The Rio Grande and Rio Obispo cross the canal eleven and seventeen times respectively, and hence must be diverted, calling for thirty miles of new channels. The most formidable obstacle, however, and one which leads many engineers to doubt the possibility of the maintenance, if not the construction, of the canal, is the controlling of the tremendous floods of the upper Chagres, — a stream which, in the dry season, has a depth of but two feet, but which, in the rainy season, becomes a raging mountain torrent, rising sometimes in a few hours to a height of forty feet, and sweeping down immense quantities of *débris*. The projected line of the canal is first crossed by it at Gamboa, at an elevation of about fifty feet above the bottom of the canal; from Gamboa to the sea the canal is crossed by it twenty-nine times. It is evident that some most substantial and expensive works are needed to restrain or divert the flood waters of the Chagres, or the canal will be ruined by its irruption. An immense dam of masonry or earth, or of both materials, has been proposed, near Gamboa, a mile in length and from 150 to 200 feet high at its highest point, to impound and store up the flood in an artificial lake, from which it shall escape more gradually through sluices and channels provided for the purpose. The storage capacity of this reservoir is estimated at 6,000,000,000 cubic metres, which is not too much for a watershed on which a depth of five and one-half inches of rain has been known to fall in four and one-half hours. The occurrence of a second tropical rain, before the first has had time to drain away, might be disastrous. This difficult problem, which was pointed out and dwelt upon by some of the delegates to the congress, but was apparently passed lightly over by the majority, seems still to be unsolved at the hands of the French engineers, although the completion of its study has been promised from year to year.

The Panama railroad was purchased by the canal company; dwellings, hospitals, and workshops were erected; dredges, machinery, and tools were procured; and excavating was begun. Considerable earth and some rock have been removed. Rapid progress has been promised from time to time, but has not been attained; 2,000,000 cubic metres per month were hoped for, but 800,000 cubic metres have not been removed in any one month, and from 1881 up to May, 1885, the amount was only 12,376,000 cubic metres. The amount of material to be moved was first placed at 46,000,000 cubic metres, then 75,000,000 cubic metres, has now swelled to 125,000,000 cubic metres, and good judges believe this quantity to be much too low. M. de Lesseps has raised amounts as follows: 50 per cent on the shares of the company, 147,500,000 francs; loan of 1882, 125,000,000 francs; loan of 1883, 300,000,000 francs; and loan of 1884, 193,692,500 francs; making, in all, 766,192,500 francs. He has now applied to the French government for permission to issue new canal bonds to the amount of 600,000,000 francs, and proposes to call to his aid a lottery. A further call on the shareholders is also to be made. Discount and interest charges will amount to a formidable sum. One observer puts the time required to finish the canal at six years, another at twelve, and still others at twenty and even fifty years. Mr. Rodrigues fortifies his statements by citations from official documents, and from reports of U. S. officers and others, who have repeatedly inspected the progress of the work. He does not hesitate to predict the failure and bankruptcy of the present company within a short time.

The author devotes considerable space to the political aspects of the question, the stand which the United States has taken in the matter, the Monroe doctrine and the Clayton-Bulwer treaty, and the serious complications which may ensue if the French government shall take up officially the enterprise upon the failure of the canal company. The chapters given to the discussion of these topics are of great interest; but space will not allow a review of them here, even if it was appropriate for these pages.

HYPNOTISM.

PSYCHOLOGY is the last of the sciences to pass from the popular and literary stage to the technical. Time was when physics and chemistry were discovering facts of so flagrant and fundamental a nature, that fine ladies could be startled and entertained by accounts of them at dinner-parties. We have seen, in the last decade, biology present, in the Darwinian theory, what probably will be its last popularly interesting conception, and then plunge into such a labyrinth of embryological and other technicalities as only dry specialists can tread with her. Psychology even now trembles on the brink. Some departments are already quite intractable to literary handling; space perception, the measurements of various discriminations, and those of the time required by elementary mental processes, for example. But still much remains in psychology for the amateur of our generation to enjoy, and it is not yet impossible for treatises with some literary flavor to be written in that science. But the time is short; we seem on the verge of fundamental discoveries, and when they are made we must bid adieu to the simple charm, the easily verified facts. Work will be carried on

in a thicket in whose darkness only technically trained eyes will feel at home.

