The antacid was not given in one, but in three separate doses; the first at the same time with the antimony, the second a quarter of an hour afterwards, and the third in half an hour.

While we reject M. Mialhe's explanation, we are not the less opposed to that view which attributes the *tolerance* to the presence of inflammatory fever. In fact, the same tolerance is established, *quite independently of acute febrile reaction*, when the patient is confined to a spare diet; and it may be established as a general rule, that the more rigid the diet, so much the more marked will be the general action of antimony; and, on the contrary, when the quantity of food is considerable, its emetic action is more decided.

Silver.—The insolubility of this metal in the gastric juice renders it inert in relation to the animal economy. The silver of the nitrate, on meeting with that fluid, is immediately thrown down as the insoluble chloride. The complete absence of any sensible effect, in the great majority of cases, during the administration of the nitrate of silver, has led many (we refer more especially to the German) physicians to deny the occurrence of its absorption in any case, and to suppose that the entire dose escapes in the form of chloride with the fæces; but the coloration of the skin, which has followed its use, though only in a few instances, places the fact of its absorption, at least in these cases, beyond a doubt; and this is made intelligible by Mialhe, who affirms that the chloride is soluble to a slight extent in a solution of common salt or sal ammoniac, both of which are present in the gastric juice. The chloride of silver, freshly precipitated in the stomach, is in a more favourable condition for solution than the same preparation in the dry form; hence the superiority of the nitrate of silver to the dry chloride as a therapeutic agent. But how is the rare occurrence of the coloration of the skin to be explained, unless perhaps we suppose, that in those unfortunate individuals in whom it has taken place, the fluids were, from accidental circumstances at the time of administration, unusually saline? As to the oxide, there is little doubt that it also is converted into chloride in the stomach, in which case it must be equally liable with the nitrate to produce the bluish-grey tint of the integuments. The following formula is constructed in accordance with the views above mentioned:—

Nitrate of Silver Pills.

Nitrate of Silver,	15 Grains.
Chloride of Sodium,	60 „
Starch,	45 „
Gum Arabic,	15 „
Water,	q. s.

Pulverize the nitrate of silver; then add the water, and afterwards the salt; lastly, the starch and gum. Divide into 100 pills; each pill contains a little more than the sixth of a grain.

As the quantity of chloride which is rendered active, even under the most favourable circumstances, is very small, it is evident that, when silver is exhibited to procure its *remote effects on the nervous sys-*

tem, a preparation which is at the same time soluble, and incapable of decomposition in the gastric juice, is much wanted. We hope to have this desideratum supplied by a solution of the chloride in the hypo-sulphite of soda. This preparation has a saccharo-metallic taste, and a dose of it, containing an amount of silver equivalent to two grains of the nitrate, is easily borne by the stomach. As it is not decomposed by *diluted* muriatic acid, or solutions of the phosphate of soda, muriate of soda, and muriate of ammonia, there is reason to believe that it is not acted upon by the gastric juice, but passes directly into the circulation. The mode of preparing this solution, together with its physiological and therapeutic action, we shall notice on a future occasion.

We shall close our remarks with an analysis of the author's observations on *mercury* and its compounds.

M. Mialhe has demonstrated by an extensive series of experiments, that all the preparations of this metal used in medicine, in reacting with a solution of an alkaline chloride, with or without the presence of atmospheric air, produce a certain quantity of corrosive sublimate. The amount of bi-chloride thus formed differs considerably, according to the nature of the mercurial preparation employed. The bin-oxide of mercury, the greater part of the binary compounds which correspond to it in composition, and in general all the per-salts of mercury, in contact with an alkaline chloride, give by double decomposition bi-chloride of mercury and a new alkaline salt. The protoxide, and the greater part of the binary compounds which correspond to it in composition, are converted first into calomel, and it is only by a subsequent reaction that a very small proportion of corrosive sublimate is formed. These reactions take place at ordinary temperatures, but are much promoted by a heat equal to that of the human body. Some are affected immediately, and the greater number do not require more than a few hours.

For the reader's convenience, we have thrown into the tabular form the results obtained in experiments with the more important mercurial compounds. In each experiment, six decigrammes of the mercurial preparation were placed in contact with an alkaline liquor having the following composition :—common salt, sal-ammoniac, of each, six decig.; distilled water, ten grammes. The operation was continued in all the experiments for twenty-four hours.

The process adopted by Mialhe to estimate the quantity of bi-chloride formed, is, we believe, quite exact. It is a modification of that recommended by Gay-Lussac.

