The Channel Tunnel: 1751-1975

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•THE Channel Tunnel enjoys the dubious distinction of having undergone a longer period of research and preparation than perhaps any engineering project in history. In a sense, the project may be said to have been discovered rather than invented: in 1753, Nicolas Desmarets published a paper entitled "Une Mémoire sur la Question de Savoir si l'Angleterre et la France Avaient Eté Autrefois Réunis." This paper marshalled persuasive evidence that a geological link did at one time exist between France and England.

Monsieur Desmarets had won the prize offered by the Academy of Amiens in 1751 for the best design of a cross-channel link. The young geologist's work attracted the attention of the king's cartographer and, in due course, Desmarets was named a member of the Institut de France. Half a century later, the engineer Mathieu submitted (in 1802) the first known detailed engineering concept of the tunnel (including a mid-channel island "to breathe the horses"). It was this proposal which was discussed by Napoleon with Charles James Fox during the short-lived Peace of Amiens. In 1803, Tessier de Mottray put forward the earliest suggestion of the main alternative method of construction—an immersed tube to be laid on the sea bed.

The re-discovery by Desmarets of the land bridge which, until about six thousand years ago, linked England with the Continent, led to two centuries of surveys, resolutions, petitions and international conferences.

As Thomas Whiteside has reported in an amusing and authoritative book (1), the main promotional activity on behalf of a Channel Tunnel occurred, not surprisingly, in France, where insular modes of thought were of little consequence. But the Victorians—among them, Isambard Kingdom Brunel, builder of the first sub-aquaeous tunnel (under the Thames)—could not resist the lure of a great tunnel under the channel itself, and companies formed in both the United Kingdom and France started digging toward each other in 1878. Five years later, fears of a French invasion led the British Government to halt further work. By this time, however, each of the tunnels had reached a length of over a mile. The information acquired in the course of this work was of immense value: it was found that the Lower Chalk was virtually impermeable to water; moreover, new boring machines had been successfully utilized, one of which (designed by Colonel Beaumont of the Royal Engineers) is commonly regarded as the direct ancestor of the powerful modern tunneling machines now in use throughout the world.

It was only after two world wars, in which both the French and the British found the absence of a tunnel a hindrance to effective military cooperation, that British public opinion—long prompted by Churchill—moved decisively into the tunnel camp. In 1964, a Gallup Poll reported only one Englishman in ten in opposition; and a powerful committee, representing all parties in both Houses of Parliament, sponsored the project as one of vital importance for the future of Britain. This committee has had as joint chairmen Mr. E. L. Mallalieu, Q. C. (Labour) and Sir William Teeling (Conservative). It was Mr. Mallalieu's question, in 1955, addressed to the then Minister of Defence, as to possible strategic objections to the project, that elicited Mr. Macmillan's famous reply, "scarcely any." Two years later, the Channel Tunnel Study Group was founded.

The London Times, expressing the new spirit in an editorial on August 28, 1961, pontificated: "A channel link would be there primarily to do a job; but it would be there also as a visible token of new times and new relationships. Shakespeare had the first words, but Donne deserves the last: 'No man is an island, entire of itself'."

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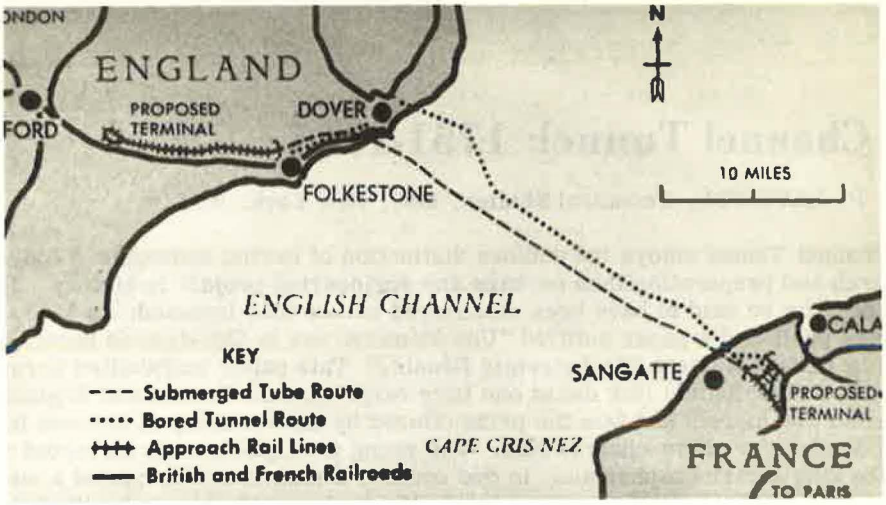

Figure 1. Map of tunnel and tube routes and proposed terminal areas.

