Air Marshal Subroto Mukerjee Memorial Oration

The Values of Aviation Medicine in the Changing World

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ON the historic occasion of the 1st April 1954, the Indian Air Force came of age and the Service was fully nationalised by the appointment of Air Marshal Subroto Mukerjee as our first Indian Chief of Air Staff and Commander-in-Chief. 1954 saw also the first anniversary of this Aero Medical Society, so that this Society has come of age now. I feel greatly honoured therefore to have been asked this year to deliver the Air Marshal Subroto Mukerjee Memorial Oration.

I had the proud privilege of addressing this Society at its first anniversary on 22nd January 1954. I am very happy to recollect that my talk entitled "The Scope of Aviation Medicine in India" was published in the very first issue of the Journal of this Society. It is accordingly, with a feeling of pride, tinged, I must admit, with some degree of nostalgia, that one recollects the considerable enthusiasm generated at that first session, that one recalls the aspirations of the few young Medical Officers who had gathered together to dedicate themselves to a career in the Medical Branch of our Air Force—daring to hope that they would, by their keenness and loyalty, develop an organisation of which the medical profession might justly be proud.

Twenty years have now elapsed. During these two decades many changes have taken place in the political, economic, scientific and technological fields throughout the World.

In Science and Technology, I may not be far off in my computation if I state that 70 per cent of the total sum of human knowledge has been acquired during these years. You will appreciate that such exponential growth is bound to have had profound impacts for us all. When we started to develop our speciality, abroad Man was on the threshold of space; manned space flight is now 17 years old; aerospace medical technology has developed to such an extent that its "spin-offs" are already bringing far-reaching benefits. The World Health Organisation, for example, is utilising the by-products to tackle medical problems on a global scale. Not only has Man started the exploration of near space, but all the corners of the Earth, highest mountains and even the depths of the deepest ocean have been explored; we have now become fully aware of the immense wealth that lies in the seas and underwater living is becoming a practical proposition.

The technology of Warfare has advanced beyond comprehension. This has had its repercussions on India also. More and more expensive and sophisticated equipment has been added to the armamentorium of our Armed Forces, which have grown in experience and stature. We are being forced, and fortunately so, to become increasingly self-reliant. The Air Force has expanded beyond recognition. It has gained many laurels in War and has earned the confidence and gratitude of the people.

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The Medical Branch also has grown greatly in size. It is heartening to record that some of the aspirations of those Medical Officers of two decades ago have been gratified ; that the inertia of ignorance, if not of vested interests, which had so bogged down the emergence on the Indian scene of Aviation Medicine at that time, has been overcome ; and that this science has taken its rightful place amongst the variety of disciplines constituting 'medicine', in its broadest sense. That the Science has been accepted by the Armed Forces of the Country is a tribute to the confidence and support of successive Chiefs of Air Staff particularly that of Air Marshal Subroto Mukerjee.

It is also heartening to relate how Aviation Medicine itself, leastways abroad has, to a large extent, kept pace with the developments in aerospace technology and solved so many of the human problems presented by the changing environment of the industry. In the past, it has always been the advance of aviation into higher and higher regions of the atmosphere and its increasing speeds that had resulted in aircraft performances often outstripping the capabilities of the human frame. But, the lessons, often very expensive and tragic, of the Second World War were well learnt. The importance of studying human psycho-physiological limitations and incorporating the data into aircraft design had been fully appreciated. The rapid progress in human engineering, systems analysis and in the techniques of providing reliable microenvironments had enabled man and machine to be more closely matched. It is for such reasons that one feels proud to know, that we too have learnt these lessons and have established our Institute of Aviation Medicine in close proximity to a major component of our developing aeronautical industry.

Once the basic lessons were learnt, fabulous resources and a wealth of scientific talent were poured into aero-medical research abroad, so that man is now able to transcend the confines of the earth's protective atmospheric blanket and venture into space — where he can be maintained at the peak of efficiency and free from the hazards of what is in actuality, a totally hostile environment. Now a stage has been reached when it is this very progress — from the atmosphere into space — which is having far-reaching impacts on Aviation Medicine itself. It is these impacts which need careful consideration today — even if it were not already high time for us to take stock of the Values of Aviation Medicine in the present context. It is my purpose today to consider the values of the classical concepts of Aviation Medicine against this back-drop of progress.

