BOOK-REVIEWS.

The Chemistry of Photography. By RAPHAEL MELDOLA, F.R.S. New York, Macmillan & Co. 12°. $2.

THIS book consists of nine lectures which were delivered as a special course at the Finsbury Technical College. With the chemistry of photographic materials, their preparation, properties, and re-actions, and with the practical details of photographic manipulation, the author does not deal, but confines his attention to the consideration of the chemical changes which occur in photographic processes, or the chemistry of photography, properly so called. His object is to present the principles involved in these processes, to show what point has been reached in the explanation of them, and to stimulate further investigation. He hopes, too, "that the present work may contribute toward convincing" purely scientific chemists "that there are many important problems still awaiting solution in this field of research." Each lecture is followed by an appendix containing directions for performing well-selected experiments in illustration of the text. As the lectures were originally addressed to an audience of chemical students and photographers, some elementary knowledge of chemistry is assumed.

The amateur picture-maker who is content "to push the button" and let some professional photographer "do the rest," or who has no ambition beyond the knowledge of the simple manipulative details which enable him to mix his solutions successfully and make passable photographs, will find little to interest him in this book. But all who have felt the real fascination of the "dark room," and desire to know more of the nature of the mysterious action of light and the "developer" on the responsive film, will give it a hearty welcome. The reader must not, however, look to have all his questions satisfactorily answered, or all his difficulties solved; for the subtile re-actions caused by light in the salts of silver are among the most perplexing problems known to chemistry, and photochemical theories are to a large extent still in the speculative stage. Mr. Meldola does not attempt to conceal this fact. He distinctly and repeatedly points out the insufficiency of certain hypotheses in regard to the nature of photochemical processes, and, as it happens, gives in his own constructive efforts one or two striking illustrations of the difficulties which beset the theorist in this obscure region, and tend to lift his feet from the solid ground of experimental facts. It should be said, however, that his theoretical suggestions are free from any undue assertiveness, and are advanced chiefly from the motive that they "may serve as a stimulus to further experimental inquiry" (p. 214). They will perhaps attain this object quite as much through their evident inadequacy and the criticism they will undoubtedly provoke as in any other and more direct way.

Lecture II. is devoted to the discussion of the composition of the darkened product formed from silver chloride under the influence of light. This is a subject of fundamental importance, for the identity of the material of the latent image with this darkened substance is universally admitted. Mr. Meldola rejects the generally accepted subchloride theory, and attempts to show that the product in question is probably an oxy-chloride. The argument against the subchloride is that its existence "is only inferred from the analogy with the metals of the copper group, and is not the result of the analysis of the pure compound" (p. 40). This is hardly a fair statement of the case. It is true that the argument from analogy is flimsy: it does not deserve the attention the author bestows upon it. It is true that no satisfactory direct proof of the existence of the subchloride has been obtained through its isolation and complete analysis; but it is also true that the loss of chlorine which occurs when silver chloride is exposed to light, and the fact that metallic silver is not the result of the action, as well as the whole mass of observation on the effect of light on this and other salts, indicate very strongly that the darkened substance is a *reduction product;* and Cary Lea's brilliant work, two or three years since, on the photo-salts of silver, furnishes weighty evidence that this product is a subchloride united with a larger amount of unchanged normal salt after the manner of a "lake." The most that can reasonably be said against the subchloride theory is that it is not yet absolutely proven by the isolation and analysis of the substance. This is no sufficient ground for its rejection, unless a better theory can be formulated. Mr. Meldola thinks that such is found in the hypothesis that the change produced by light is probably due to the formation of an oxy-chloride of the formula $Ag_4 O Cl_2$. This he supports on an experiment of Robert Hunt's in which oxygen was found to disappear during the darkening of silver chloride, some conclusions of Dr. W. R. Hodgkinson the experimental evidence for which does not seem to have been yet published, and an appeal to the analogy supplied by the darkening of thallous and cuprous chlorides on exposure to light; the change in the case of the latter "being in all probability due to the formation of an oxy-chloride" (p. 57).

Now, not only is direct proof of the existence of the alleged oxy-chloride wanting, but its formation during the action of light is opposed to all the evidence which points to the reducing nature of that action; for the oxy-chloride is in no sense a reduction product, oxygen simply taking the place of chlorine in a complex molecule.