Hypnotism now stands where gravitation, galvanism, and the 'metamorphosis of plants' once stood. In France, especially, a real *fureur* of investigation is going on, and all sorts of people are trying their hand as magnetizers or as subjects. Repeatedly assailing the academies for recognition, as repeatedly rejected by reporting committees, whose criticism occupied itself too much with a few exceptional claims, and too little with the fundamental conditions of the hypnotic state, this latter at last wears official robes; and it is as 'bad form' now to be ignorant of its phenomena as a while ago it was to know any thing about them. To those who would no longer remain ignorant, Dr. Cullerre's little compilation[1] may cordially be recommended as the work of one who has tried to survey the whole ground, and who has certainly brought a great deal of scattered material together, and put it into readable shape. There is no other account of the subject at once so short and so complete. More than this we need not say of the book, for it makes no pretensions to originality, and the author's own critical comments are so rare, that a certain intellectual commonness about them may well be overlooked.

As matters now stand, the fundamental phenomena, sleep, narrowing of the field of consciousness, blotting out of memory, insensibility or hyperaesthesia, modifications of neuro-muscular irritability, hallucination in obedience to suggestion, etc., etc., are too *banals* to excite any longer much interest; and the attention of investigators is directed more and more to the *curiosities* of the hypnotic state, to those exceptional phenomena belonging to the individual subjects from which (by virtue of the law that nature shows us her secrets most readily in her monstrosities) most may be hoped for in the way of light thrown upon what is, after all, a great mystery.

Foremost among these novelties are the 'post-hypnotic impulsions,' which may take place weeks, or even months, after the patient has been hypnotized, in obedience to suggestions made during the trance; of which suggestions themselves nothing is remembered, the patient usually assigning for the act he finds himself irresistibly driven to perform, some pretext trumped up at the moment. It is obvious what power this gives to any unscrupulous operator who might wish to use his subjects as cat's-paws to crime. The remedy on the subject's part, if once he mistrusts the operator, would seem to be to get himself hypnotized by some other person, who, by suggesting that the former operator's proceedings should thenceforward be ineffectual, would in many cases actually render them so.

These inhibitions of certain processes by *negative suggestion* are among the greatest curiosities of hypnotism, and bid fair to put us on the track of important psychological secrets by isolating phenomena which usually are found combined. We may make a patient blind or deaf to special objects, and to nothing else, just as we may make him blind of one eye, deaf of one ear, or insensible to pain in one part of the body, — all by verbal suggestion that he shall become so. And the distinction that psychology makes between the mere *sensation* we receive from a thing, and the mental apperception or assimilation of the latter, so as to form a *percept*, is beautifully brought out in these experiments. For it seems that in them the blindness or other peculiarity is not the lack of sensation. A patient, for example, made to look at a red wafer on a sheet of paper, but told that there is nothing there, will not see the wafer — will say that the entire field of view is white. As soon, however, as the wafer is blown away, he will say he sees a green spot, its negative after-image. So a patient made blind to a particular by-stander cannot be made to see *him*. But how can the patient know *which one* to be blind to, without in some way discerning him? Some sort of a sensation of him must be there, or he would not be so singled out for invisibility.

The 'hemi-hypnotic' phenomena again afford a sort of moral vivisection of the patient into two halves. One side of the body may be cataleptic or lethargic, the other awake. One side of the face may be made to laugh, the other to weep. "If, in the hands of an open-eyed cataleptic subject, her knitting-work is placed, she takes it, and works away with remarkable skill. If the operator then close one of her eyes, the hand on the corresponding side falls inert, and the other hand continues all alone to perform the knitting movements, which, of course, then produce no effect." M. Richer describes a similar transformation of the act of washing the hands, into a unilateral operation. MM. Binet and Féré in some papers in the *Revue philosophique*, too late apparently to be noticed in Dr. Cullerre's book, have described most wonderful transferrences of the unilateral phenomena from one side to the other of the patient, whenever a magnet was brought near her, even without her knowledge. Many parts of their account are so startling that more verification is highly to be desired.

[1] *Magnétisme et hypnotisme.* Exposé des phenomènes observés pendant le sommeil nerveux provoqué. Par le Dr. A. CULLERRE. Paris, *Baillière*, 1886 [1885]. 16°.