MERCURIAL PREPARATION EMPLOYED.	QUANTITY OF CORROSIVE SUBLIMATE FORMED.	
	At the Ordinary Temperature, from 15° to 20° Centig.	At a Temperature of om 40° to 50° Centig.
Calomel (prepared by sublimation.)	6 milligrammes [1]	15 milligrammes.
Proto-bromide,	6 „	15 „
Protiodide,	5 „	6 „
Protoxide,	11 „	19 „
Proto-nitrate,	4 „	13 „
Proto-sulphate,	7 „	14 „
Proto-acetate,	8 „	11 „
Proto-tartrate,	4 „	8 „
Ammonio-chloride,	82 „	180 „
Bin-oxide,	47 „	154 „
Bin-iodide,	110 „	193 „
Bi-cyanide, Per-nitrate, Per-sulphate,	Entirely converted into bi-chloride.	
Turbith Mineral,	112 „	228 „
Bi-tartrate,	312 „	362 „
Metallic Mercury,	4 „	7 „
Per-sulphuret, Black Sulphuret,	Are not acted upon when pure.	

So long ago as 1763 Capelle affirmed, that calomel, when mixed with muriate of ammonia in solution, undergoes some important change; but as to the nature of the chemical reaction thus induced, chemists were by no means agreed. Some maintained that the proto-chloride was merely held in solution; others, that a portion of it was converted into corrosive sublimate and metallic mercury, the truth of which view Mialhe has been the first to demonstrate by experiment.—(P. 10, *et seq.*) When the experiment is performed with distilled water, and the atmosphere is excluded, the change is correctly represented by the following formula:—

$$Hg\ ^2Cl\ ^2 = Hg\ Cl^2 + Hg$$

But the reaction is more complex when the fluid is exposed to the atmosphere, in which case the quantity of sublimate produced is much greater. Under these circumstances, the calomel absorbs a certain quantity of oxygen, one equivalent of bi-chloride being produced for every two equivalents of oxygen absorbed; further, each equivalent of the bin-oxide of mercury thus formed gives, by double decomposition with the chloride of sodium or ammonium in solution, one equivalent of sublimate and two of soda or ammonia.

In the case of calomel, Mialhe has performed a number of ex-

[1] 100 milligs. = 1 decigramme.
1 decig. = 1·54 gr. English Troy.

periments to determine the effect of circumstances in modifying the amount of bi-chloride formed. He has thus shown:—

1. That when calomel, prepared by precipitation, is employed, the quantity of bi-chloride produced is greater than from the same drug obtained by way of sublimation.

2. That the quantity of bi-chloride produced bears no proportion to the amount of calomel employed; but is in exact relation to the quantity of alkaline chloride present in the solution.

3. That the quantity of sublimate produced is greatest when the alkaline solution is most concentrated.

4. That the presence of organic matter in the mixture does not prevent the reaction, and that while fatty matter retards, dextrine favours it.

5. That although the change may take place in water entirely deprived of air, yet it is promoted in a marked degree by exposure to the atmosphere, the quantity of bi-chloride formed being more than three times greater in the latter than in the former case.

The immediate agent of the physiological action of all mercurial compounds is, according to Mialhe, the corrosive sublimate formed by the agency of the gastro-intestinal fluids, which contain the muriates of soda and ammonia, accompanied or not with muriatic and other acids, which promote the reaction on the preparation employed; and, as a corollary to this proposition, he maintains that their activity is in exact relation to the facility with which they are converted into bi-chloride. However true this proposition may be in reference to the insoluble mercurials, we deny its application to all the soluble compounds. We have induced salivation by the use of *large* doses of a soluble and non-irritant salt, the tartrate of potash and mercury, without exciting the slightest irritation of the stomach or intestines; for which, and other reasons derived from the chemical properties of this salt, that we cannot now enter into, we presume that it is absorbed directly, without previous conversion into the acrid bi-chloride.

By inspecting the table which we have given above, the reader will observe, that it corresponds in its results pretty closely with clinical experience; thus, the bi-cyanide and per-sulphate of mercury, which are known to be heroic poisons, are there seen to be entirely converted into corrosive sublimate; the results obtained in the experiments with the ammonio-chloride, bin-oxide, and bin-iodide, tally satisfactorily with their well-known energy; while the small amount of bi-chloride formed from the proto-chloride, proto-bromide, and proto-acetate, accounts for the lesser activity with which these agents are endowed. At the same time, we think that the proto-salts hold here a lower place than experience has generally assigned to them. That the alkaline chlorides and muriatic acid should have no action on cinnabar, or the black sulphuret of mercury, is in exact accordance with the inert character of these compounds.