The hypothesis is further in direct contradiction to certain well-known facts which the author has apparently overlooked in his study of the matter, though he gives them place in the discussion of other points. Thus on p. 75 it is stated that hydrogen acts as a sensitizer, accelerating the photo-decomposition of silver chloride; on p. 227, that action goes on under a film of benzene even to the point of reversal; and again on p. 197, that the invisible image is destroyed by oxidizing agents. An action which takes place in hydrogen, or under a liquid destitute of oxygen, and which is undone by oxidizing agents, can hardly consist in formation of an oxy-chloride. It is, in fact, a weak and untenable hypothesis. Not only does it offer the same difficulty which Mr. Meldola urges as a chief argument against the subchloride theory, but it breaks down completely when confronted with facts which the latter readily explains. It is interesting to note that since the appearance of the book, Mr. Lea has published in the *American Journal of Science* a clever bit of experimental work which disposes of the oxy-chloride hypothesis in the most final manner. Mr. Lea found that silver chloride, poured in the molten condition into naphtha, blackened instantly in sunlight, and that a black iodine product was formed by the action of light on metallic silver covered with naphtha containing iodine in solution; that is, the darkened substance is produced under conditions which rigorously exclude all possibility of the presence of moisture or of oxygen in any shape.

In his discussion of the action involved in the reversal of the image on the photographic plate under prolonged exposure to light, or "solarization," as it is often called, the author again shows his lack of that comprehensive grasp of facts and principles which is an essential qualification for all sound theorizing.

The explanation which he proposes for this most perplexing phenomenon is, that in a gelatino-bromide plate, for instance, the bromine lost at first by the silver salt under the influence of light is taken up by the gelatine in which the salt is embedded, until "the vehicle becomes brominated up to a certain degree of saturation; complex bromo-derivatives, or additive compounds, or oxidized products, are formed, and these at length begin to re-act with the reduction product aided by the external oxygen" (p. 225). His conception of the mechanism of the process is clearly given in the closing sentences of Lecture VI.: "A ray of light falling upon a sensitive plate is like the motive power driving a dynamo-machine which is feeding a storage-cell. When the charge of the latter has reached a certain point, it is capable of reversing the motion of the system, and of converting the dynamo into a motor. The sensitizer plays the part of such a storage-cell. When it becomes charged, i.e., halogenized, to a certain amount, the chemical energy stored up in it begins to run down, and reversal takes place." Or, to take an equally pertinent but simpler illustration, the ray of light is like a weight resting on a piston which works in a cylinder full of air. The piston sinks under the weight; but when the compression of the air has reached a certain point, it is capable of reversing the motion of the piston and raising the weight! It does not require a scientific training to see that this is absurd. It is a scheme for perpetual motion. We have every reason for believing that the law of the conservation of energy applies to chemical as well as to mechanical action, and it is obvious that under this law Mr. Meldola's explanation is preposterous.

Aside from these unfortunate ventures, speculative regions, and a certain tendency to looseness of statement, which is, however, in most cases annoying rather than misleading, we find much to commend in the book. It presents the most complete and connected discussion of photochemical theories with which we are acquainted, is in the main accurate in its statements of experimental facts and the explanations which have been proposed for them, and thus forms an important and valuable contribution to the literature of the subject. It is rich in suggestion to the chemist, and will undoubtedly fulfil the author's hope of attracting new workers to this field for experimental inquiry.

Evolution. Popular Lectures and Discussions before the Brooklyn Ethical Association. Boston, James H. West. 12°. $2.

THIS book consists of fifteen different papers, originally prepared for a popular audience, but designed to present the evolution theory in a thorough and scientific manner. They are by many different authors, and deal with all the leading aspects of the subject. The two opening papers treat of the life and work of the two chief expounders of the new doctrine, Darwin and Spencer; then follow others on the evolution of the earth and the solar system; then the biological department is dealt with; while a considerable portion of the book is devoted to the evolution of morals, religion, and society. The essays, or lectures, are in the main well adapted to the special object in view, that of making evolutionary doctrines better known to popular audiences and general readers; for the writers seem to have taken pains to make their subject plain, and to have had good success in doing so. Each lecture, as originally delivered, was followed by a discussion, in which views opposed to those of the lecturer, and even to the evolution theory generally, were sometimes expressed, and which seem to have been of considerable interest; but the report of them in this volume is rather too brief to give an adequate idea of them.

The views expressed in the various lectures are, of course, in the main those of Darwin and Spencer; but we notice, nevertheless, a decided disagreement with those thinkers on certain points. Thus Professor Raymond regards the theory of natural selection as inadequate to account for the derivation of species, and intimates that "Darwin's formula left out more important factors than any of those it contained;" and Professor Cope expressed a similar opinion. Again, Mr. Chadwick, speaking of Spencer's proposed reconciliation of science and religion, says that he "cannot conceive a more senseless and ridiculous reconciliation than this;" and he elsewhere speaks of it as "the disreputable compromise between science and religion." We notice, as the most prominent fact in the series of discussions, that when the subject of religion was introduced, a great divergence of opinion was immediately manifest; one, at least, of the speakers expressing the extremest materialistic views, while the views of others were strongly spiritualistic, and of others still pantheistic. Indeed, it looks very much as if the evolution school was likely to divide, as the Hegelian school did after its founder's death, into three distinct branches, — one theistic, another pantheistic, and the third atheistic. However, we have no desire to set up as prophets; and so we close by recommending this collection of essays to those who wish for a simple but accurate exposition of the evolutionary philosophy.

