SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 3, 1886.

THE PANAMA CANAL.[1]

THE Isthmus of Panama is the narrow neck of land which connects North America with South America. It is bounded on the east by the Caribbean Sea, and on the west by the Pacific, extending northwards to the state of Costa Rica, and southwards to the territory of Colombia (New Granada).

The backbone of the isthmus is formed by a prolongation of the Cordilleras. Nearing Aspinwall, the town on the Atlantic side, the country presents little variety; but as one proceeds towards the interior, the landscape undergoes a rapid change, the country becomes mountainous, and is cut up into deep valleys, whose sides are covered with rich tropical vegetation.

From the hydrographical stand-point, one is struck by the number of streams, — one can scarcely call them rivers, — such as the Rio Trinidad and the Rio Gatuncillo, each of which, during the rainy season, has a volume of 14,130 cubic feet at its widest part. The most important of these streams, however, is the Chagres, which, rising near the north-west coast, makes an immense bend, and finally empties its waters into the Caribbean Sea. The volume of water discharged by the Chagres at its mouth is, in summer 460 cubic feet, in winter 21,190 cubic feet; but in exceptional circumstances it sometimes reaches as high as 56,510 cubic feet per second during the latter season.

The Panama canal company has erected an observatory at Gamboa, about 100 feet above the sea-level, where for some time observations have been carried on, with the result of establishing the following meteorological facts:—

	Rainy season.	*Dry season.*
Average temperature	86°.4 F.	89°.2 F.
Barometric mean	29.892 inches.	29.922 inches
Hygrometric mean	96.	88.

The temperature ranges between the extremes 25° and 35°.

The year is divided into two seasons, the dry (*verano*) and the wet (*invierno*). The dry season continues from December to May, the interval between it and the wet season being occupied by the short but delightful 'St. John's summer' (*veranito*).

[1] From *The Scottish geographical magazine*, November.

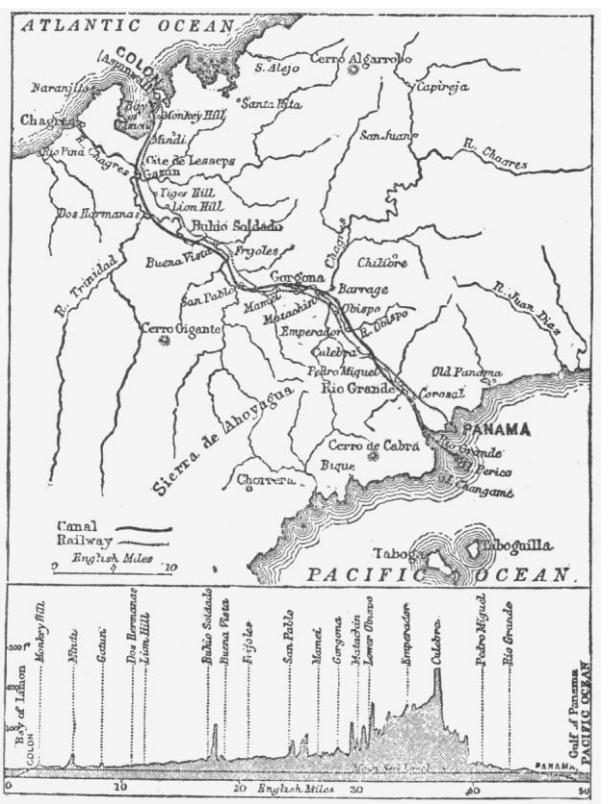
The advantages of establishing a waterway between the Pacific and the Atlantic were recognized in the beginning of the sixteenth century, and as early as 1550 four projects were already before the world, one of them suggesting a passage by the Isthmus of Panama. But the data were too vague to give rise to the formation of any definite scheme. The geography of the isthmus was practically unknown, and rumor whispered strange and disquieting reports of an inhospitable soil and dangerous natives. One explorer succeeded another without throwing any new light on the matter; and the seventeenth century passed away, leaving the great problem still unsolved. Not, indeed, until 1780 do we come upon any thing like an attempt at scientific exploration. In that year, however, an expedition was organized under the command of two engineers, — Martin de la Bastide, a Frenchman; and Don Manuel Galistro, a Spaniard. Unfortunately, when these men returned to Spain, they found the whole attention of the nation occupied by the political situation; and, the death of Charles III. occurring shortly afterwards, all hope of a practical outcome of their researches speedily vanished.