First let us consider what impact man's advance into the space environment has had. You are all aware that the physical transition from atmosphere to space is, by and large, a gradual one—the atmosphere thinning out smoothly, the pressure falling off, the primary cosmic ray intensity increasing and so on. The same is not true, however, of the physiological attributes of this transition. As higher and higher altitudes are attained stages are reached at which the limits of human tolerance for various bodily functions are surpassed—as an example consider the breathing function ; above 63,000 ft. the exchange of carbon dioxide from the lungs for oxygen from the air cannot take place by the process of external respiration and special breathing equipment is required. Whilst higher altitudes can be attained for short periods by the use of what is called partial pressure breathing assemblies, a height is soon reached, and this is as low as 15–20 miles up, when only a complete pressure assembly will suffice. Now, it is immaterial whether you are 20 miles up or sitting 240,000 miles away on the surface of the Moon, or for that matter floating in some remote recess of planetary space, as far as the breathing function is concerned, the same protective device will suffice. So this altitude of a bare 15—20 miles up can be regarded as totally space equivalent. If the problem of breathing, at this altitude or distance away is completely solved, it is solved for any region in space.

In a like manner, there are space-equivalent altitudes for a number of other bodily functions and all such-like altitudes or barriers have been successively overcome. Such has been the mastery of the human aspects of rocketry, that space flight has become almost common place—it no longer excites the same intense interests and awe that it did just five years ago. The implications of such concepts

as weightlessness—something we hardly thought about some years ago, are now understood by an average schoolboy, who I am sure has a better understanding of what gravity is than we did in our time; some space-minded school boy would even be able to enunciate how gravity is the most exceptional and perverse of all accelerations known to Nature.

This mastery, you will appreciate, has been well demonstrated by the success of the Apollo and Skylab series of flights and the repeated landings on the Moon—the unfortunate American and Russian mishaps can be ascribed to technical failure rather than to any deficiency in physiological knowledge of the hazards involved or the measures necessary to obviate them. By human engineering research, design and development, it has been possible to provide man with an almost natural environment in any form of flight. By added sophistication and redundancy it has become possible, by and large, also to provide for his safety.

What does all this imply?

Against this background, one cannot but believe that since manned aeronautics has advanced from supersonics through hypersonics to space, very few medical problems remain for solution. What then is the place of Aviation Medicine now?

There has been in recent times, certainly abroad, a playing down, as it were, of this speciality in some circles. The American Medical Association has disbanded its Committee on Acrospace Medicine resulting in a tendency to isolate the Speciality; there is a feeling that the medical requirements of Civil Aviation, for instance, relate only to health maintenance and licensing. Last year the 21st Congress of Aviation and Space Medicine held in Munich discussed the future of the Speciality in this context, arguing that the major questions relating to Aviation Medicine had been settled.

One reason for all this is, of course, the narrowing fields of research in the Speciality. More and more, normal environmental conditions are being provided by human engineering techniques, so that Man is not being exposed to an adverse milieu. After all, Man evolved over the past two million years and more, within a particular biosphere and though he has some capacity to adapt physiologically to alterations in his environment such as those of atmospheric pressure, oxygen and carbon dioxide tension, various pollutants, gravity, temperature, humidity, day-night phase shifts, electro-magnetic radiation and so on, there is a limit for each of these parameters beyond which his homeostasis is affected and his efficiency falls off. Aviation physiology has been concerned with determining these limits, in so far as they are related to the aviation environment, and it is now evident that the body's ability to adapt and acclimatize, even to the limited variations met with on our planet, is not as great as was once thought possible. "Man adjusts by controlling his environment, not his physiology." Man cannot get away from his biologically determined environment heritage. As Rene Dubos has pointed out, "we are still operating with the physiological equipment that fitted us to the natural environment prevailing during the late Stone Age." "Man continues to function according to the Cosmic order."