The great difference in the quantity of corrosive sublimate form-

ed from the proto-salts, when compared with the per-salts, is well shown in the iodide and bin-iodide, proto-tartrate and per-tartrate. Mialhe affirms, that the physiological action of the last two salts differs in a like degree. The French possess two empirical preparations (liquors of Pressavin and Diener,) which contain the tartrate of mercury for their active ingredient. These are very unequal in activity; the preparation which at one time displays an almost poisonous energy, at another acting as the mildest of mercurials. Mialhe has shown, that this is owing to differences in the mode of preparation, in consequence of which they contain, along with the proto-tartrate, very variable proportions of the per-tartrate.

Our author's experiments show, further, that the pure metal itself, when exposed to the action of the atmosphere and of alkaline chlorides in solution, is converted in part into corrosive sublimate; and to this fact we can have little hesitation in ascribing the therapeutic action of metallic mercury, and of the compounds in which it is present in a state of fine division. When these contain in addition the protoxide, their activity is augmented, as the table indicates; but that their action, as mercurials, is due solely to the small proportion of oxide which may be present, cannot now be maintained. The pure metal, even when given in the fluid form, is not inert. As administered generally, it passes so rapidly through the intestines, that no time is afforded for the gastro-intestinal fluids to act upon it. But if from any cause it be retained, the result is very different; as in the case of a woman recorded by Mialhe, to whom fifteen ounces of the pure metal were administered to relieve obstruction of the bowels. She lived for six days afterwards, during which period the symptoms of obstruction continued, and the mercury was retained in the body. M. Mialhe saw her on the day of her death; the pulse was then almost imperceptible, the skin was cold, and the face was emaciated and painfully contracted. She complained of acute pain in the belly, which was enormously swollen. But in addition to these symptoms, which might be due as much to the intestinal affection as to the mercurial poisoning, she was affected with a peculiar and constant trembling of the superior extremities, and of the lower jaw; the gums were violet-coloured and bleeding; the inferior incisors had all fallen out two days previously; one only of the superior incisors remained, and it was so loose that the slightest effort would have sufficed to extract it; the inferior maxillary bone was exposed in several points over the areolar processes, and the mouth exhaled a strong mercurial and fetid odour. There was little salivation. A post-mortem examination was refused.—P. 107.

This view is opposed to that of Dr Christison, who doubts whether metallic mercury, swallowed in the fluid state, has ever excited mercurial action, and who believes that all the mechanical preparations of this drug probably contain a quantity of oxide sufficient to

account for their specific effects. The researches of Mialhe, in reference to arsenic, mercury, and other metals, fully establish the correctness of the general law in physiology laid down many years ago by Dr Christison, "that metals do not act as such, but must first be converted into oxides or salts" (*Dispensatory*, 1st Ed. p. 503); but they show further, that the changes which are requisite for absorption may take place in the interior of the body.

There are many circumstances in connexion with the physiological action of calomel, which admit of explanation on this theory, which attributes its absorption to a partial conversion into corrosive sublimate; such as the equal activity, in so far as absorption is concerned, of small and large doses, the quantity of bi-chloride formed being determined by the saline strength of the secretions, and not by the amount of calomel taken; the advantage of the frequent administration of small doses, and in this manner exposing the chloride to the agency of a large quantity of the secretions. Ptyalism is said to be readily induced in seamen. Is this owing to an excess of chloride of sodium in their gastric and intestinal fluids, on account of their eating salted provisions? In cholera, and other enteric affections, we know that the blood is exhausted of its saline constituents, and that the secretions consist of little more than water. Now, placing this fact in connexion with the action of large doses of calomel in these diseases, in which, instead of exciting violent mercurialism, or "of adding to the local irritation, as might be expected from the well-known effects of that drug on the healthy bowels in less doses, they have a tendency to soothe pain, allay spasm, abate redness, and lessen excessive secretion" (*Christison's Dispensatory* p. 512), is it not probable that this remarkable suspension of the physiological action of the medicine, is dependent on the watery state of the secretions, and consequent non-production of corrosive sublimate? Unfortunately, this leaves the therapeutic action as far from comprehension as ever.