In 1844, a French engineer, Napoléon Garella, succeeded at length in establishing exact data for the simultaneous construction of a railway and canal across the isthmus. A French company was formed for the construction of the railway, but from one cause or another delays arose: the directors lacked energy, the revolution of 1848 supervened, and the work was finally carried through by an American company.

Convinced of the importance of an inter-oceanic canal, America inaugurated a series of investigations, some of which were never fully carried out, while others ended in failure, more than one explorer meeting an untimely if glorious death in the endeavor to achieve success. The American government itself fitted out a properly organized scientific expedition, but without any definite result: the problem still remained unsolved.

At last, in 1875, the Geographical congress at Paris, to which were submitted the various schemes already suggested, decided that a new and thorough investigation should be made. A society of exploration was formed, the necessary funds were raised, and two naval officers, MM. Reclus and N. B. Wyse, with an engineer, M.

Celler, were sent out to survey the isthmus and judge of the relative merits of the various regions suggested as suitable for the construction of a canal. After three years of incessant toil, they returned to Paris to give an account of their mission. Another congress met at Paris in 1879, and, after careful examination and consideration of all the proposed schemes, decided by a majority of seventy-eight that the canal should be constructed between Aspinwall and Panama, without tunnels or locks, from ocean to ocean. The routes by Tehuantepec, by Nicaragua, by Atrato and Napipi, by Darien (the proposal of San Blas), were, on the report of M. Voisin-Bey, rejected as unsuitable on account of technical difficulties. The cost was estimated by the commission of the congress at £44,585,000, exclusive of the interest on the capital engaged.



The route of the new waterway will be from the east side of the Bay of Limon on the Atlantic coast, by the valleys of the Chagres, the Obispo, and the Rio Grande to the Bay of Panama, entering the Pacific near the islands of Naos and Clamenca. Its total length will be 73 kilometres, or 45 miles, and, like the Suez canal, it will be absolutely open and unobstructed throughout. On the Pacific side a dock will be constructed so as to insure free communication with the ocean at all hours and all states of the tide. The width of the cutting at the bottom will be 72 feet; at the water-level it will be 164 feet in soil and 105 in rock; its average depth, 30 feet below the mean level of the oceans. There will be two ports, Colon and Panama, and a dam will be constructed at Gamboa to regulate the waters of the Chagres.

At Colon or Aspinwall the company has reclaimed from the sea a large tract of land, where a new town has been built, named after Christopher Columbus. The streets are wide and regular, affording free play to the fresh sea-breezes; and here a number of the officials of the company are already located in commodious dwellings.

The cutting of the canal presents no difficulty for the first fifteen miles after leaving Colon. For that distance, as also from the sixty-second (38½ miles) to the seventy-third kilometre (45 miles), the soil consists chiefly of clay and mud; so that for 21½ miles operations may be carried on by means of dredging, the cheapest and most expeditious mode of excavation. From the twenty-fourth (15 miles) to the thirty-fifth (21½ miles) kilometre no serious obstacle to progress occurs, but between the thirty-fifth and sixty-second kilometres it will be necessary in great measure to carry on the work by means of dynamite.

The port at Aspinwall is already nearly completed, and that at Panama presents no technical difficulties. Outside the latter there will be 'roads' formed by a maritime channel, where vessels may lie previous to entering the canal. The left bank of this channel can easily be made to communicate by road with the Panama railway. At Panama the company has acquired land favorably situated for the construction of wet and dry docks, dock-yards, and warehouses, and all the adjuncts necessary to the maintenance of an extensive mercantile and shipping industry.

From fifteen to twenty thousand workmen, mostly from Jamaica, Colombia, and the Antilles, are already employed on the canal banks, and this number could easily be doubled. The construction of the banks has been intrusted to a number

of contractors, each of whom is bound down to have his portion of the work completed within a given time, the company retaining the power of breaking the contract at a moment's notice should the work prove unsatisfactory. It is confidently expected that the canal will be finished by the end of 1889.

