

Booming *discorde*

by John G. U. Adams and Nigel Haigh

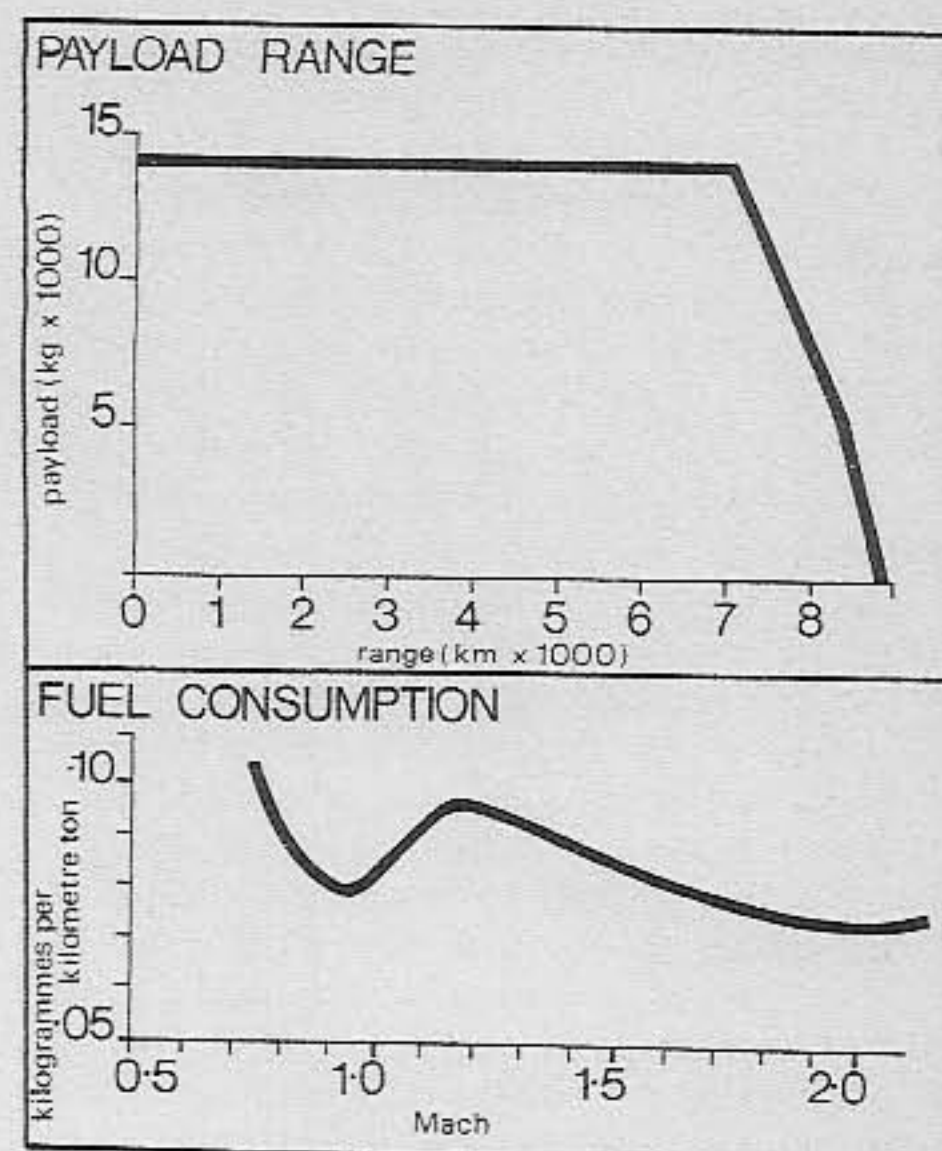
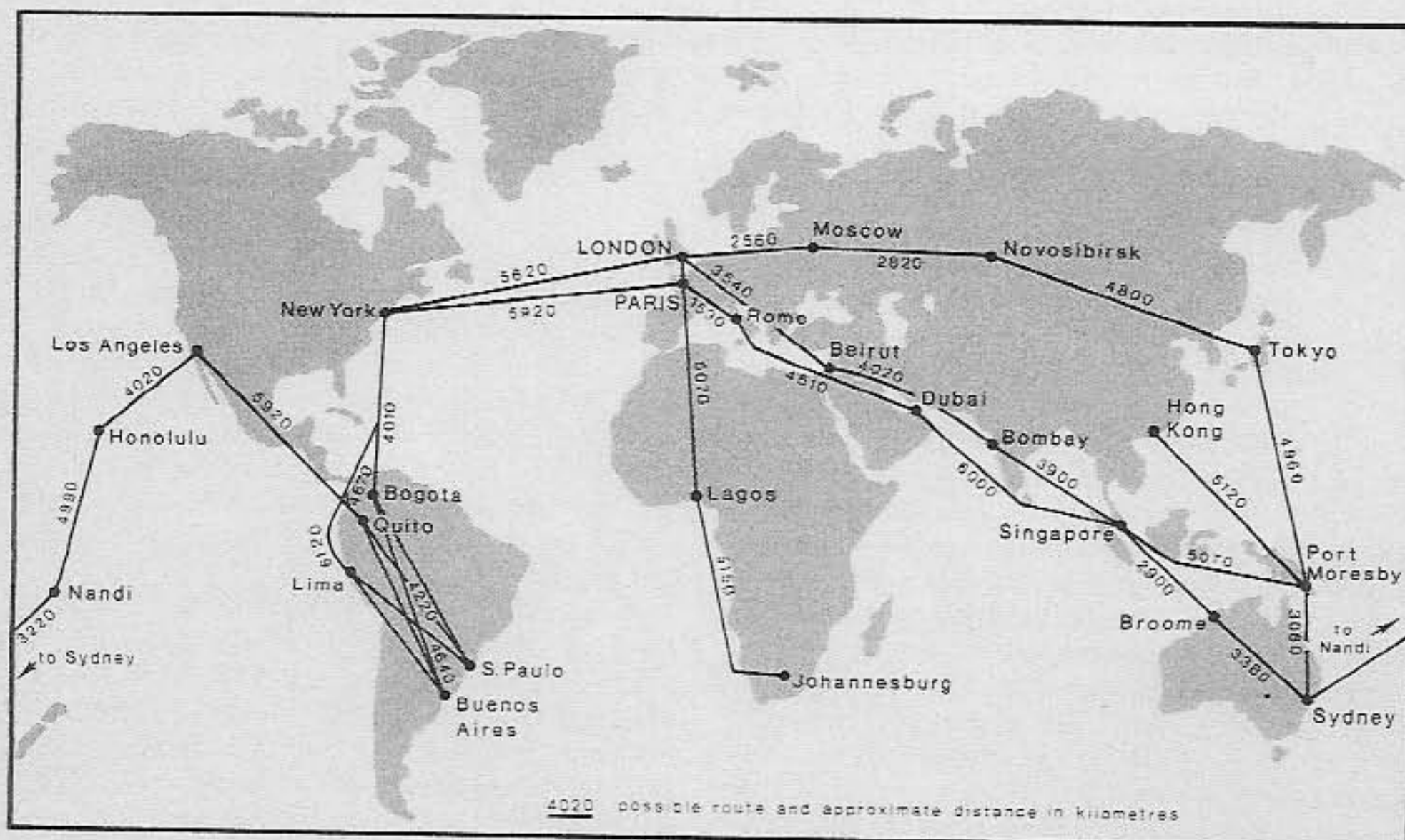
THE MANUFACTURERS OF CONCORDE claim that 'the main aim in civil aircraft development has always been increased speed'. Concorde, they say, is for 'passengers to whom time is money'. The problem facing airlines is where they will be able to fly it. Contradictory answers have been given in the past to this awkward question. In 1966, in the early days of Concorde's development before BAC and Sud Aviation recognized the sonic boom as a serious problem, the makers of Concorde said: 'In the final analysis, the general public will be the arbiter of what is an acceptable level of sonic boom intensity. Sonic boom considerations have had an important influence on Concorde design, and it is so adaptable that it will be able to operate economically within any likely pattern of sonic boom legislation.'

