
Influences on the Development of Aviation

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It is, of course, a very great honour and pleasure for me to act as Honorary President of the Royal Aeronautical Society in its Centenary Year. This would be true even if I did not know the first thing about aviation but for someone who enjoys flying and takes a close interest in the whole subject of aeronautics this is a very special experience.

I have already been able to extend a very warm and cordial welcome to all the delegates attending this Congress but I want to repeat how delighted the Society is to have so many distinguished guests from abroad. Aeronautics is one of the few truly international activities right through from research and development to the carriage of passengers and freight all over the world. No matter how hot the commercial competition between manufacturers or operators, there is a very close bond between all people who suffer or enjoy the fluctuating fortunes of every branch of aeronautics.

This occasion is, of course, intended to celebrate the centenary of the formation of the Royal Aeronautical Society and I suppose it would be considered appropriate for me to trace in more or less detail the development of aeronautics during the past hundred years. This would not pose any insuperable problems but I decided against it because I suspect everyone present has a pretty good idea of the history of this subject and yet another recital is unlikely to add anything startling or constructive. If anyone is uncertain about the early history of aeronautics, I suggest a visit to that film 'Those Magnificent Men in Their Flying Machines'. The first part is particularly instructive!

In any case it seems to me that a bald knowledge of the exact sequence of events, however detailed, is not history. The important thing is to extract from the known sequence of events an appreciation of cause and effect and ultimately a better understanding of the present situation.

It may be fun to try and look into the future but it needs a vivid and informed imagination. The present always appears to be in turmoil and there never seems enough time to stand back and sort out what is and what is not

important in the long run. The past is more distant, the important events have been winnowed to the surface and it should be possible to pick the broad pattern of development and the influences which have been at work.

The interesting point about today's meeting is that the hundred years which it celebrates virtually covers the whole story of man's aeronautical activities. Although much thought was given to the problems before that and there were isolated attempts to get into the air, a consecutive series of events only began about a hundred years ago.

Considering the enormous preponderance of heavier-than-air flying machines in use today, it is not altogether surprising that we have come to associate aeronautics exclusively with that particular branch of the art, science, or black magic of getting off the ground.

It comes as quite a surprise to many people to find that the Royal Aeronautical Society was formed almost forty years before the first powered flight. To anyone involved in aeronautics this is of course very stale news, but even so it comes as a healthy reminder that some very ambitious and enlightened men were trying hard to get into the air a long time ago. It also says a lot for these early enthusiasts that, unique among similar groups, they formed an association before rather than after any recognised profession or industry had come into existence. I wonder if the first members would not find that a more satisfactory state of affairs than things are at the moment.

That kind of hopefulness, or perhaps wish-fulfilment, seems to have remained with aeronautical people ever since. How else can one explain the breathtaking impudence of the early long-distance flying feats or the flights of fancy which have given rise to latter day projects in aeronautical engineering?

There can be no doubt that the foundation of the Royal Aeronautical Society and its subsequent activities have had a profound effect on the development of aviation in this country and to a certain extent all over the world.

It is easy enough to assess the contribution which individuals have made in particular cases and the records of companies and research establishments are there for all to see. The Society's influence on the other hand, is more subtle. It has brought together individuals from all sides of aviation with theories and calculations, arguments and novel ideas and from this exchange the broad pattern of British aviation practice emerges.

Every occupation or profession seems to develop its own group characteristics. I am not going to attempt to describe them but I do not think I am being fanciful by suggesting that farmers on the whole have a different general approach to, say, lawyers or civil engineers. I suppose the simplest explanation would be that certain occupations and professions attract like-minded people, particularly when the motive for joining is more than purely commercial.

This really must be so because if the selection of a career depended solely on commercial considerations I think I am safe in saying that aeronautics would have taken a great deal longer to develop, if indeed it had started at all. More than any other of mankind's occupations, aeronautics has depended upon enthusiasm and utter devotion, bordering on an obsession, to the whole idea of flying. Matched, I might add, by anything ranging from indifference to horror felt by people who are not interested in flying.

Whereas the early days of the railways, for instance, saw a few light-hearted stunts, railway engineering very soon settled down to a severe and practical commercial development. Railways had their steam locomotive fans but only with the recent crop of closures has any public emotion been re-awakened. Aeronautics, on the other hand, owes its very existence to showmanship, stunts, gimmicks and popular wonder and excitement. The whole business was new and mysterious and delightfully dangerous and uncertain. Today railway and shipping companies can order what equipment they like with but a passing flutter of comment or criticism.

Not so in aeronautics, where every bit of equipment for civil or military use is argued with an ignorance almost directly proportional to the emotion provoked and inflamed by righteous indignation about the cost.