Figure 2. Napoleon described the Channel Tunnel to Charles James Fox as "one of the great enterprises we can now undertake together."

Figure 3. Charles James Fox, leading English exponent of a reconciliation with France, visited the First Consul in 1802.

This paper, however, is limited to a description of the studies carried out in recent years, and it concludes with some comments on the implications, for the engineering profession, of the financing by private means of a project which many thought to be of such magnitude that it could be accomplished only on a wholly governmental basis.

Not the least interesting aspect of this venture is the form of the body established to conduct the studies. The Channel Tunnel Study Group came into existence during the summer of 1957 as a joint venture of five distinct entities: the International Road Federation (Paris Office); the Suez Canal Company (on whose initiative the first meeting was called); the Société Concessionnaire du Chemin de Fer Sous-Marin entre la France et l'Angleterre (whose predecessor Association was formed in 1875, and of which the French National Railways owns half the shares); the Channel Tunnel Company, Limited (also formed in the 19th century and of which the British Railways Board remains the leading shareholder); and Technical Studies, Inc., of New York. The Study Group was fortunate in having as its co-chairmen Ambassador René Massigli, former Secretary-General of the Quai d'Orsay, and the late Sir Ivone Augustine Kirkpatrick, G.C.B., G.C.M.G., former permanent Under-Secretary of State of the Foreign Office. (Viscount Harcourt now serves as British co-chairman.)

A small engineering staff was set up under M. René Malcor, Ingenieur-Général des Ponts et Chaussées, and Sir Harold J. B. Harding, recently president of the Institution of Civil Engineers in London. Extensive geophysical and geological investigations, including a preliminary program of core borings, were conducted in the Straits of Dover, and a report presented early in 1960 indicated the technical and financial feasibility of building a tunnel, either through the lower chalk or by laying prefabricated sections in a specially prepared trench in the channel bed. It was concluded that road vehicles could best be carried on railway flatcars because of (a) the greater capacity that this method would provide, (b) the evident disadvantages of driving for more than twenty miles in a closed tunnel, and (c) the high cost of efficient ventilation.

Meanwhile, an influential international group proposed the construction of a bridge for road and rail traffic and, to evaluate the rival proposals for a channel tunnel or a channel bridge, the British and French Ministers of Transport, on November 17, 1961, named a Working Group of British and French officials. Their joint report, published as a White Paper in 1963, considered not only the "established means" of cross-channel transport by sea and air, but also new developments such as hovercraft, hydrofoils and hovertrains. Both tunnel and bridge were found to be technically feasible, but the bridge was adjudged "a new and serious hazard and a source of delay to mercantile and naval shipping." Moreover, the bridge project could not be carried out, having regard to the principles of international law, until the United Kingdom and France had sought the concurrence of the States principally concerned with navigation in the channel, whereas "the construction of a bored tunnel linking France and Britain would not appear in law to require prior consultation with third States." A combination road and rail tunnel was considered by the Working Group, but its capital cost was thought prohibitive.

In February 1964, Queen Elizabeth II and General de Gaulle exchanged messages announcing the decision, as a matter of high policy, to authorize construction of the Channel Tunnel. The Governments then set in motion the machinery for a final and detailed survey of the channel bottom; the Study Group was appointed to supervise the program, for which the Governments supplied the equivalent of five and one-half million dollars. Field Headquarters were established in Dover Castle and a fleet was assembled to undertake a program of more than sixty core borings in the open sea. Geophysical surveys linked up the information from the core samples and a satisfactory route for a bored tunnel was identified and mapped in considerable detail. At the same time, feasible routes were confirmed for an immersed tube. The Study Group's reports on the final survey having been satisfactory, the Governments commenced a more detailed review of the financial and legal arrangements appropriate for construction of the tunnel. It was decided to finance the project with recourse to private investment, and qualified bankers were invited to submit proposals. Offers to underwrite the costs of construction were received by the Governments during 1967 from three consortia of international bankers. Last summer, The Illustrated London News asserted that "work will start in 1969 and . . . the link will be in operation by 1975." It is expected that underwriters for the tunnel will be selected during the current year.