It only remains for us now to consider briefly the importance of the canal for the commerce of the world in general. It is almost unnecessary to speak of the saving in time and money that will be effected when the necessity for the long and perilous voyage round Cape Horn has been obviated. The following table shows, in round numbers, the distance in miles saved between various ports: —

Names of ports.	Distance by Cape Horn.	Distance by Panama canal.	Distance saved.
London or Liverpool to San Francisco	16,900	8,200	8,700
Havre to San Francisco	16,100	7,900	8,200
London to Sydney	16,400	10,900	5,500
Havre to Sydney	16,100	10,600	5,500
Bordeaux or Havre to Valparaiso	10,900	7,450	3,450
London to Sandwich Islands	14,900	7,900	7,000
New York to Valparaiso	10,600	3,900	6,700
New York to Callao	11,200	3,000	8,200
New York to Guayaquil	12,000	2,400	9,600
New York to San Diego	15,400	3,700	11,700
New York to San Francisco	15,900	4,200	11,700
New York to Vancouver	16,600	4,600	12,000

This saving of distance will confer a great benefit on merchants and traders, who will thereby be enabled to get their goods more quickly into the market. It will also effect such a saving on insurance, both of goods and shipping, as will cover the extra expense of the dues levied on going through the canal.

The field for commercial enterprise opened up to the world by means of the Panama canal is immense, comprising, as it does, Peru, Chili, Colombia, W. Mexico, California, Oregon, the north of China, Japan, East Australia, and a great part of Polynesia. By request of the International congress of 1879, a report was drawn up by M. Levasseur, estimating the future traffic of the new route. From the statistics at his command, M. Levasseur estimated the total annual traffic at seven and a quarter million tons, of which five and a quarter million represents the traffic between Pacific and Atlantic ports; the remaining two millions, that between Europe and the east. This, however, he states to be only the net tonnage, which is less than the gross and actual tonnage by about a third, — a not unimportant consideration as regards the revenue of the canal. Thus, dues at the rate of 12s. 6d. per ton will annually be levied on ten millions aggregate tonnage; and the company has an additional source of income in an immense tract of land (1,930 square miles) with all the minerals it may contain, — the gift of the Colombian government.

The Panama canal will have no prejudicial effect on the Suez canal; rather it will be the complement of it. The two great highways of commerce and civilization are absolutely distinct, and there can be no rivalry between the two great maritime canals, — that of the east and that of the west. The Suez canal is the open door between Europe and the north of Africa, on the one hand, and the south of Asia and its archipelago, on the other. The Panama canal opens up a way for Europe and America to carry on their commerce with the western shores of the great western continents, with the north of China and Japan, and with Australia.

The commercial revolution effected by the cutting of the Suez canal will be altogether surpassed by the similar revolution now about to be effected by the cutting of the Isthmus of Panama. The Suez canal could only be used by steamers, and when it was opened the commercial world was not yet ready for it. The Panama canal, on the contrary, may be used by steamers and sailing-vessels alike. The commercial world is eagerly awaiting its opening, and from the very first the advantages it affords will be gladly seized. M. Amédée Marteau, the editor of the *Journal de Havre*, has devoted an article to the Panama canal, in which he estimates the number of tons that would have passed through it had it been open in 1884. Founding his conclusions on official documents, he says: —

"We are in a position to state exactly and precisely, without hypothesis and without exaggeration, the amount of tonnage now passing between Europe and America, Asia and Oceania, three-fourths of which must go round by Cape Horn or the Cape of Good Hope, a détour which the opening of the Panama canal will henceforward render unnecessary. The total tonnage is as follows: —

1. Between Europe and the Pacific coasts....2,570,774 tons.
2. Between Europe and Australia, Oceania, Malaysia, and the Philippine Islands ...2,696,754 "
3. Between the United States and the above regions (except San Francisco), besides India, China, and Japan.....1,619,440 "

Total.....6,886,968 tons.

6,886,968 tons in 1884 represents 8,539,840 in 1888, the average increase of tonnage being six per cent per annum. Eight and a half million tons, paying dues at the rate of 12s. 6d. per ton, would give a revenue of £5,312,500, exclusive of the in-

come derived from the company's land, passenger dues, etc.