The novelty and audacity may have worked off but in their place aeronautics has become delightfully spiced with that irresistible element of national prestige and international competition, otherwise reserved almost exclusively to popular sporting contests.

Even though aeronautics may owe a great deal to showmanship, spectacular stunts and popular excitement, that should never be allowed to obscure the more decisive contribution of rational scientific engineering, solid technical progress and commercial development.

Yet popular interest and inventive engineering alone could not have provided the pressure to bring about the improvement in performance which has since taken place. I do not think anyone could reasonably claim that the present or future standards of air liners were entirely due to spontaneous public clamour.

The determining factor was undoubtedly the military application of aeronautics very early in its existence. Like so many other novel ideas, this happened almost entirely in spite of conventional military thought. It needed the stimulus of actual warfare to make aviation an accepted part of the military establishment. Military — and I include naval — aviation certainly would not have developed at the rate or in the direction it has done without the necessity and practical experience of the two World Wars.

Furthermore, the technical progress stimulated by wartime necessity had a profound influence on the subsequent commercial development of aviation.

The very novelty of aviation meant that before the First War its military application was entirely speculative and then during the War its development

depended upon an arbitrary and pragmatic reaction to events.

The development of military weapons and techniques between wars is always a bit uncertain because the difference between what people think is going to happen in war and what actually happens increases in direct proportion to the interval between wars. It is further complicated by what some people would like to happen in war.

The potential in aviation was so great between the Wars that it is not at all surprising that policy decisions about the system for stating requirements, research and development of designs and manufacture, the creation of an independent air force, the bombs versus battleships excitement, air defence problems, the relative values of tactical and strategic operations, the cost-effectiveness of the bombing campaign, abstract concepts of air power and the practical exploitation of flying machines, have all generated a heat and passion well in keeping with the popular excitement, personal devotion and brilliant engineering which is the hallmark of aviation.

The argument about the use of air power in the Second World War is only just beginning to hot up, while the military application of aviation now, and in the future, is being debated with an abandon previously only experienced in religious arguments, and with about as much chance of a rational outcome. On top of that it is obvious that ordering military equipment abroad is a new and important influence on the development of aviation in this country.

I do not propose to go any further into the development of military aviation for obvious and sufficient reasons, but naturally the demands made by military aviation in the light of the world situation have a very considerable influence on the work done at research establishments and the designs produced by the manufacturers. Even though warfare demanded particular types of aircraft this development certainly helped to advance the whole art and science of aeronautics.

As the Wars receded and designs became more specialised, so the division between military and civil aviation has grown. The very peculiar and special conditions under which civil aviation operates today and the areas in which competition takes place, have helped to create specialised civil aircraft which are economic within those particular conditions. National prestige, the international control of ticket prices, the control of landing rights and national air space and so on, all tend to modify the purely commercial considerations of manufacturers and operators. But like so many things, the game has to be played to the rules even if the rules look a bit odd sometimes.

Military and civil passenger aircraft are of course the major components of aviation today but it would be wrong to ignore the tremendous growth of what has come to be known as general aviation. The environment in which general aviation has developed is quite different. For one thing the price of light aircraft is now well within the purchasing power of many individuals in the more prosperous countries. Unlike the big stuff, the use of aircraft in

general aviation is influenced to a greater extent by weather conditions, distances, the existence of other means of transport and other very practical considerations. It is quite obvious, for instance, that the potential use of light aircraft in this country will never compare with the larger countries with better weather conditions. As there is little prestige value or technological fall-out to be derived from general aviation, the degree of official encouragement varies very much from country to country. I am sure everyone here knows only too well the conditions which prevail in this country.

Yet the pattern of control and support, and general involvement of Government in the aircraft industry was set by the special circumstances of war and this has had a decisive influence on the whole evolution of aviation.

If there have been endless discussions about the military and civil applications of aviation, these have only been rivalled by the discussions about the relationship and responsibilities of Government to aviation. This has been reflected in the variety of agencies and ministries which have come and gone in this country in recent years. The recent reports of the Public Accounts Committee also have some bearing on this difficult subject.

No matter how efficient the component parts of Government or an industry may be, how competent the managers or how brilliant the engineers, its general performance is governed by the environment in which it works. The factors which control the aircraft industry, apart from defence, are first, the commercial considerations and the relationship between makers and users; second, the method of control and support employed by the Government and third, the degree of personal enthusiasm and competence of individuals at all levels in the industry.