Having entered the circulation, our author supposes that the bichloride unites with the albumen of the blood; the combination thus formed, insoluble in water, is soluble when in the state of hydrate, in the solution of an alkaline chloride, as the serum of the blood. Of the existence of mercury in the blood, and its passage into the secretions, there is now no doubt. Mialhe succeeded in detecting it in solution in the urine twelve hours after taking a dose of nine grains of calomel. The quadruple compound of albumen, chlorine, mercury, and the alkali, which results, is very fluid and remarkably stable. It is not decomposed by hydro-sulphuric acid, the alkalis, or the ordinary tests of mercury, which fact, we think, offers a probable explanation of the difficulty of detecting mercury in the blood, and the general necessity for that purpose of destructive distillation. Is the formation of this compound, and its circulation with the blood throughout the body, the cause of that remarkable combination of symptoms termed mercurialism? The diminution

of the albumen effected in this way, would account for the dissolution of the blood, and loss of its plasticity, as indicated by paleness and hemorrhages, which is now generally recognised as an effect of mercurial action.

The general opinion that corrosive sublimate in combining with animal matters is reduced to calomel, is denied by Mialhe; and the results obtained in his experiments have been subsequently confirmed by MM. Chantourelle, Lassaigne, and Selmi. When, for therapeutic use, it is allied to certain organic bodies, as milk, sugar, or gum, its action is much milder, as it is thereby deprived of its irritant and caustic properties. Its absorption and general action on the system, are not the less certain, as was pointed out by Soubeiran in 1840.

There is one substance, however, contained in several pharmaceutic compositions, which has the property of converting corrosive sublimate into calomel. This is the formic acid, produced by the action of an alkali on glucose. Thus, when grape sugar is boiled with potassa, there is obtained a brown liquor, which has the property of immediately reducing corrosive sublimate to calomel, and lastly to metallic mercury. It is to the presence of this body that Mialhe attributes the diminished power of corrosive sublimate when added to certain compound syrups, and more especially to the compound syrup of sarsaparilla of the French codex, which is directed to be prepared by boiling. But it is not essential to combine the bi-chloride with organic matters to deprive it of its causticity. It is sufficient for this purpose to unite it with chloride of sodium or muriate of ammonia. After what has been said, it is unnecessary to add any thing in explanation of the *rationale* of the following formulæ:—

Solution of Corrosive Sublimate.

Distilled Water,	1000 parts.
Muriate of Ammonia, and Chloride of Sodium, of each,	2 parts.
Bi-chloride of Mercury,	1 part.

Dose, a table-spoonful three, four, or more times daily.

Pills of Corrosive Sublimate.

Corrosive Sublimate,	8 grains.
Chloride of Sodium,	30 „
Starch,	45 „
Gum Arabic,	15 „
Distilled Water,	q. s.

Divide into 48 pills; each contains one-sixth of a grain.

Ointment of Corrosive Sublimate.

Bi-chloride of Mercury,	4 parts.
Muriate of Ammonia,	8 „
Axunge,	30 „

This is an active mercurial preparation for external use, and ought to be used with circumspection.

From the foregoing outline of some of the subjects embraced in M. Mialhe's treatise, the reader will be able to form an opinion of the general character of the work. We cannot observe too much caution in accepting chemical explanations of physiological and therapeutic phenomena, more especially when coming from one who is not himself a practical physician; but although several of our author's inferences, as we have ourselves shown in one or two examples, should not be confirmed by future observations, still the facts on which they are based remain to science, and the erroneous deductions themselves will not be unproductive of good. Such inquiries are in an eminent degree suggestive; and though they may sometimes lead to error, yet, to use the words of Andral when speaking of the same subject, " L'esprit s'y arrête et y revient, comme s'il avait la conscience qu'elles le placent à un point de vue d'ou des vérités importantes vont lui apparaître."

There are portions of the work with regard to which the office of the critic might be exercised with some severity; more especially is the author open to censure when he leaves his proper science, which is that of pharmaceutical chemistry, and enters the domain of physiology. But the fault for which he is above all blameworthy, is an obvious carelessness in distinguishing facts from mere suppositions, and actual observations from loose conjectures. These and other blemishes, however, we willingly overlook in consideration of the merits of the book, which is the fruit of much patient labour and superior ability. We are no more than just, when we characterise it as forming a most valuable contribution to our knowledge of the changes that drugs undergo in the stomach and intestines—a department of therapeutics, the importance of which can hardly be overrated, but which, it is much to be regretted, is still in its infancy.