THE SUNDAY TIMES

FEBRUARY 9 1964 PRICE 6d

De Gaulle praises tunnel

In a telegram to the Queen published yesterday President de Gaulle says that the French are deeply aware of the historical importance of the decision to build a Channel tunnel. He adds: "I am convinced that Great Britain and France will find strong reasons to strengthen still further their solidarity and friendship."

In her reply the Queen said: "I thank you very warmly for your friendly message regarding the tunnel under the Channel. I am sure that the carrying out of this important project will have happy long-term results for the people of our two countries."

Figure 4. The Sunday Times, Feb. 9, 1964, carried the announcement of the historic exchange of messages by Her Majesty the Queen and President de Gaulle, authorizing the construction of the Channel Tunnel.

Figure 5. Dover Castle, headquarters for the survey which the Study Group carried out for the British and French Governments.

Inasmuch as valid routes have been delineated for either a bored tunnel that would be embedded in the lower chalk, or an immersed tube laid in a trench dredged in the sea bed, the actual decision as to the type of construction may depend upon the terms and conditions submitted by contractors.

The total length of the tunnel is expected to be thirty-two miles (of which twenty-three will be under the sea). The distance between the coastal terminals has been estimated at forty-four miles, permitting a shuttle service taking less than an hour, including twenty minutes for driving on and off and for clearing customs, etc. The tunnel will be well illuminated, as will the piggyback wagons, which are expected to be enclosed and sound-proofed.

Twenty-four hour service will be available, with trains departing every five or ten minutes during peak periods. This will eliminate the long delays characteristic of the existing services. With the

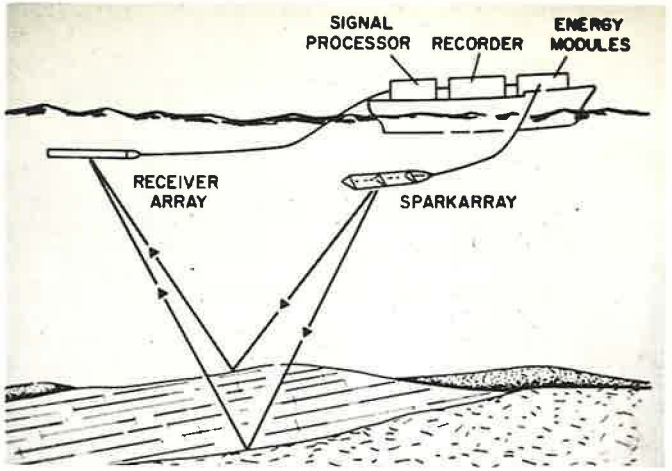

Figure 6. Modern geographical devices such as the Sparkarray have confirmed the general findings of the survey carried out in 1875 by the French Geological Commission.

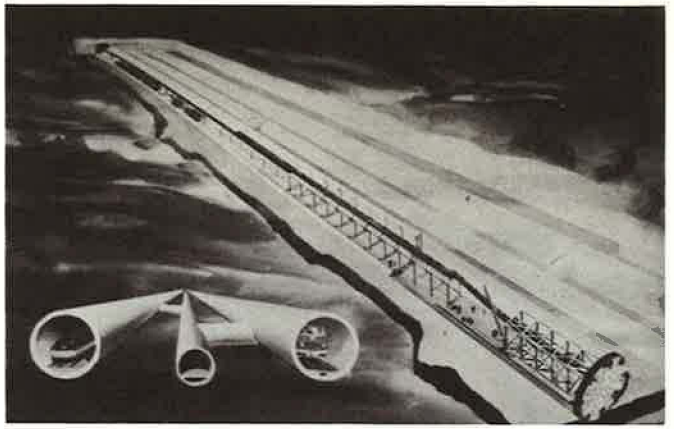

Figure 7. This schematic sketch of the construction of a bored tunnel was prepared by Morrison-Knudsen Company, Inc., Brown & Root, Inc., and the Bechtel Corporation.