"In this estimate," continues M. Amédée Marteau, "not having full statistics, we have taken no account of the present and future trade of the Atlantic ports of South America and the Antilles, with all parts of the Pacific, which cannot be reckoned at less than half a million tons. Neither have we attempted to estimate the increase of European and North American tonnage which must result from the impetus given to the trade with the Pacific and Oceania, and which probably would not amount to less than an additional one or two million tons."

The aggregate tonnage, therefore, that will annually pass through the canal must be reckoned at about eleven or twelve million tons. The cost of the canal is estimated at about £50,000,000, and the interest due annually to share and bond-holders amounts to £3,000,000.

FERDINAND DE LESSEPS.

A PLEA FOR THE SENSE OF SMELL.

THE division of the five senses into higher and lower has carried with it both a moral and an aesthetic implication. While it is granted as a general proposition that sight and hearing have been the aesthetic educators of our race, yet at various times have attempts been made to rescue one or other of the remaining senses from the aesthetic degradation to which they were consigned. The aesthetic value of the tactile-mater group of sensations is deduced from the educability of the blind as regards artistic conceptions. That taste and smell play a real and worthy *rôle* in aesthetic life is the claim of every epicure. The very word which we use to denote artistic appreciation, 'taste,' owes its origin to this class of sensations. A recent writer[1] in this field urges the claim that the sense of taste has no right to the aesthetic position it occupies, and that it has usurped the place that of right belongs to smell. The question discussed is that of the 'gastronomic value of odors.' The point of view can be most briefly described as epicurean. The thesis is, that the pleasures of the table usually assigned as 'matters of taste' are really 'matters of smell.'

Taste and smell have all along acted in such close association, — have, so to speak, gone to the same school, learned the same lessons, enjoyed the same pleasures, and suffered the same pains, — that they have almost come to be regarded as one sense: only by special artificial means do we fully realize their dual nature. That a blindfolded person, clasping his nose tightly, will not be able to distinguish between beef, mutton, veal, or pork will be similarly confused by bits of chicken, turkey, and duck, etc., is a familiar experience. Apart from the different kinds of feeling which these food-stuffs produce in the mouth, they are distinguished by smell alone. Hence, to get the real pleasure of eating, one must smell the food. True, society discountenances this proceeding if done in the ordinary way: but, says Mr. Fincks, there is a second way of smelling not usually recognized except unconsciously by gastronomists; viz., by exhaling through the nose. In ordinary expiration the air does not touch the olfactory region of the nostril; but by a special effort the air laden with all the perfumes that make up the epicure's paradise can be turned into that direction. On this depends the art of eating. There are great individual differences in the power of accomplishing this result, and perhaps color-blindness has its analogy in smell. On the other hand, gastronomic practice for smell is as essential as artistic training for color. In both cases the teaching is largely unconscious, and instinct points out the best method of enjoying food. The mistake is, that we call every mouth-sensation a taste, and do not analyze it physiologically.

Taste is a very meagre sense: at best we distinguish six kinds, — alkaline, metallic, bitter, sour, sweet, and saline. The first two have no gastronomic value; salt is at best 'that which spoils the soup if it isn't put in,' and is not relished for its own sake; while a taste for bitter is a morbid craving for contrast, at which the unsophisticated tongue of children would revolt. Even sour and sweet must be allied with fragrance, to yield much pleasure. What we call sour is usually a combination of tastes, smells, and touches. We distinguish one sour from another by the accompanying odor. Sweetness is the 'only original and genuine' pleasure of the overrated sense of taste. Yet even here the pleasure would be small if smell did not aid. "Were taste alone to be considered, confectioners might as well close their shops, and leave the sale of sugar to grocers." No one cares much for plain sugar: even children soon learn to prefer candy; i.e., flavored sugar.

"A few gifted mortals, known as epicures, have had an instinctive knowledge of the importance of odors, and the same is true of a few original and immortal cooks." The two main obstacles to the recognition of the gastronomic reform embodied in the principle that the object of cookery is to develop the "countless delicious perfumes latent in the raw material of food, or to add others when the food is deficient in natural flavor," are the "amazing gastronomic indifference

[1] Henry T. Fincks, *Contemporary review*, November.