Researches on the Motion of the Juices in the Animal Body. By JUSTUS LIEBIG, M.D., Professor of Chemistry in the University of Giessen. Edited by WILLIAM GREGORY, M.D., Professor of Chemistry in the University of Edinburgh. London: 1848. Pp. 109.

THE present work belongs to a class which we are always disposed to receive with pleasure, and which we never peruse without great expectations. We have always held, and have often asserted, in the pages of this Journal, that the true mode of cultivating the science of the vital phenonema is by giving scientific precision to our ideas of the relations of these with physical science; and we are convinced that it is only by a thorough understanding of the latter, that success can be attained in the attempt to reduce the more recondite and complex vital phenomena to those simple and general expressions which we term laws.

Physiological science appears to us to be at present in a transition state. The old parties have been broken up, the new are scarcely yet formed. The vital, chemical, and mathematical schools in physiology have each had their day, and have done their work; but all of these, considered as exclusive systems, may be said, with truth, to have vanished from modern physiology. If a physiologist of the present day speaks of a theory as being too mechanical, he refers to a particular instance; he does not mean to deny in general that mechanical laws enter deeply into the explanation of the phenomena of organized bodies; nor does a chemist attempt to refer *all* physiological phenomena to the laws of his own peculiar science. On the other hand, there are now few who would hesitate about admitting, that the result of chemical and physical reasonings, as applied to physiology, has been only the more clear and distinct isolation of phenomena to all appearence as different in nature from those of dead matter, as the phenomena of chemical affinity are from those of gravitation.

In building up chemical science, it was necessary to eliminate those phenomena which could be explained by the laws of mechanics. This done, the resulting phenomena were seen to be referrible, in great part at least, to a law of affinity which produced combinations of different substances in definite proportions, and with material alterations of their original most essential properties. In building up vital science a similar method must be pursued; the laws of physical and chemical science must be applied rigidly to the investigation of the phenomena of organized life; and thus by the method of exclusion we shall arrive at more definite ideas as to the nature of the laws which are peculiar to organized existence.

In this mode of inquiry Liebig has earned one of the greatest reputations of the present age. If some of his researches have exhibited, in particular cases, a too exclusively chemical bias, this is perhaps no more than was to have been expected; and no one can deny that, in his general scientific doctrines, Liebig has at all times showed the fullest and most correct appreciation of the present condition of physiological science. It is impossible, therefore, to turn to a new work of so distinguished an observer, without having our expectations immoderately raised. We must confess, that the present work does not entirely satisfy those expectations; still, it contains the result of an extensive series of researches, some of which will probably come to be of the greatest value in science, and the entire value of which will, perhaps, not be appreciated until they have been some time before the public. In this article, we propose to give our readers an idea of some of the principal results arrived at in this work, without, in the mean time, attempting to give a *systematic* view of the researches on which these results are founded. This attempt must remain to be made at a future period, if, indeed, that be possible for any one, which the author himself has not even attempted.

The title of this work is scarcely indicative of its exact nature. The greater part of the volume is devoted to an inquiry into the physical conditions of imbibition and endosmosis, phenomena which are by no means exclusively confined to, or illustrative of, the motions of the *animal* fluids, and which have been conclusively shown to occur in unorganized as well as organized textures. The body of the work is, therefore, a purely physical inquiry. Applications to animal physiology, and an account of Hales' observations on vegetables, occupy the latter part; but the former are illustrated by very few new observations, and are, indeed, more of the nature of speculations, thrown out for future inquiry, than of positive additions to physiological science. These hints, however, imperfect as they are, appear to us to be founded on sufficiently good data, and are certainly of the greatest interest in a physiological point of view.

With respect to the physical and experimental part of the inquiry, we find little which is not better and more philosophically illustrated in the lectures of Professor Matteucci of Pisa, delivered in 1844, and now so well known in this country; with which, however, Professor Liebig seems not to have been acquainted, as the name of their author is not, so far as we have observed, once mentioned in the present volume. This is the more to be regretted, as we cannot help thinking, that an acquaintance with the views and experiments of the Italian professor would have caused a considerable modification in those contained in the volume before us. They would, at least, have had the effect of stimulating the acute mind of Liebig to accomplish more than, as it appears to us, has been done in the present instance. We shall probably seize an early opportunity of bringing before our readers some of the recent contributions to this department of physical science. At present, we shall confine our remarks, for the most part, to a theory, which it appears to be one of the main objects of this series of researches to support, and in which Liebig decidedly differs from all other writers on the subject.