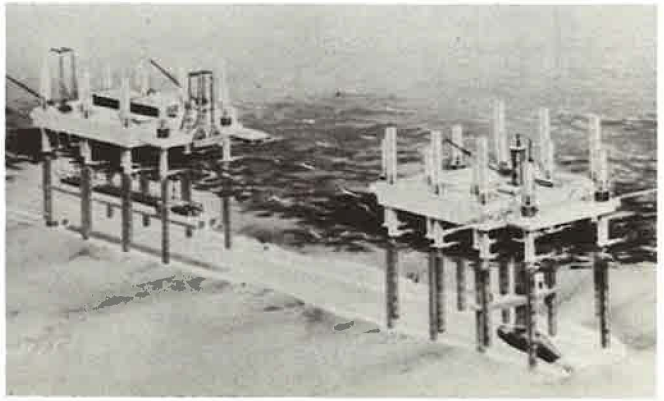

Figure 8. The construction of an immersed tube is illustrated in this diagram prepared by Raymond International, Inc.

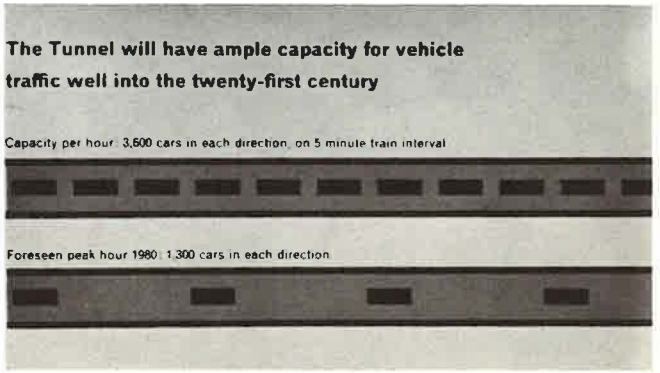

Figure 9. The tunnel capacity will be ample.

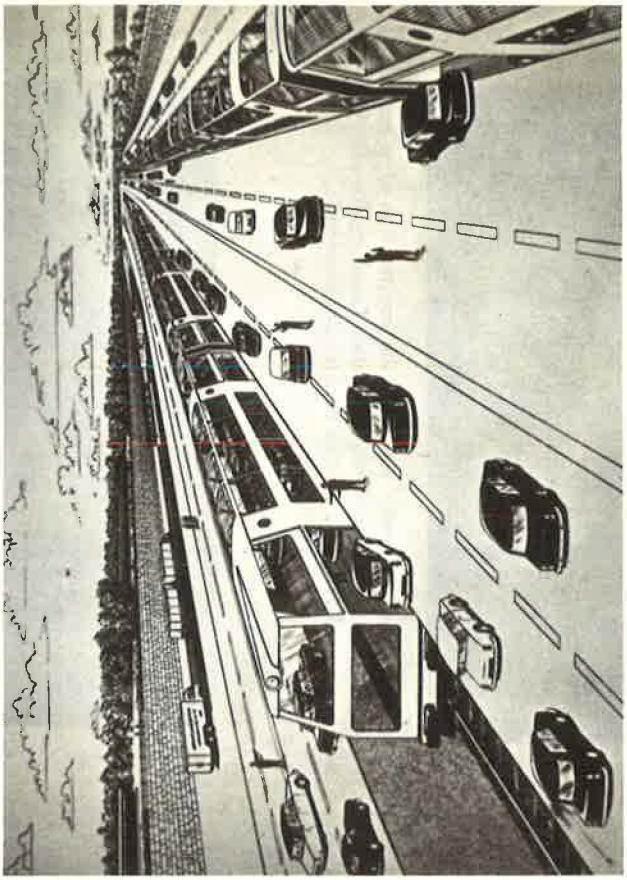

Figure 11. An artist's conception of the loading and unloading of trans-channel shuttle trains.