Since this statement was made, the official view of the manufacturers and their government sponsors has vacillated between two basic positions; *either* the boom is negligible and supersonic flights overland will be permitted, *or*, if the boom is not permitted overland, Concorde will still be able to operate successfully flying supersonically only over water.

It has become obvious that neither position is tenable. The view now being put forward is that Concorde will be a commercial success if it flies supersonically only over water and 'sparsely populated areas'.

The cost of flying Concorde will be high. Precisely how high has not yet been determined, but the general consensus seems to be that the airlines will have to charge a fare at least equal to the existing first class rate if they are to operate the plane on a commercially viable basis. The figure will be influenced by various factors which have not yet been established. It is not known, for example, if the plane can fly from Paris to New York with a full payload, if it will be allowed to land at certain key airports such as New York, and whether or not it will be allowed to fly over certain key countries that lie beneath its prospective routes. Can it reach Singapore from Dubai without booming over India? Should it go across Australia or around it? Is it feasible to fly to very high airports such as Bogota and Quito . . . ? The route planning exercise is greatly complicated by the fact that Concorde's great speed means that it can turn much less quickly than a subsonic jet in order to avoid obstacles in its path, and also by its peculiar fuel consumption characteristics. Where it is impossible to go around an obstacle such as the isthmus of Panama, it is expensive to slow down to a subsonic speed in order to cross it quietly. Slowing down and then accelerating again to normal cruising speed would require passing through the 'difficult transonic regime' between Mach 1 and Mach 2 in which Concorde is markedly less efficient. This would reduce Concorde's speed ('its

The future of Concorde may well depend on the reactions of an environment-conscious world public to the noise problem. Decisions taken by governments responsible for 'sparsely populated areas' will be vital to the aircraft's economic viability. Map illustrates some possible routes which Concorde may take. Official routes have still to be negotiated but many problems are involved



Severe payload penalties are incurred beyond a distance which is critically close to that from Paris to New York (top). Concorde may be able to fly at Mach 1.15 without a disturbing boom but fuel demands in the transonic regime between Mach 1 and Mach 2 are high

main aim'), increase the fuel bill, and make flights with lengths critically close to the maximum supersonic range impossible.