Still more startling things are reported by MM. Bourreau and Burot of Rochefort, being nothing less than 'stigmatization' by suggestion, in a certain patient, i.e., the bleeding of spots of the skin at word of command. They have also seen, and convinced others, that this patient and one other, were influenced by medicines *in closed vials held near them*, salivated and sweated by Jaborandi, vomited by ipecac, purged by scammony, put to sleep by opium, etc. In these experiments the subjects were not hypnotized. They remind one of observations published long ago by Dr. J. R. Buchanan, and republished last year in his work, 'Psychometry.' Thus miracles expelled by 'scientific good sense' clamor again for admission. In particular the limits of suggestion have not to be re-tested. The new results seem to point towards some effects that may be direct and physical, and not due to suggestion or expectation. We are as yet but on the threshold of the subject.

If one wishes to see what hopes for success the method may inspire, one should read the brilliant article of Mr. F. W. H. Myers, entitled 'The human personality,' in the *Fortnightly review* for November. As Mr. Myers there says, we hold the wand of Hermes, which we have not learned to wield.

S. E.

THE UTILIZATION OF BY-PRODUCTS IN CHARCOAL-BURNING.

In many processes for the conversion of crude materials there is much waste, which is likely to be remedied only when such materials become scarcer, and hence more costly. In producing charcoal for use in the iron manufacture, the wood is commonly burned simply for the sake of the charcoal itself; and brick, dome-shaped ovens are used, from which the smoke and other products driven off by the process of slow combustion pass freely into the air. But in some cases such of the products as are commercially valuable are saved, with results that render it surprising that more care is not usually taken to retrieve what is so often lost. The success which has been met with at Elk Rapids, Michigan, in saving and profitably utilizing the by-products of charcoal-burning, is worthy of imitation.

At this place is a blast-furnace, turning out some seventy tons of charcoal-iron daily, and consuming the charcoal from one hundred and twenty-five cords of wood, previously carbonized in thirty-five kilns. The smoke and vapors given off in the latter process are drawn — by means of two exhaust-fans three feet in diameter, and making twelve hundred revolutions per minute — through the bottom of the kilns, and thence through a long wooden pipe forty-two inches in diameter, to the chemical works. Here the vapors are distributed to ten condensers, each containing seventy-five copper tubes two and a fourth inches in diameter, through which cold water is passed. So much of the vapor as is condensed is then drawn off into a large settling-tank: the uncondensed part is forced under the boilers by steam-injectors and burned, thus helping to furnish the motive power required at the works. In the tank the larger part of the tar settles to the bottom. This tar is now mixed with sawdust, and burned under the boilers; although formerly, when more in demand, it was drawn off and barrelled for market.

The remaining liquor is pumped to a second tank, and neutralized with lime. After the impurities have had time to settle, it is conveyed to a still, where the wood alcohol is distilled from the acetate of lime just produced. The liquor of acetate of lime is next evaporated by steam-heat nearly to the granulating point, then conveyed to grainers, and, by the further application of steam, it is obtained in the solid state. Finally it is shovelled out, drained, dried in pans, and put up in bags as the acetate of lime of commerce. The capacity of the works is 10,000 pounds of acetate of lime per day.

The alcohol, on issuing from the still, has a strength of eight per cent; but further distillation brings it to eighty-five per cent, when it is barrelled for shipment. It is, however, again refined by other parties to ninety-five per cent alcohol, and used for various mechanical purposes. The daily production can reach one hundred and seventy gallons.

An experiment has recently been tried at the London inventions exhibition aquarium, by Mr. W. August Carter, with a view to discovering how far fish are prone to sleep. After close examination, he found that among fresh-water fish the roach, dace, gudgeon, carp, tench, minnow, and catfish sleep periodically in common with terrestrial animals. The same instincts were found to actuate marine fish, of which the following were observed to be equally influenced by somnolence; viz., the wrasse, conger eel, dory, dogfish, wrasse bass, and all species of flat fish. Mr. Carter states, that, so far as he can discover, the goldfish, pike, and angler-fish never sleep, but rest periodically. Desire for sleep among fish varies according to meteorological conditions. Fish do not necessarily select night-time for repose.