there can now be scarcely any doubt, if the sum of the aggregate result of the replies recorded may be taken as a guide. The system hitherto may be said to have been somewhat tentative; but, if the rate of development shown in the past year continue, it appears probable that it will be far-reaching in its effect.

The system is undoubtedly peculiarly adapted to the moist climate of England; and the success there met with, in connection with past experience of a somewhat longer and wider range in this country, certainly points to a future which will make this method of feeding stock of the greatest value to the stock and dairy farmer. The evidence of the British farmer is of particular interest, in regard to a new system of this sort, as, from his habits of intensive farming, he is perhaps more qualified to judge of it than his American fellow-laborer.

## *THE PANAMA CANAL.*

THERE is no engineering enterprise now in progress which has excited more general interest, or the successful completion of which will affect more deeply the concerns of the commercial nations of the world than the Panama canal. As work was begun in 1880, or perhaps more accurately in 1881, and as the completion of the undertaking was promised for 1888, it is quite time to inquire what progress has been made up to the present date, and what is the prospect for the future. The book of Mr. J. C. Rodrigues,[1] which is a reprint of a series of articles written for the London *Financial news*, gives a summary of the operations from the beginning until now, with his opinion of the condition of the company, the political bearing of enterprise as regards the United States, and the impending catastrophe. It deserves a careful perusal by every thoughtful citizen, and presents a more concise, and at the same time comprehensive statement of the case than has as yet appeared.

After a brief survey of preceding explorations of the isthmus, he gives an account of the expeditions of Commander Lucien Napoleon Bonaparte Wyse, of the French navy, and of the concession he obtained from the United States of Columbia, in 1878, for a canal at the Isthmus of Panama. In 1879 the 'International scientific congress,' as it was called, at Paris, under the auspices of M. Ferdinand de Lesseps, decided to recommend the construction of a ship canal at the Isthmus of Panama, to be built without locks and as an open cut from ocean to ocean. Those American delegates to the congress who were well fitted to judge of the facts from personal examinations, or reports of surveys at Darien, Tehuantepec, Panama, and Nicaragua, and other delegates qualified by practical experience, opposed in vain this decision, pointing out the difficulties and uncertain quantities which rendered a wise judgment and a reliable estimate impossible at that time, and urging the advantages of other sites. The enterprise, however, was to be carried on by Frenchmen; the assistance of M. de Lesseps was assured; and his success in carrying through the Suez canal, a far different undertaking in character of materials and obstacles to be overcome, was pointed to as an answer to all objections. The intention appeared to be to forestall any work which others might undertake at points which have been and still are regarded as much more favorable.

The canal congress estimated the cost of a sea-level canal at 700,000,000 francs, or £28,000,000, although a sub-committee had practically put the cost at 1,040,000,000 francs, and added that the "execution of such works, and principally that of such deep cuts, the stability of which is problematical, as well as the operations relating to the course of the river Chagres, constitute a complication of difficulties that it is impossible to estimate." There was added to the prime cost 25 per cent for unforeseen expenses, 5 per cent for expenses of banking and administration, and 3 per cent per year for interest during construction. An 'international commission' visited the isthmus in 1880, and reported that the canal would cost 843,000,000 francs, without preliminary, banking, and administrative expenses, and interest during construction, and estimating contingencies at but 10 per cent. They reported 75,000,000 cubic metres to be excavated, in place of 46,000,000 previously estimated. This estimate of cost M. de Lesseps first cut down to 658,000,000 francs, and later to 530,000,000 francs. A more extended acquaintance with the problem has raised the estimate of quantity to 125,000,000 cubic metres.

The dredging through the low alluvial lands near the sea, and the formation of harbor works, would, of course, present no difficulty; but the two rock-cuttings — the deepest at the Culebra, 820 feet in width at the top, containing from 25,000,000 to 30,000,000 cubic metres, of which but a small portion has yet been removed; and the Emperador cut, not so deep, but containing about the same quantity of rock — are very formidable obstacles, which will, at the rate work has as yet progressed, require many years to overcome. There is also the uncertainty whether little or much water will be encountered in the lower portions of these cuts. The removal of rock under water will swell the cost greatly.

[1] *The Panama canal: its history, its political aspects, and financial difficulties.* By J. C. RODRIGUES. New York, *Scribner*, 1885.

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