One inescapable fact is that it is not possible to connect the termini of most prospective routes by boom corridors that pass only over the sea, without making enormous detours that would in most cases more than cancel out Concorde's speed advantage. There are many possible routes, but all of them will confront route planners with the temptation to 'boom' just a few people in 'sparsely populated areas'. Because a growing number of countries have either banned supersonic overflying, or have expressed the intention of doing so, or contain influential pressure groups advocating such a ban, the designation of boom corridors has become critically important to all the calculations upon which Concorde's future depends.

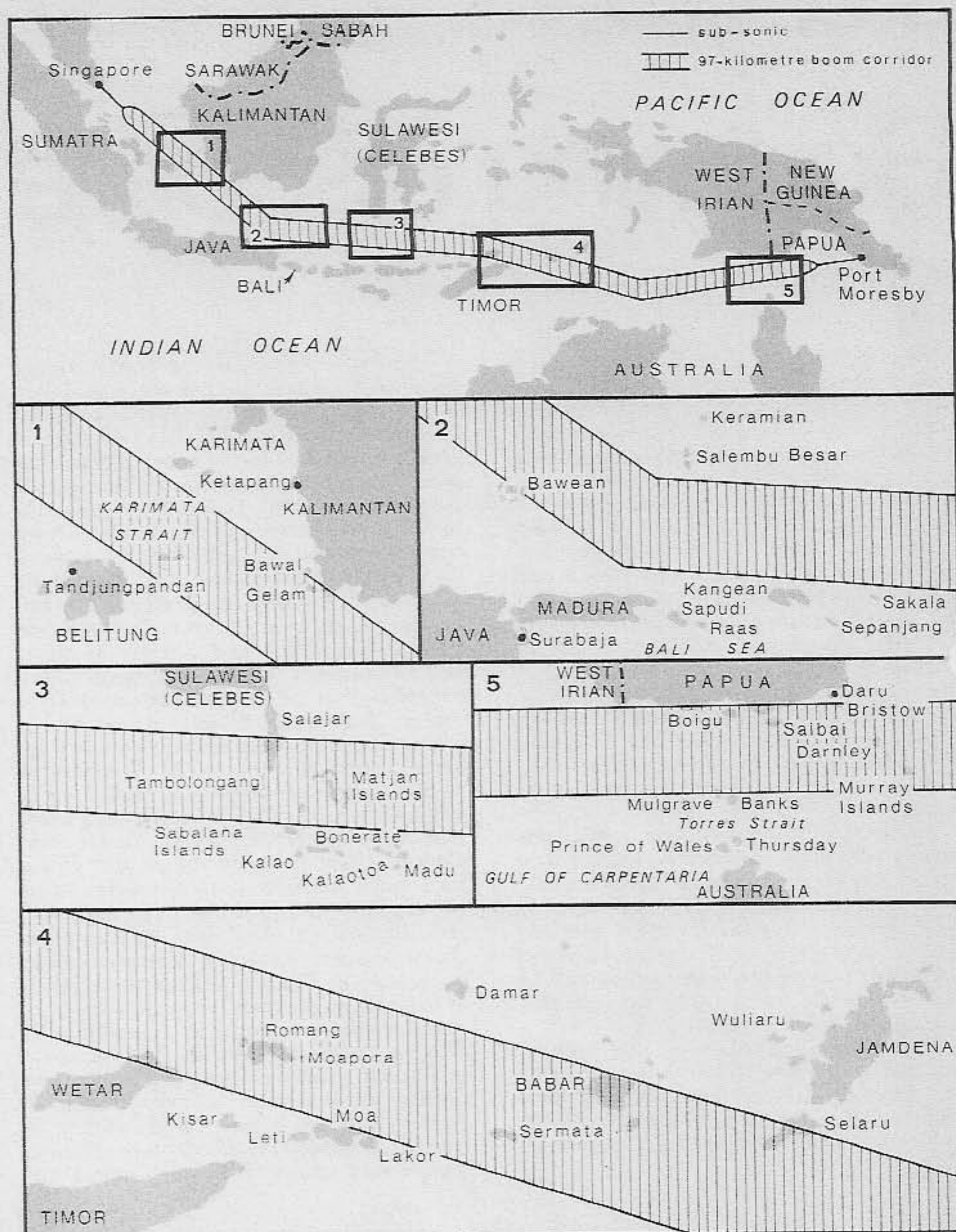
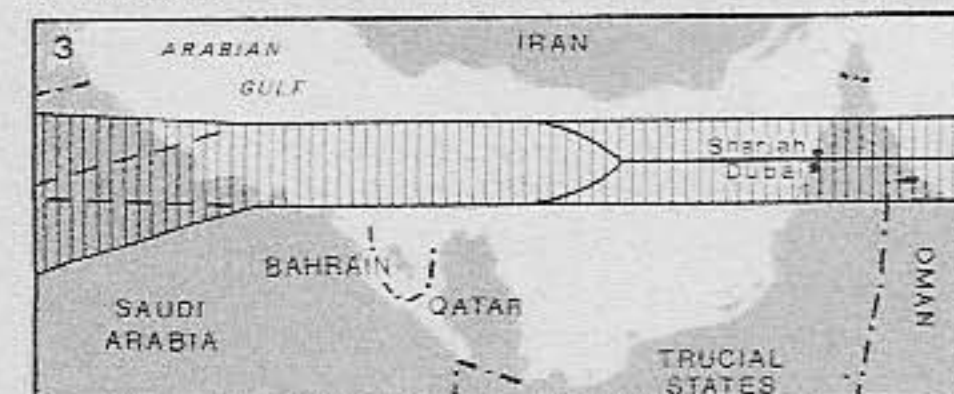
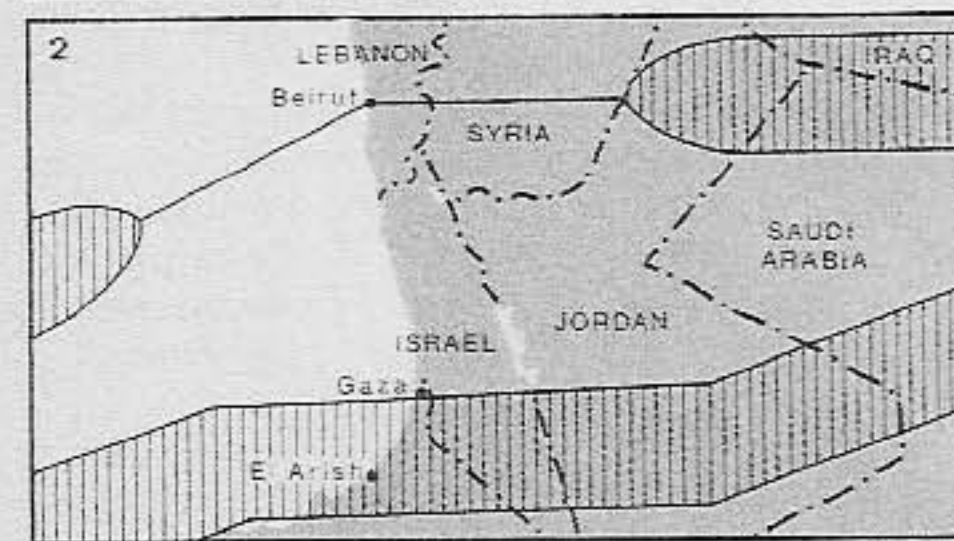
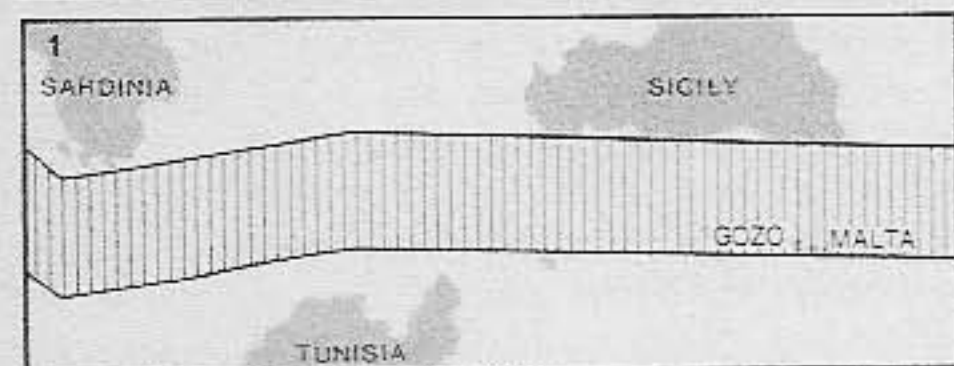
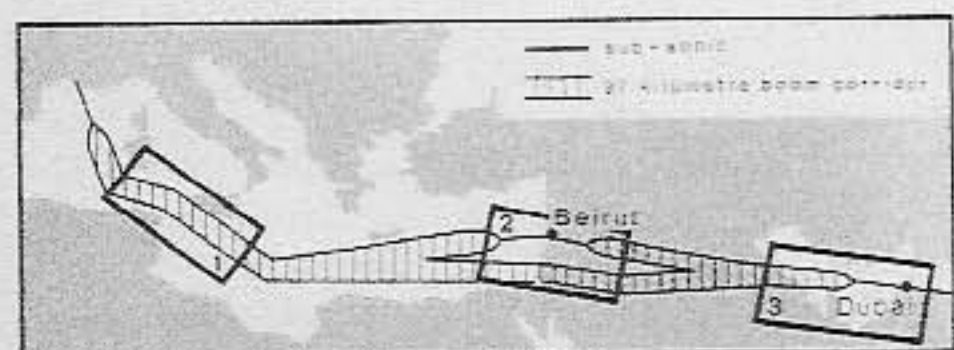
The boom is caused by shock waves and occurs continuously along a wide swath beneath an aircraft travelling faster than the speed of sound. It has been described in a BAC report as a sound that can vary from a low rumble to a loud crack. Although it has been compared to thunder it occurs with the startling suddenness of lightning. Concorde flies too high for its engine noise to give gradual advance notice of its approach and so the boom arrives without any warning. It is also extremely variable and unpredictable. It depends on factors such as aircraft speed and weight, which affect the intensity of the pressure wave produced. It also depends on other factors such as acceleration and turning, atmospheric conditions, topography and buildings which can focus or amplify the pressure wave. A very pronounced focusing occurs during acceleration to cruising speed and produces a 'superboom' with an intensity five to ten times greater than the average cruising speed boom.