The general tendency of this work is, to claim for chemical attraction, or affinity, a much larger share than has been hitherto conceded to it in the production of the phenomena of solution, endosmose, imbibition, and even capillary attraction. In accordance with this view, the term "*chemical* attraction" undergoes, in Professor Liebig's hands, an extension of signification, of which it is necessary that our readers should be aware. Not only is a simple solution, or the intermixture of two liquids, such as alcohol and water, arbitrarily referred to the law of chemical affinity; but the simple circumstance of adhesion of the particles of a liquid to those of a solid, when the latter is moistened, is owing, according to Liebig, to an affinity between the particles of each. He admits, indeed, in the beginning of the work (p. 4), that "the penetration of a fluid into the pores of a porous body, is the result of capillary attraction;" but, throughout the work, he speaks of imbibition, and even moistening of bodies, as mainly the result of chemical attraction. Indeed, in p. 27, he boldly

asserts that chemical affinity is manifested *every where*, when two dissimilar bodies come into contact:—"Although we are accustomed to limit the notion of affinity to such cases as exhibit a change perceptible to our senses, in the properties of the substances employed, as, for example, when sulphuric acid and lime, or sulphuric acid and mercury, combine together, this limitation arises from the imperfect apprehension of the essence of a natural force."

According to Liebig, the solution of a salt in water is an example of chemical affinity; the attraction of the atoms of salt for the water, being in this case stronger than their attraction for each other. In like manner, the precipitation of the salt from the water by the addition of alcohol, is likewise an example of chemical affinity, in which the former attraction is overcome by a yet stronger one, that of the alcohol for the water. Now if, instead of adding alcohol, and thus precipitating the salt from its solution, we place that solution in contact with a piece of dried animal membrane (or indeed almost any body capable of imbibing it), the salt is in this case also precipitated, provided the solution be sufficiently strong; a result which, according to Liebig, springs from exactly the same cause as in the former instance,—viz. that the affinity of the salt for the water has been overcome by a stronger affinity, that of the membrane for the water; and, as the membrane has little or no affinity for the particles of the salt, the latter is partially separated in the crystalline form.

Thus, according to this definition, a change in the properties of the substances (which has hitherto been identified with the very nature of chemical phenomena), is by no means necessary as a manifestation of affinity. Neither is combination a necessary part of Liebig's idea of affinity; combination being only one result, which occurs when the attraction is stronger than all the obstacles opposed to its manifestation, and not otherwise.—(P. 27). Mere adhesion of particles, on the contrary, if they be particles of dissimilar bodies, such as water and membrane, water and clay, even water and glass, when the latter is moistened, is accepted as a proof that chemical affinity has been brought into play.

Now, we must say that this arbitrary alteration of verbal meanings appears to us a most illogical, and (where supported by so great a name) a most dangerous way of dealing with a scientific question. There is not, in the whole of the present volume, the shadow of a proof that the phenomena of imbibition and moistening of porous or other substances are due to any other force than that which has hitherto been well known under the names of attraction of cohesion, molecular or capillary attraction. There is not the slightest proof that the moistening of a porous body is in nature different from the moistening of any other body, or that the affinity which exists between the particles of water and glass, water and membrane, water and alcohol, is in any way different from that which undoubtedly exists between the particles of water and water, alcohol and alcohol, glass and glass, &c. Yet these last have been always admitted to

be the most undoubted instances of molecular attraction, a mechanical, not a chemical force.

That molecular attraction varies infinitely in amount, both between different substances, and in the same substance under different external conditions, is perfectly well known. That a porous substance, therefore, should absorb more of a fluid for which its attraction is great than of one for which its attraction is small, is not new either in theory or experiment. That water, by its attraction for salt, should reduce the particles of the latter to a molecular form, and diffuse them intimately through its substance, is another phenomenon of the same kind. That alcohol, by its greater attraction for the water, should remove the atoms of salt from their molecular condition, and resign them to their attraction for each other, is again due to a molecular attraction of the water for the alcohol, stronger than that of the water for the salt. Liebig has indeed admitted that capillary attraction is present in these cases; the only question is as to the presence of chemical affinity.