Whilst it was of fundamental importance, in the past, to study the effects of hypoxia, of cold stress and so on, the emphasis has been shifting towards preventing exposure to such conditions by the provision of suitable and adequate micro-environments. Further studies in these areas turn out to be largely attacks on old problems with more expensive apparatus and with sophisticated and advanced technology; often the research becomes more and more an academic exercise which may not have a ready practical application to aviation. I use the words "ready practical application" with due circumspection. Let me clarify: We all know that "Black-out" is of vascular origin, due to a failure of blood supply to the eye. Acceleration physiologists, however, want to know the underlying mechanism for this phenomenon — the actual site of the disturbance—whether this is in the retina and if so, exactly where; whether a failure in nerve conduction and if so, at which particular ganglion cell or synapse, or whether in pigment metabolism at the receptor site. If asked, these physiologists would, I am sure, answer either that the reason for this search was the pursuit of knowledge for the

sake of knowledge, or that deeper understanding of the mechanism of black-out might enable improved methods of prevention or protection. What I would like to ask is how localisation of the site of the disturbance to, shall we say, the ganglion cell of the retina could possibly, in the present state of the art, have ready practical applicability? If one briefly surveys the current research literature one can get some idea of the relative emphasis given to basic research as compared to that given to applied work.

Our speciality has, par excellence, been an applied Science utilizing knowledge from a great many disciplines for the solution of problems of aviation. During the early phases of development, impaired performance due to physiological factors played an important part in the attrition rate among flyers. Man was forced by the stress of circumstances, mostly the aweful stress of war, to expose himself to increasingly hostile conditions and as a result aviation physiology came into its own and became a subject of basic importance in support of the flyer. Before the First World War, for example, it was oxygen lack and G_z forces that decreased aircrew efficiency and called for research into human tolerances to these stressors; during the Second World War it was, inter alia, decompression effects and short duration accelerations in the G_z and G_y axes; later came thermal stress, long duration G_x accelerations, disorientation, metabolic disturbances, vibrations and weightlessness. Now that it is less necessary to face physiological stresses, it would seem that the importance of physiological function in exotic conditions has declined. By this I do not mean to imply that no problem areas in such fields remain. What I wish to put across is, that as human engineering technology and resources have evolved, the need for physiologically stressing the human organism has become so much less. Take for example the issue of human tolerance to transverse accelerations in the G_x axis. The initial Vostok and Gemini flights imparted tremendous loads on the body—but now, as rocket technology has advanced, it is no longer necessary to do this and it is visualised that the G_x loads during the Shuttle, for instance, will be pleasantly tolerable. Similarly in atmospheric flight, as air conditioning units become more and more efficient, the necessity of thermally stressing the man will become less and less.

This, then is one of the features of the present situation—and a most important one. I am aware that this view of the narrowing field of aerospace medicine particularly in research, has been considered as pessimistic and has even been called "Stygian," but it is difficult to get away from the facts.

Another feature of the current situation arising out of the first is the highly specialised and sophisticated nature of aero-medical research. Whilst speeds and heights have lost much of their significance certain other issues have no doubt arisen. As far as space flight is concerned, the emphasis has shifted to certain matters concerning habitability and particularly to those relating to the state of weightlessness. The problem now is whether man can survive more prolonged periods of weightlessness—he has already done so for 85 days—or whether he will have to call on the engineers to provide him an artificial gravitational field. But without going into Space, even in conventional flight within the atmosphere, there are certain unresolved problems —e.g. safe escape at high effective air speeds or the incidence of unexplained accidents. The important fact about this is that research in these areas is highly specialised and not only needs an extensive scientific organisation but tremendous financial and technology resources for adequate progress. Such requirements are not easily met.

Just consider what experimental and other facilities would be needed to simulate the conditions for developing a safe escape system at supersonic speeds at low altitudes. Economic factors quite apart from the technological, preclude the possibility of putting forth the large scale effort that would definitely be required. Even purely physiological work today requires expensive, intricate and time consuming methodology, such as bio-assay techniques, the use of radio-isotopes, gas chromatography, various electronic devices and the like. Large scale data collection which offers a ready means of solving some issues needs the services of a computer. Such R and D can only be undertaken by wealthy nations with scientific talent to spare or if such development is considered of national

importance. For a developing country, it would probably be considered more advantageous to import the know-how. Rapid and spectacular developments in human engineering in the Space Age have guaranteed a safer and more tolerable environment for the flyer on the one hand, so that he is not likely to be subjected to abnormal physiological stress, whilst on the other, the remaining problem areas have become so highly specialised that they are almost out of reach of those not possessing the necessary economic and technical resources.