There is also great variability in human response to sonic booms. Some people are obviously more upset by frequent, loud and unpredictable noises than others. An additional important consideration is what

is known as the 'ambient noise level'. It was established to the satisfaction of the Roskill Commission that loud noises in quiet rural surroundings are more disturbing than the same noises in noisy urban areas. Thus the subjective loudness of a given boom is likely to be greater in the 'sparsely populated areas'. Finally, although 'annoyance' in varying degrees is the most widespread consequence of the boom, it also causes physical damage.

The definition of the 'sparsely populated areas' is important. How does an area become designated as 'sparsely populated' and might the designation include areas such as northern England and Scotland? It was reported recently in *The Observer* that the Government is hoping to establish boom corridors over areas having population densities of about seven per square kilometre. But such a figure is not at all helpful. The area boomed on a flight from London to Sydney is about 1,784,500 kilometres (18,490 long by 97 wide). Thus it would be possible to boom more than 11,000,000 people while keeping the average boom corridor density below seven. At the opposite extreme, because population patterns in sparsely populated areas are highly clustered, almost every small inhabited island or oasis will have local population densities in excess of seven per square kilometre. Because a population density is a ratio of people to area, unless the area is specified any such figure is meaningless. Thus, the figure can mean anything between 11,000,000 and seven.

It is, according to the Minister for Aerospace, a question of 'The balance of disturbance against the benefit of faster travel.' According to the reasoning of the cost/benefit analyst, any project whose benefits outweigh its costs will make the world a better place. It is important not to maxi-



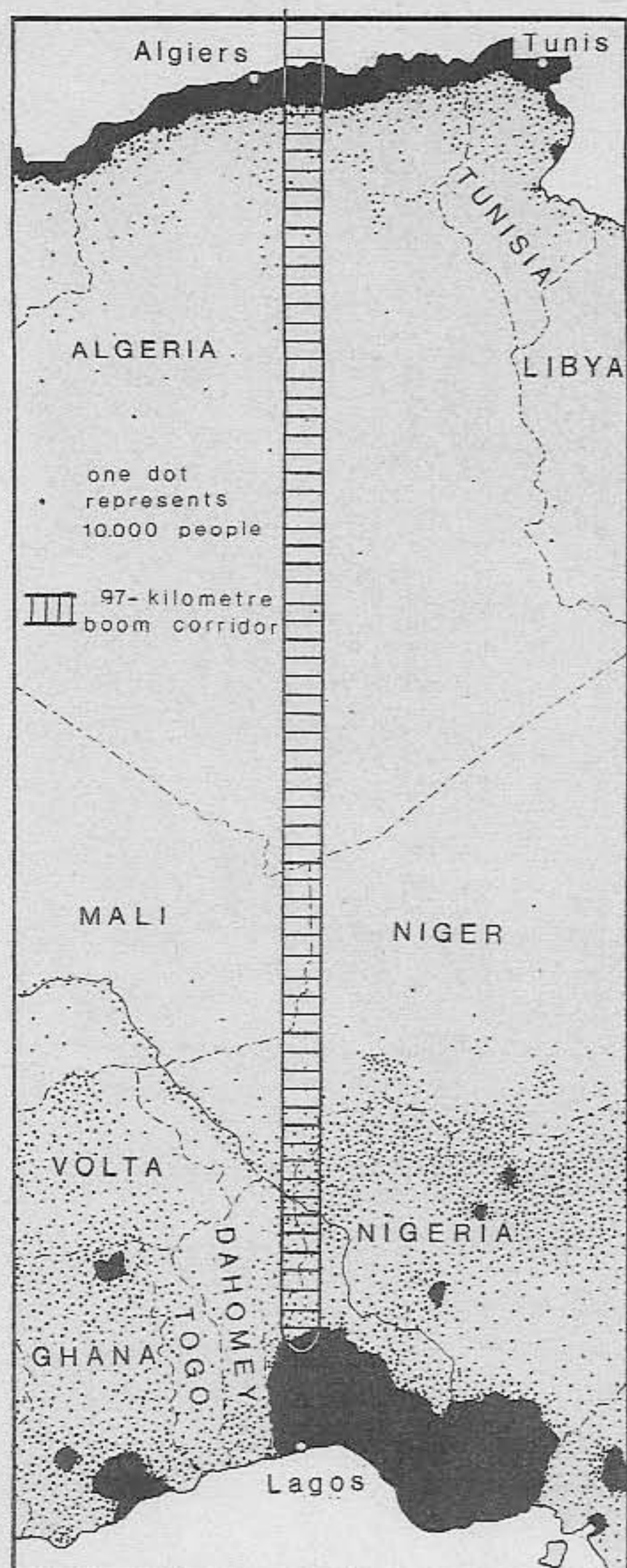
Boom corridor ninety-seven kilometres wide is drawn assuming an eighty-one kilometre wide boom carpet and a sixteen-kilometre wide airline. This pre-supposes a much greater consistency of navigation than that achieved at present by sub-sonic jets. Examples of supersonic routes illustrate problems involved. In the Mediterranean (left), it is not possible to avoid booming either Sicily or Malta and although major cities in the Middle East would not be boomed, inhabited land cannot be entirely avoided. Any attempt to avoid booming Australia by diverting to Port Moresby (above) must result in booming some islands in the Indonesian archipelago