There has never yet been any doubt about the degree of personal enthusiasm and competence and even though Government is deeply involved through its fiscal measures and as the major customer, there is nothing mysterious or special about commercial considerations as related to the aviation industry. This leaves the problem of Government control and support. As this is an extremely touchy subject let me just put it this way. If the relationship between Government and aviation is right and if the system it uses to support the industry and to order military equipment as a whole is the right one, then aviation and the nation will benefit. If the relationship is wrong and if the system of support is applied in the wrong way, all branches of aviation will have to operate under a very severe handicap. It is, of course, easy enough to say what is wrong — it is a great deal more difficult to suggest what would be right.

Now that almost all the basic industries in this country are more or less dependent on Government support in one form or another, and as Government by its purchases for defence is by far the biggest customer of the aviation industry, it would seem about time to make a rational assessment of the principles of applying this support. By support I mean loans, direct subsidies for

particular projects, capital write-off, import restrictions, discriminatory taxation and tax relief, development contracts and various methods of assisting exports and partial or outright ownership of manufacturing companies. Every human endeavour is governed by the environment in which it seeks to operate. Subsidy in any form is a very important factor in that environment and it may well be decisive when it comes to planning future developments. In my opinion at least it is much more important to get the environment right than to worry exclusively about future projects.

In retrospect the sequence of discoveries, inventions and applications seems to follow a nice orderly path, as one leads logically to the next. In fact at any given point in time the future is obscure and the next step is nothing like as obvious as it appears after it has been taken. The most remarkable example of this was the hiatus after the Wrights' first successful attempt at powered flight. In current jargon this would have been described as a dramatic breakthrough, but at the time it was strangely ignored.

For many of the early years the progress of aviation was more or less haphazard. Only war necessity and later commercial interest brought some coherence to the selection of projects and the planning of research. On the whole the deliberate selection of the next step probably speeded up progress, but there are a good many examples of wrong projects being selected which led to dead ends or very expensive failures. As aviation has developed so has the cost of projects. Once upon a time it did not really matter whether the wrong project was selected and it was still possible to make jokes about 'back to the drawing board'. Today a wrong selection can destroy great companies with reverberations throughout the national economy. The problem of selection goes right through from research programmes, development projects, commercial contracts, to the proper use of equipment.

The problem of making the right selection in research programmes and development projects has become crucial to the whole of aeronautical evolution. Selection is a function of assessment, judgment, imagination and the ability to make decisions. It is a purely human responsibility and there is no way unfortunately of making selection automatic.

Selections can eventually turn out to be right or wrong but decisions can be right, wrong or avoided altogether. If there is anything worse than making a wrong decision it is the inability to make a decision at all. Decisions, preferably the right ones, taken at the right time can make all the difference to success.

Furthermore, time-wasting and indecision cost a very great deal of money with nothing to show for the expense.

The critical factor is the atmosphere in which the decision-making machinery has to function. If right decisions are rewarded by progress, success and prosperity, people and organisations will be thrown up capable of making these decisions. If, on the other hand, the atmosphere demands

that no risks should be taken, that it is more important not to be wrong, then inevitably the machinery of decision-making will be governed by caution and a negative approach and before long it leads to an attitude which says nothing should ever be done for the first time. This latter situation is bound to be fatal in the long run because the only way never to be wrong is to remove the necessity of making any decision at all. You could not be wrong about any aviation project, for instance, if aviation did not exist.

It is a truism that decision-making is the prime function of management. It follows then that as Government responsibility for various industries increases, so does its management ability become more important. The concept of Government as a purely policy-making and administrative system no longer applies as Government becomes more directly involved in the process of industrial management. In effect, Government becomes a member of the Board of Directors and this means that Government needs all the specialist management, technological and factual experience which industry has found necessary in order to make the right decisions. This experience is also necessary to give the industries, for which Government has acquired particular responsibilities, the feeling that the decisions are being taken for the right practical reasons and from a position of knowledge. It is probably easier to get a solution to this problem in a wholly free economy, or in a wholly controlled economy, than it is to find a workable answer in an economy which is partly free and partly controlled. There is probably much to be learnt from a comparison of the methods employed in other countries.

Whatever the purely commercial results may have been, aviation has led the field in scientific and technological progress and it has probably been the most important single cause of technical advance in industry as a whole. Quite apart from introducing novel methods of construction and manufacture, it has brought into being the whole vast business now called avionics whose techniques have found their way into almost every branch of industry. No one can pretend that the commercial returns of aviation have been spectacular, yet it has attracted probably the best brains in all departments of technology. Unless we are prepared to accept that our best is not good enough we must look elsewhere for an explanation of the industry's problems.

The fact is that not all industrial undertakings operate in exactly the same environment. Mining, for example, has problems which do not exist in the boot and shoe industry. Similarly aviation occupies a totally different position within the economy and as a commercial undertaking, to the motor industry. Lumping them all together, however convenient or philosophically satisfying, cannot result in getting the best out of each of them.