Thirdly, we must remember that Aviation Medicine came into existence out of dire operational necessity because of the high attrition rate amongst Service Flyers during World War I. It came into prominence during the Second World War in successful support of enlarging air operations both Military and subsequently Civil and it reached its acme in support of the Space programmes that have culminated in Skylab. There now appear to be no revolutionary developments forthcoming in the aerospace industry or in aerial warfare in the foreseeable future, leastways this century, which are likely to require further boosts from our Speciality. Incidentally, even the radical changes in the upper atmosphere which have been forecast as a result of SST operations are not likely to be with us till something like 500 of these aircraft are flying for eight hours a day—which may not transpire for the next two decades or more.

Another factor which is not of recent development, however is that in Medicine, the doctor is in great demand when the patient is in trouble or is anticipating trouble. In the Military, the Medical Services gain in importance and prestige during War and at times of such-like stress. The practice of preventive medicine also gains added impetus under such conditions and in point of fact its development was greatly stimulated by wars. Under peace-time conditions and individually when health is on one's side, the need for preventive medicine, and for that matter, for the doctor, becomes less urgent and insistent. This socio-behavioural phenomenon perhaps explains why central funds allotted for health promotion sometimes get diverted and why diseases such as malaria and small-pox cannot be readily eradicated in this Country. Moreover, whilst in the fight against diseases, statistics can be produced, whether factual or otherwise, to show the number of lives saved, it becomes less convincing to translate this into material economic benefits accruing to the Nation—especially in the context of unemployment and a Malthusian doom hanging over us on the one hand, and the rigorous requirements of cost accounting on the other. It becomes even more difficult to justify expenditure on a preventive art, because of the well-nigh impossibility of proving that by its practice accidents were prevented. This is another reason why investment of funds in aeromedical research, which is also essentially preventive in its modus operandi, or for that matter into medical research in general, is not favoured. It seems that hunting for and tracing out the symmetry of elementary particles, the development of such fields as radio astronomy and the study of cosmic rays is of greater importance to human welfare.

In addition to all this Aviation Medicine has never been a popular medical speciality. It has never had, leastways in this country, the money-spinning potentialities of the more popular, "clinical" specialities. Certain NATO countries also have found it extremely difficult to interest doctors in taking up this line of practice. There has been talk of incorporating the speciality into a more comprehensive field, such as exploration medicine or transportation medicine, or generally into the broad embrace of environmental health. In our acquisitive society, we can readily understand how such a situation has come to pass.

Still another factor which has to be taken into account when considering the impact of changing conditions is that during the past decade or more, we have been carried away by the momentum of advance so that the future has been fogged by the glare of achievements. The spectacular gains made during and after World War II and the barriers that have been overcome during the advance across the sound frontier and beyond have placed undue emphasis on many related specialised aspects. All the specialities that supported Aviation Medicine, ophthalmology, oto-rhino-laryngology, internal medicine, preventive medicine, psychology and psychiatry, quite apart from physiology, the speci-

alities which Aviation Medicine called on to solve the mounting aviation problems, made spectacular advances in the pursuit of applied knowledge. As always happens, such application opened up vast avenues for fundamental research.

Consider the issues related to the disorientation problem—the more we seem to have learnt about these minute organelles, the otoliths and the semicircular canals, the more we marvel how much we still have to understand about their functions, mode of action and inter-relationships and the more we want to study them. This sort of situation is true for many other disciplines as well. The result has been that each discipline has tended to channel its efforts, just as in physiology, more and more deeply into highly specialised and naturally narrower, what may be called, abysses of knowledge so that it often appears extremely doubtful whether the information so garnered will ever see the light of day. It appears extremely doubtful whether this knowledge can even be practically applied to aviation. Often such efforts are doomed to become merely academic exercises. By what I have said I do not mean to imply that I have no time for basic research. I have also believed that the pursuit of knowledge for the sake of knowledge itself is a soul-satisfying human need—whether this be in the realm of space exploration or nuclear technology—but today, I am not concerned with basic research but with the application of knowledge which is the aim, the raison d'etre of Aviation Medicine. What appears to be happening is that scientific talent is being led, or rather by the sheer momentum of its progress is coasting, into what, for us, may be the vacuum of basic research—each speciality and allied discipline finding deeper happy hunting grounds and thereby tending to retire into its own little "ivory tower".