mize benefits or minimize costs in isolation but to maximize the difference between them, in order to gain the greatest benefit for mankind. The difficulty with this reasoning is that it is unconvincing if there is a lack of identity between the group that reaps the benefits and the group that bears the costs. Maximizing the net benefit of a project to speed first class passengers about the world would no doubt make an interesting cost/benefit study, but it would only be an abstract conscience-salving exercise for the passengers and worse than irrelevant to those who stand no chance of sharing any of the hypothesized benefits. A global benefit/cost ratio would in this case be nothing more than a measure of the rich

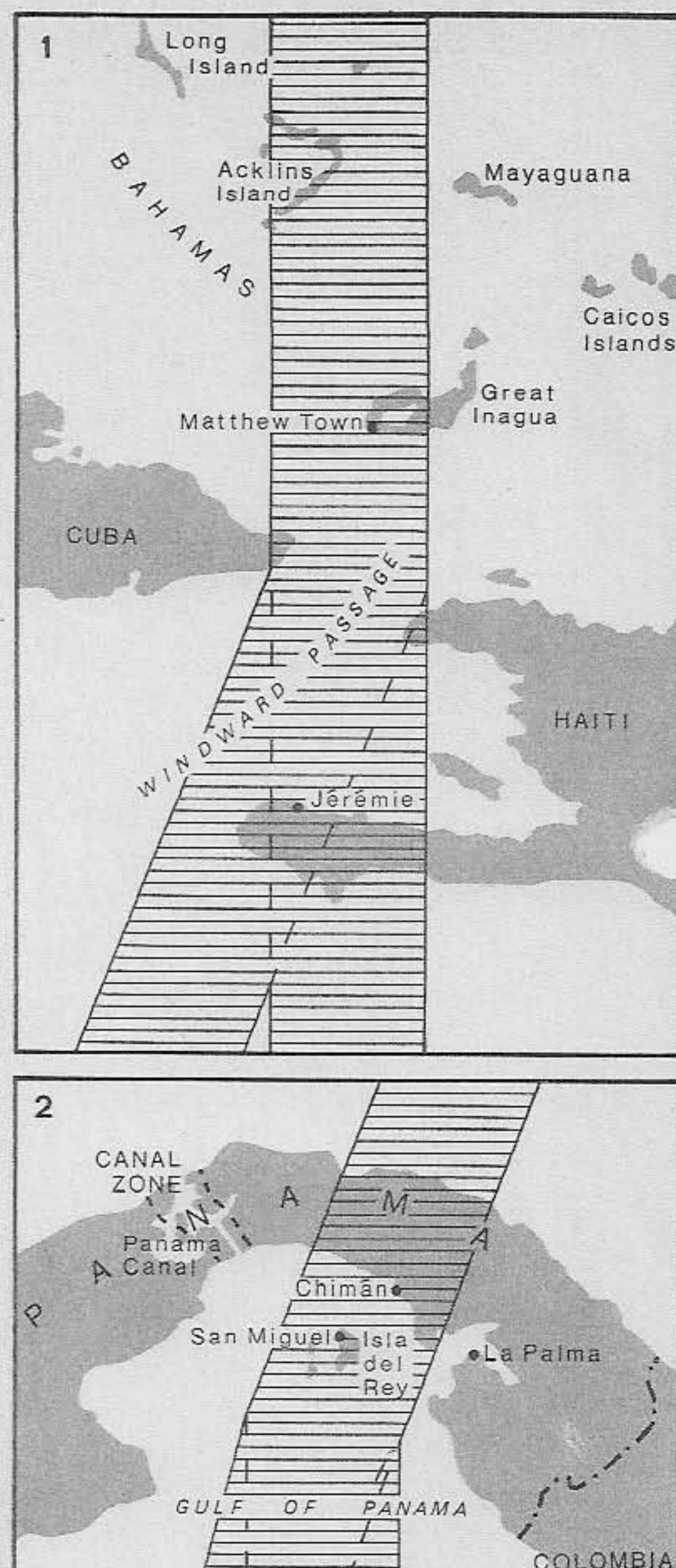
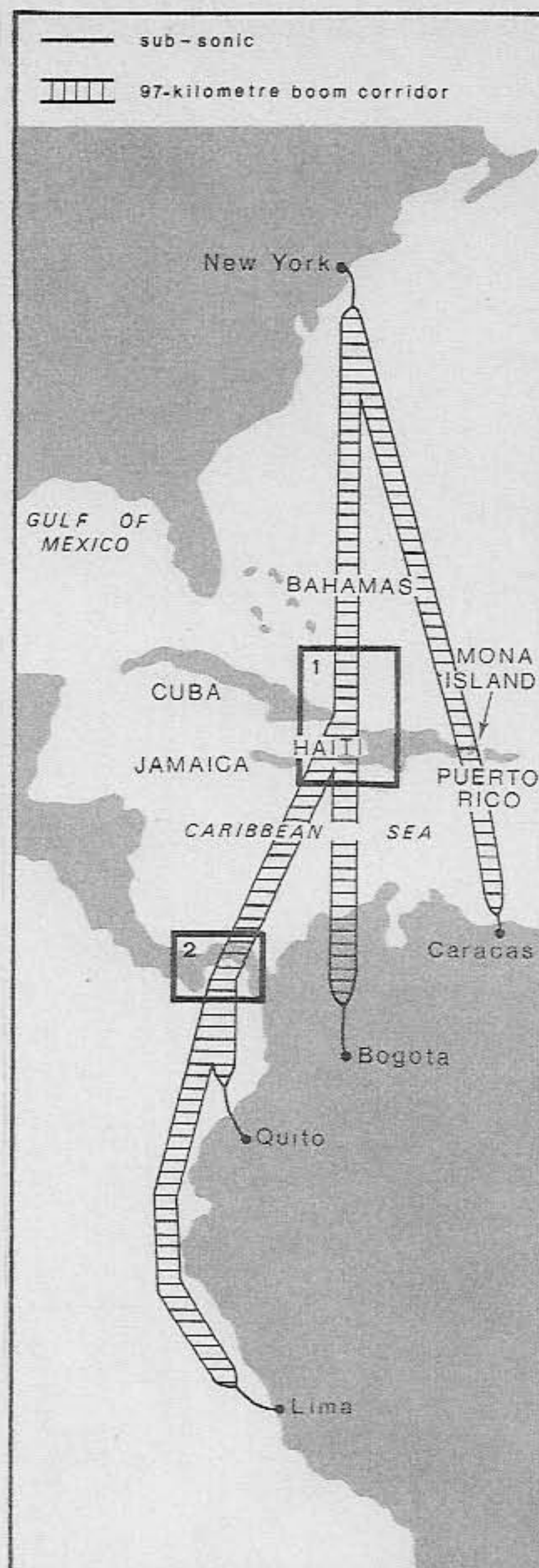
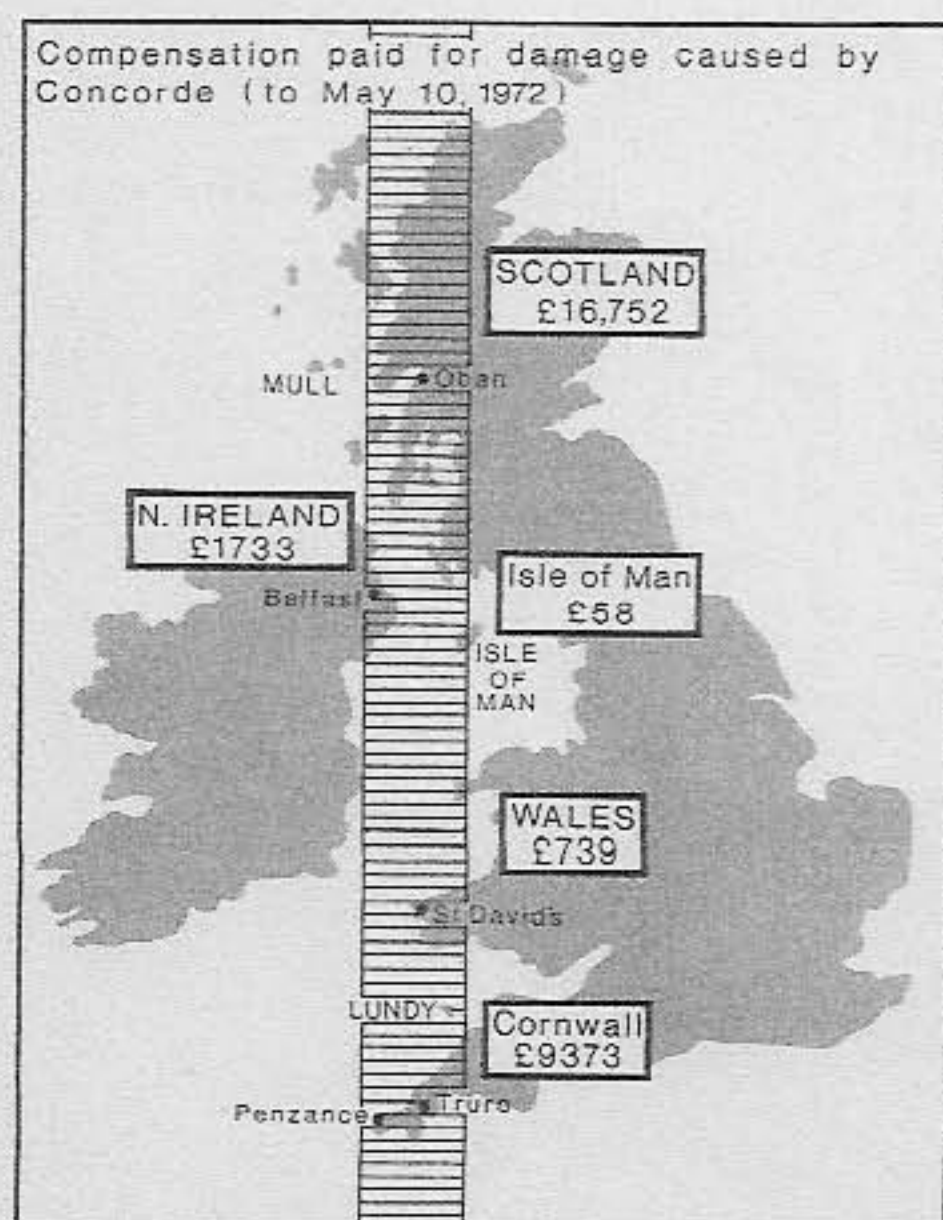
getting richer at the expense of the poorest.