An Appeal to Pharaoh. The Negro Problem and its Radical Solution. New York, Fords, Howard, & Hulbert. 16°. $1.

THE anonymous author of this work is very much troubled about the negro problem, and he here devotes two hundred pages to a proposed solution of it. He dwells at great length on the fact that the black and the white races in this country show no sign of intermingling even socially, and paints in extraordinary colors the antipathy that exists between them. He maintains that in the Southern States the two races are farther apart in feeling, and less disposed to social intercourse with each other, than they were when slavery prevailed; and he fears that this estrangement will increase with the progress of time. In the North, too, he asserts that the separation of the two races is scarcely less marked; and for this race antipathy there is, in his opinion, no cure. Moreover, he predicts that all sorts of evils will result from this antipathy in the future; that race conflicts of one kind or another will continually arise; and that there will never be harmony between the North and South till the negro is got rid of. And so he proposes to send the whole body of seven million blacks back to Africa, whether they will or no. A colony is to be planted on the Kongo or somewhere else, and the negroes are to be transported thither, the United States paying for their passage, and also furnishing them a little money with which to begin their new life. The author fears that his scheme will be pronounced impracticable, and devotes a great deal of space to showing how it could be put into execution. To our mind, however, the scheme is not so much impracticable as inhuman; though its inhumanity is perhaps exceeded by its silliness. If the negroes should choose to emigrate, there is no objection to their doing so; but this proposal to compel them to go is one to which the American people will not listen. The negro is here to stay, and men like the author of this book must make up their minds to treat him with justice and fairness; and when they do so, all danger of trouble between the two races will disappear.

The Psychology of Attention. By Th. RIBOT. Chicago, Open Court Publ. Co. 12°. 75 cents.

THIS work is an authorized translation from the French, and originally appeared in the pages of the *Open Court*. It might better have been entitled the "physiology" of attention, for it treats almost entirely of the motions and other physical phenomena that accompany attention, and has very little to say about attention itself. The author defines attention as "an intellectual state, exclusive or predominant, with spontaneous or artificial adaptation of the individual;" yet when he comes to treat the subject he neglects the intellectual state entirely, and confines himself to its physical and emotional accompaniments. The thesis that he attempts to prove is that every species of attention is invariably accompanied by certain motor changes in the bodily frame, and that these are so essential to attention that they may almost be said to constitute it. In other words, after defining attention as an intellectual state, M. Ribot treats it as if it was a bodily state. Moreover, he fails to show that attention is always accompanied by motions or motor phenomena. Of course, in the case of sense-perception the motor element in attention is apparent; but in the case of abstract thought it is not at all apparent to the ordinary consciousness, and M. Ribot does not make it any more so. Nevertheless there is much in his book that will be interesting, especially to students of psychophysics. The work is divided into three parts, treating successively of spontaneous, voluntary, and morbid attention; and under all these heads are presented facts and ideas that will serve towards a more perfect theory of attention hereafter.

AMONG THE PUBLISHERS.

THE supplement to *Harper's Weekly* of Jan. 18 contains an interesting article on recent discoveries in the Kongo basin, detailing "the geographical surprises and new-found peoples of the past five years." The article is from the pen of C. C. Adams, and is illustrated by a large map and several other engravings.

— The picturesque forest pavilion at the Paris Exposition is illustrated and described in *Garden and Forest* for Jan. 15, where we find, as well, an account of the delightful voyage down the Rhone, so seldom made by tourists, and a picture of a positively unique orchid, *Phalænopsis F. L. Ames.*

— The closing volume of C. A. Fyffe's "History of Modern Europe" is now in the hands of Cassell & Co. The volume embraces the period from 1848 to 1878, and throws, we understand, considerable light on the complex problems in European politics which led to the Franco-Prussian war.

— More than twelve thousand letters and manuscripts of John Ericsson, the great engineer, have been put in the hands of Col. W. C. Church, to use in the preparation of his biography. The first of two articles on Ericsson, by Col. Church, will appear in the February *Scribner's*, with some illustrations from rare sources, among them the reproduction of an engraving made by Ericsson at the age of eighteen. G. Frederick Wright, president of Oberlin College, will have a short article on the curious and very ancient image thrown up not long ago by an artesian well at Nampa, Idaho.