To summarize the situation as it faces us therefore :—

1. Most of the Physiological problems of manned flights have been solved.
2. The entirely hostile environment requires fail-safe techniques and redundancy which are being provided.
3. There is little necessity for physiological adaptation as suitable micro-environments are being provided.
4. Whatever areas remain for research in manned flight are highly specialised ones and expensive and sophisticated facilities are required for their exploration. The financial and other resources necessary are not easily procurable.
5. Scientific and medical talent is not readily attracted to Aviation Medicine.
6. The expanding horizons of basic clinical research have diluted applied effort.

Under these circumstances, one may be forgiven, if we were to agree with the pessimists that the prospects for Aviation Medicine do not appear very bright. In 1954, I concluded my talk at the First Meeting of this Society with the expression—"As far as Aviation Medicine is concerned the Sky is the Limit." Today, within a short period of twenty years we seem to have reached the Sky—which for us appears to have a limit, after all.

But we forget the main issue, the real crux of the situation. As aviation has opened up fields for research in a whole spectrum of specialities—from physiology right through the clinical specialities and advanced knowledge in their respective disciplines, we have come to think of Aviation Medicine, as embracing this knowledge, as consisting of it. We seem to have forgotten its true meaning. We seem to have forgotten its raison d'etre. To give you an example of what has been happening during the last half century: we have learnt much about motion sickness. We know now that it is primarily head movement with the associated Coriolis phenomena in a changing gravitational field, giving rise to conflicting sensory impressions that is the cause of it. Does this information constitute aviation medicine? I do not think so. This is physiology—vestibular physiology, if you will. Similarly, the action of oxygen at supranormal partial pressures on the sulphydryl groups of tissue enzymes is not aviation medicine at all. We have forgotten that since its inception our speciality has been an applied and preventive art rather than a science in its own right. Its modus operandi has been the

application of scientific knowledge, from whatever source, to the solution of problems of those who were exposed to the particular environments of aviation. It was found necessary to draw on many fields of knowledge for this purpose. The practitioner of Aviation Medicine had to co-ordinate information, knowledge and data from these sources and many others and apply them for the purpose of increasing operational efficiency on the one hand and safety on the other, of those who operated flying machines. As the USAF emphasises, this "group draws together under one functional area all medical and related disciplines to support flying."

I must add that it is essential to have such specialised practioners or otherwise the peculiarities of the environment are neither experienced, nor are the impacts of these on the individual appreciated. Such a principle, is, of course, a well established one and not peculiar to our speciality. It is the very basis of the practice of social medicine.

Axiomatically, the necessity for the development of this type of specialised social medical practice has lead to the concept of the "Care of the Flyer," which was developed into a fine art some time ago.

I will briefly recall what this concept comprises:

(*a*) Firstly, the psychological as well as the purely medical selection of personnel for aircrew training. For some reason, despite the advances in psychological medicine, we have kept these two inter-related parts of the unified whole as separate functions to be performed by separate bodies.

(*b*) Secondly, it envisages the training of these aircrew in the physiological aspects of flight and in the proper use and maintenance of protective, survival and other allied aeromedical equipment.

(*c*) Thirdly, the maintenance of aircrew in a state of good physical health by the practice of preventive medicine and the supporting of morale and psychological fitness by the practice of psychological techniques in more simple forms. The questions that we have to answer now are therefore:

1. In today's context, is there still a requirement for support of the flyer as envisaged by the Care of the Flyer Programme?
2. Why should a special group of practitioners be appointed for this purpose?

It is true that most of the physiological and medical hazards of flights which were characteristic of the early days of aviation are now so well understood that generally flying has been made safer — particularly so in Civil Aviation; nevertheless new dimensions of psychological and social stress have intervened so that the human factor is still responsible for a regrettably and unacceptably high proportion of aircraft accidents. There are still too many unexplained accidents which merely leave large holes in the ground, which baffle investigators — an aircraft slowly banks continuing till it crashes without radio communication; another, on normal instrument approach, does the same thing, yet another suddenly power-dives into the ground.