The attitude of those who would inflict sonic booms upon the sparsely populated was demonstrated by Charles Gardner, BAC's Publicity Manager, who was quoted (in *The Sunday Times*) as saying on the subject of a boom corridor across Australia: 'In the Australian desert there's nothing except a couple of abos and plenty of kangaroos.'

Australian Aborigines, Indonesian islanders, desert nomads, Arab refugees in Gaza, Maltese, Tuaregs, Hausa villagers, Haitian and Colombian peasants and Panamanian Indians are among the sparsely populated peoples at greatest risk. The calculations that have put them at risk can



Large areas of the Sahara over which Concorde might pass are not uninhabited (above) and the north and west coastal fringes of Africa are very densely populated



Flights from New York to South American cities will almost certainly result in booms over Cuba or Haiti or both, as well as adjacent islands. Over bird sanctuaries such as Inagua and Mayaguana Islands flights must be restricted. Route to Caracas passes conveniently between Dominican Republic and Puerto Rico but supersonic flight would boom holiday island of Mona. Major cities on Panama Isthmus may be avoided but small villages would be boomed. Caracas, Bogata, Quito and Lima may be stop-over points en route to Sao Paulo and Buenos Aires

About twenty supersonic test flights have been made down the west coast of Great Britain. (Left) compensation has already been paid for structural damage and for harm to animals

only be based on the assumptions that either these people do not matter or, more cynical yet, that they are the least able to retaliate or make any form of effective protest. If a boom corridor is negotiated over Australia, it will not be by the Aborigines who will be boomed, but by people in Sydney and Canberra. Such political ineffectualness is characteristic of technologically under-developed, 'sparsely populated areas' everywhere. A general concomitant of it is an almost complete indifference on the part of the political centre to their rights and needs.

To this point the argument has been conducted on the assumption, made in all the manufacturers' calculations, that it is permissible to boom over the sea. Con-

corde, if it goes into service in any significant numbers, will boom over the busiest shipping lanes in the world. In terms of the numbers of people who will suffer, these areas are indistinguishable from the sparsely populated areas discussed above. Moreover, it is the coastal waters, which are inhabited by pleasure boats as well as by commercial shipping, which will be the areas affected by the superbooms produced at the beginning of every supersonic flight.

It may well be true that 'the main aim in civil aircraft development has always been increased speed', but this is a peculiarly backward looking justification for a project which would propel us forward through the sky at twice the speed of sound without reference to the people who live below.