Now we maintain, that if molecular or capillary attraction, in the ordinary sense of the term, be sufficient to account for the phenomenon, it is unphilosophical to suppose chemical attraction superadded to it. If, on the other hand, it be asserted that capillary attraction and chemical affinity are in reality one and the same force, we reply that it may be so, but we do not find in the present work any additional evidence on the subject. The analogies between chemical affinity and molecular attraction must, we think, have struck every one, as well as the arguments which have been urged in favour of the identity of the latter force with gravitation. Nay, we are by no means insensible to the proofs which have lately been adduced, that the whole of the physical forces are essentially modifications of one great force acting universally throughout nature; but the evidence of such propositions as these must be drawn from extended observation, and new experiments upon these forces in every possible mode of their action, and not from a few crude analogies, which have been a hundred times observed. In the mean time it is customary and right for scientific purposes to distinguish between molecular and chemical attraction. Thus copper and silver may be intimately mixed, forming an alloy. This is molecular attraction; the combination takes place in all proportions indifferently, and the properties of the two substances remain the same as before, except in so far as altered by the physical law of mixture. Again, copper and silver each combine with oxygen. This is true chemical affinity, with combination in definite proportions, and is manifested by such an alteration in the properties of the compound as cannot be accounted for on simple physical laws. While we hold, therefore, as we do, the provinces of these separate classes of phenomena to be, in the present state of science, sufficiently well defined, we cannot but think it extremely unadvisable to adopt the terms and arguments of Liebig in the present work; for not only have they a tendency to confuse and

unsettle the mind of the inadvertent reader, but they appear to us to have led the author himself in many instances to a false application of the results of his own experiments.

We have already indicated the part of this work which relates to the animal organism, as containing some valuable speculations well and clearly stated. The conclusion at which Liebig arrives in this part of the work is, that, according to the laws of endosmosis and exosmosis, the cutaneous transpiration and respiration must exercise a more considerable influence than has been generally admitted, upon the motion of the fluids in the vessels; that these fluids, indeed, must be drawn towards the skin and the lung with considerable force to supply the loss of fluid in these situations. That the pulmonary and cutaneous exhalations are conformable to the physical laws of endosmosis and exosmosis, and are probably very much promoted by these forces, there can be no doubt. The experiment of Liebig, illustrating this point, is very ingenious; it is, however, nearly the same with one performed by Professor Leslie of Edinburgh, in connexion with a different subject. If a bent tube, widened at one extremity, and closed at this end by a piece of moist bladder, be filled with water, and the narrow end be then placed in a vessel of mercury, evaporation will take place from the surface of the membrane, and the volume of the water within will be diminished. At the same time, air will pass slowly into the tube, and partially replace the water. Nevertheless, it will be found that a pressure from within outwards is generated, sufficient to raise a column of mercury in the smaller end of the tube from 12 to 24 inches, according to the thickness of the membrane. This pressure, of course, is generated according to the law of exosmosis.

Leslie's experiment was nearly identical with that of Liebig, the only difference being, that the evaporating surface was formed by a thin ball of porous earthenware to which a glass tube was adapted. This instrument was filled with water, and inverted in mercury, as in Liebig's experiment; the same results were produced, thus showing what Matteucci's experiments so clearly demonstrate, that exosmosis is a purely physical phenomenon.[1]

In the animal body a similar process goes on. There is a perpetual evaporation from the surfaces of the skin and lungs, which tends to diminish the volume of the fluids; and there is likewise an absorption of gases from the atmosphere into the blood. In so far as this process, therefore, follows a physical law, it is perfectly clear that there must be a constant pressure exerted towards the surface.

Liebig has not investigated the relations of the skin in animals which live in water, to the physical processes of endosmosis and

[1] This instrument was used by Leslie for determining the rapidity of exhalation from a porous surface.—See *Encyclopædia Britannica*, article *Atmometer*, and Leslie's *Short Account of Experiments and Instruments depending on the Relations of Air to Heat and Moisture.*

exosmosis. In relation to this branch of the subject, Matteucci discovered the remarkable fact, that, in the skins of most amphibious animals, endosmosis takes place much more actively from the internal to the external surface, than in the contrary direction. The application of this fact to physiology is obvious. Some differences in this respect also exist in nearly all animal membranes, the transudation being found to differ in rapidity, according as the one side or the other is placed in contact with the denser liquid. The ignorance of this fact by Liebig is an unfortunate circumstance, as it may have unconsciously interfered with the results of some of his experiments.