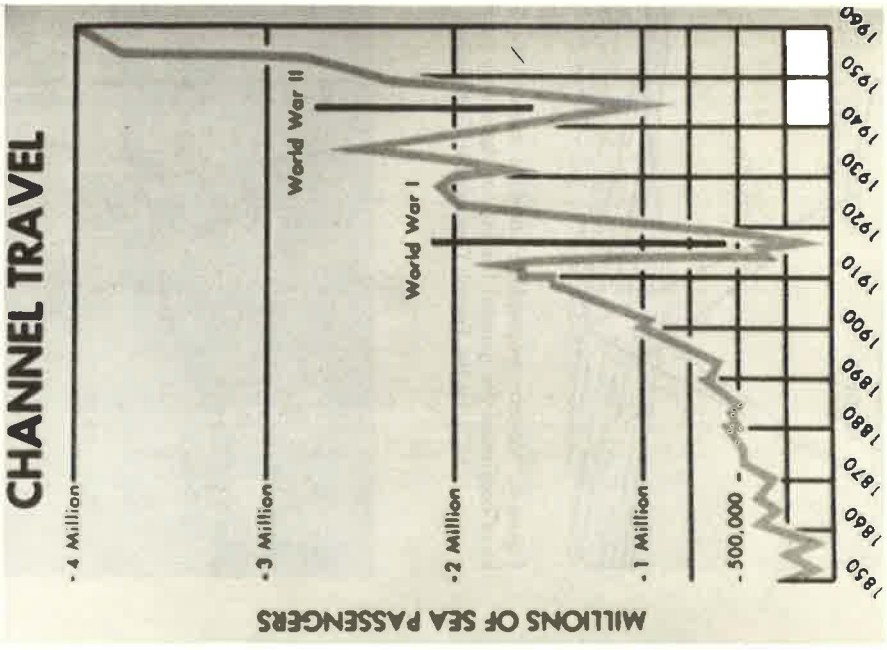

Figure 10. Cross-channel traffic provides an assured economic base for the Anglo-Continental link.

"Chunnel" in operation, no advance bookings will be necessary, even at the height of the tourist season.

Shuttle trains, operating at five or ten minute intervals in either direction, could carry at peak periods a combined total of seven thousand automobiles per hour. The cost of transporting cars will be approximately 30 percent less than current sea-ferry charges. Charges for freight—estimated to account for only slightly more than 20 percent of the total traffic—will be close to 50 percent less than at present.

From one point of view, the building of a Channel Tunnel is a less dramatic affair than the choice of transport systems that are to use it: in other words, the transit time from Folkestone to Calais may be of less significance than the travel time (for instance) from Birmingham to Bonn. It is not inconceivable that by 1975 hovertrains will be capable of carrying passengers via the tunnel from the center of London to the center of Paris in less than two hours.

The total cost of the tunnel, including financial charges, will be well over half a billion dollars. That sums of this magnitude have been assured by the private sector, on a basis of cooperative arrangements with sovereign governments, has important and encouraging implications for the development of world commerce in the years to come. The Channel Tunnel, following by a century the construction—under Ferdinand de Lesseps—of the Suez Canal, provides in our contemporary setting an example of the efficacy of private initiative in a field aptly described by Dr. Shannon McCune of the American Geographical Society as that of "geographical engineering." When the British and French Governments select underwriters for the tunnel, the event is almost certain to lead to reconsideration of similar macro-engineering projects, long delayed, but which may now be regarded as within the range of practical realization. Among such projects may be mentioned the Hudson Institute's brilliant concept of a series of "Great Lakes" based on the river systems of South America (to provide cheap hydro-electric power and access, on economic terms, to the interior of the continent); agro-industrial complexes based on nuclear energy centers, as persuasively proposed by AEC's Commissioner Ramey; the Great Belt Bridge in Denmark; novel transport systems using the air cushion principle, and the steady improvement of inter-modal technology.

By 1975—the target date for completion of the Channel Tunnel—we shall be living in a world where cooperative procedures involving the public and private sectors alike may be more widely understood. If this is so, perhaps the greatest achievement of the "Chunnel" will be its demonstration of a practical method whereby national governments can utilize the resources and skills of the international capital markets for the re-engineering of the world's transport and communications infrastructure.

REFERENCE

1. Whiteside, Thomas. The Tunnel Under the Channel. Rupert Hart-Davis, London, 1962.