A lot of effort has been devoted to determining the part played by drugs, as for example alcohol, in the causation of such accidents. Similarly over the years, volumes have been written on the subject of episodic unconsciousness in the air due to such factors as G-forces, hypoxia, decompression, heat stress, hypoglycaemia and seizure disorders. Series of necropsies have been performed to determine the occurrence or otherwise of myocardial infarction or sudden death from other causes — and yet, the number of cause-unexplained accidents remains distressingly high. Even with the best of techniques, though definite loss of consciousness in the air has been established, it is not possible in a high proportion of such cases to determine the cause. In a large number of cases where some such preventable factor has been found to co-exist, it is never established why the condition was not obviated. Is there some factor operating other than organic pathology? Why do such accidents occur more frequently to trainee flyers? Are we dealing here with psychological causes when the aircraft becomes "a weapon of self-destruction" (I do not mean suicide) — the factor involved being psychological overload? Is there a personality type more susceptible to these reactions? I think it is

in this field of psychology and stress that the least significant developments have been made so far as aircrew are concerned—despite the fact that many advances have been made in the behavioural sciences.

This being so and taking into consideration the astronomical cost of the present generation of aircraft, is there not a continuing requirement for the care of flying personnel? It is perhaps true that the programme has not been as successful as it promised to be at one time. This has been due to many factors. There have been too many distractions for one thing. Quite apart from the required organisation, leadership and motivation, whilst physiology and the other medical disciplines have found ready acceptance and could be profitably applied to the aviation environment, the same does not appear to have happened to the same desirable extent in psychology and psychiatry—particularly in this Country. Generally these subjects are unpopular with medical students and the medical profession at large who have to deal with a more naive, at least in this respect, clientele. The practice and application of psychiatry at the level of the flyer is fraught with many difficulties due to the emotional connotations involved.

It has not been possible to deal with human factors which are the predominant causes of aircraft accidents "as critically as is done with hardware" for a variety of reasons, foremost amongst which is our inability to discuss human shortcomings rationally, particularly our own.

Today, it should be possible to utilise advanced psychological techniques to select aircrew not only to predict success in flying training but also to determine their ability to face stressful situations such as combat. We now know that behaviour patterns are laid down in very early post-natal life. Do we know how to apply this knowledge? But until such techniques are evolved, there is only one group of individuals who are even barely qualified to assess the effects of psychological stress on aircrew whilst being in an organisational position to do so—the practitioners of aviation medicine at the flying level.

If aviation medicine is to survive as a practica implement to increase operational efficiency and safety, it seems to me that there are very few options left to the medical profession, especially in a Country placed as we are. As I said twenty years ago, we can, of course, emulate the ostrich, bury our heads in the sand and pretend that all is going smoothly, borrow ideas from abroad and drift with the times. The ostrich leaves a vulnerable portion of its anatomy exposed! To my way of thinking, if our science is to justify its existence in today's world, there is no alternative to developing this group of practitioners in an effective manner. There are no other individuals who are in a position to study the whole problem and who can even remotely claim to possess the requisite qualifications. They can study the flyer and his problems in his particular environment and apply a holistic approach for their solution. They can assess the inter-actions of day-to-day psycho-social factors on the personality, can evaluate the import of individual behavioural responses to a changing environment. Even in the assessment of disabilities and their affect on performance whilst, no doubt, the particular clinical specialists are the right persons to determine the existence, progress and outcome of particular disease processes, I consider that the effect of this on the ability to perform and to operate the flying machine can only be adequately assessed by the aviation medicine specialist and the squadron medical officer's specific opinion in this regard must carry great, if not overriding weight. There is no other group which can bolster the psychological needs of the flyer as can the squadron 'docs.'

In the totality of the Country's medical problems, those of aviation may seem merely trifling, but we should remember that our speciality employs concepts and principles which are common to many other groups and which are important if so-called social medicine is to be delivered in an effective manner. Today, we are not able to deliver social medicine to the masses because we have not been able, under the present circumstances, to identify ourselves with the would-be-users and we fail to provide the attractions and incentives that would make for successful and sound practice. We must not allow this to happen in Aviation.

In conclusion then, it is apparent that we have reached the cross-roads. It is for us to decide the path we are now to follow. We can go along with the tide beguiling ourselves that we are making practical contributions to aviation: we can turn our backs on the Values of Aviation Medicine in the belief that we have accomplished whatever is possible to do in this area, or we can reapply ourselves to making our Speciality more meaningful and effective. To my way of thinking, we must not exhaust our resources by sterile approaches to the issues at stake. We must not divorce ourselves from the basic issues of understanding the flyer and his world—a world described by Douglas Bond in the words—"this new world without visible limit, already rich in communal legend and superstition, that the flyer enters, a world with special characteristics which cannot help but have meaning for his emotional life." We must enter this world and remain in it as well.