The influence of these physical circumstances upon pathological processes, is certainly worthy of attention. It is clear, that the physical effect of diminished transpiration, must be diminished motion of the fluids towards the surface. This circumstance, in Liebig's opinion, may be explanatory of many diseases, and is an obvious cause for the relation of diseases to the hygrometric state of the atmosphere. Not only is this the case in animals, but in plants. The blight of hops and potatoes may probably be owing, like the influenza in the human subject, to suppressed transpiration. A considerable space is given to the observations of Hales in reference to the hop-blight, and the motion of the fluids in plants.

We refrain from pursuing this subject further at present. These speculations seem to be sufficiently important; but, in the crude theoretical form in which they are here presented, it would be impossible to make them interesting to the majority of the profession. They are undoubtedly capable of being submitted to the test of direct experiment. Indeed, the researches of a recent observer (Fourcault) have been directed to the careful experimental investigation of the effects of suspended transpiration. We shall probably soon be able to lay these results before the readers of this Journal.

Recent Advances in the Physiology of Motion, the Senses, Generation, and Development. By WILLIAM BALY, M.D., F.R.S., Physician to Millbank Prison, and Lecturer on Forensic Medicine at St Bartholomew's Hospital; and WILLIAM SENHOUSE KIRKES, M.D. Being a Supplement to the Second Volume of *Müller's Physiology.* London, 1848.—Pp. 132.

THIS exceedingly careful and elaborate compilation forms a useful supplement to the second volume of Müller's Physiology, a work which, although not, perhaps, the most readable and generally useful in our language for the beginner in physiological science, must long maintain its place in English literature, as the most trustworthy and satisfactory guide for the advanced student. The same spirit of careful and impartial research, which formed the distinguishing characteristic of the original work, appears to have

guided the authors of the volume before us; the details of which are so varied and numerous, as to render it impossible for us to go into them at any length.

We hope that ere long Dr Baly will turn his attention to the subjects contained in the first volume of Müller's work. Some of these, such as Digestion and the Nervous System, require revision no less than those in the second volume. Meanwhile we have much pleasure in recommending the work of Drs Baly and Kirkes to our readers, as being at once well executed, handsome, and moderate in cost.

Part Third.

MEDICAL NEWS.

MEDICO-CHIRURGICAL SOCIETY OF EDINBURGH.

SESSION XXVII.

MEETING XIII.—*Wednesday, July* 5, 1848.—Dr D. MACLAGAN in the Chair.

ON SEVERAL NEW GALVANIC BATTERIES. BY DR WRIGHT.

1. IN the *Monthly Journal* for July, I inserted a short notice of this new battery, as I wished to publish as soon as possible the principle on which it was founded, viz. *the inactivity of zinc in a mixture of concentrated nitric and sulphuric acids.* I now proceed to give an account of the mode of arranging the apparatus, sufficiently detailed to enable any person to construct it, as the battery is especially adapted for medical purposes, on account of its high intensity, and the facility with which it may be put together.

2. The battery essentially consists of a positive plate of zinc associated with a negative plate of the same metal covered with platinum, the former immersed in a solution of some neutral salt or caustic alkali, the latter in a mixture of nitric and sulphuric acids. The intermixture of the two liquids is prevented by the intervention of a porous cell, which may be formed of garden pot-clay, pipe-clay, or plaster of Paris. The cheapest and most convenient form of the apparatus is constructed in the following manner:—Take a common jelly jar two and a half inches in diameter, and line it with a strip of the thinnest sheet zinc two inches wide, from the edge of which a narrow strip or ear is cut, turned over the edge of the jar, and twisted to a copper wire (No. 20); within the zinc place a small porous earthenware garden-pot rendered water-tight by a plug of sealing wax, and within this again a roll of platinized zinc, to which a similar wire has been twisted. The battery is now complete; on charging it, pour a saturated solution of common salt or muriate of ammonia in the space without the porous cell and within it, and in contact with the platinized zinc the nitro-sulphuric acid.

3. The nitro-sulphuric acid consists of *nitric acid one part and sulphuric acid five parts.* In such a mixture zinc, the one of the most oxidizable metals, is as inactive as a plate of glass or porcelain; but a very slight deviation from the above proportion by the addition of nitric acid or water dissolves the charm, the metal is acted on, and the platinum is thrown off its surface, for which reason it is advisable to let the nitro-sulphuric acid have an elevation within the porous cell, higher than that of the saline solution without it.

4. I have now described the mode of constructing a single cell of the battery, which is well adapted for use in conjunction with the electro-magnetic coil machine; but when the instrument is to be applied to the decomposition of saline or other fluids, it is proper to use from four to six cells in series, the