The tremendous practical advantages of aviation for long-distance passenger travel and for so many defence purposes has resulted in the rapid growth of the industry and an even more rapid growth in the cost of successive generations of aircraft.

The Government has, of course, always been involved as the sole purchaser of defence equipment and also because so much aviation constitutes a civil social service which needs to be regulated by public authority. Few major aircraft in recent years have cost less than £250 million to produce and the next generation looks as if they are going to cost twice as much. To make economic sense the research and development costs should represent something less than 50% of the total costs. In the normal course of events the profits from past successes are used to pay for future projects. For this to happen in the aviation industry would mean an accumulation of profits which, even if possible, public opinion would be bound to feel was excessive. Yet we all believe that it is ridiculous for a country which is supposed to be well advanced in engineering technology, to admit that it cannot cope with aeronautics — the most advanced technology of them all. It is partly for this reason that Government is prepared to use taxpayers' money to support the industry, but it is also partly because of the glamour of aviation which makes people prepared to risk more resources in the development of aircraft rather than in other forms of transport, for instance in railways.

For European countries the total investment necessary to achieve success has become so great that individual countries are finding the risks a bit daunting. Out of this has grown the beginnings of international co-operation. It is the obvious answer and technically it has been surprisingly successful, but the system of official co-operation and decision-making still seems to be a bit vague. If it is important to see that aviation is fitted into the national economy in such a way as to enable it to function most efficiently, it is even more important to work out an international structure which will enhance and encourage the chances of success, rather than frustrate and defeat them. One major difficulty is that the development and manufacture of aircraft is a very long term business which means that decisions have to be taken well in advance. Political government by its very nature is inclined to be short term and a state of political stability and economic certainty do not always coincide in the different countries concerned.

It is not as if international industrial co-operation is something new or experimental. Several of the largest companies operating in this country have been international for many years. The aviation industry is rather a special case because inter-governmental co-operation must also take place if it is to meet with any long-term success.

One of the features of aviation is the vast range of potential developments which it contains. Railways and ships, for instance, can be used in a number of different ways but there are certain well-defined limitations. Apart from refinements in control and operation they have reached the end of their practical development. There are practically no such limitations in aviation as yet. Development has always depended upon imaginative projects and imagination in the exploitation of new ideas. The most important factor is the

correct use of a new development, not necessarily as an alternative to an existing system, but as an entirely original concept which has never previously been possible at all. Helicopters are quickly finding their proper use but air cushion vehicles are still only on the fringe. As much depends upon imagination in the use of novel equipment as it does on its invention and design.

In this sketchy assessment of the influences on the development of aviation I have made no reference to astronautics. It is true that it has grown out of aeronautics but it has really become an entirely separate subject with its own possibilities, limitations and problems and with its own different reasons for development. In spite of the tremendous public interest in human space flight and the possibility of a man landing on the moon, it all seems rather remote and technological. Aviation is within the grasp and imagination of the average man, it has become part of our human environment. Space activity is more like a gigantic scientific experiment to be admired or to be encouraged for its practical benefits, but difficult to bring within the bounds of human experience.

I might add that it is also fairly difficult to bring the scale of costs within human comprehension. This alone means that dabbling in space without a coherent programme or a rational system of supervision wastes a great deal of money with virtually nothing to show for it.

Anyone who knows the facts of aeronautical history and has the time and inclination to analyse them can advance his own ideas of their significance.

This necessarily rather brief review just happens to be the way I choose to interpret the facts.

I find that aviation as a human activity has certain highly individual characteristics. It is as much an enthusiasm as a scientific, technological or commercial undertaking. More than any other activity it has always depended upon the personal contribution of gifted and far-sighted individuals.

Its development has been decisively influenced by historical events and it has grown up with, rather than before, the progressive involvement of Government in industrial activities.

Aviation is not comparable with the straight-forward manufacturing industries. All its projects require massive speculative investment and special arrangements have to be made in all economic systems; free, partially free or wholly controlled. The most important of these special arrangements include the system of applying Government support, the relationship with Government for the purpose of organising research, the selection of civil and defence projects and the arrangements for their design and manufacture.

The cost and effort required to maintain a viable aviation industry are so great that international co-operation is almost essential. The administrative arrangements necessary to achieve effective international co-operation are even more important than the internal and purely national arrangements.

Intuition and imagination have always played a most important part in

aviation; without them further progress is virtually impossible. However, they cannot ensure success on their own and they cannot begin to operate at all unless the whole system has a thoroughly rational basis.

The first hundred years of aviation have seen some spectacular developments but I do not believe even these will compare with the development in aeronautics and astronautics during the next hundred years. There are formidable problems to overcome, there are any number of possibilities waiting to be exploited and the challenge of space is the most exciting and daunting which mankind has ever faced.