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RESEARCH REPORT

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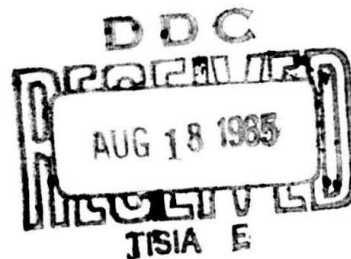
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REPORT NO. SEVEN

TITLE: THE CONCEPT OF AVIATOR'S "VERTIGO"

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## SUMMARY

An analysis was made of the concept of aviator's "vertigo" based upon personal interviews with Naval aviators. To clarify the term, factors in the environment and experience of pilots are presented which bear upon the use of the word "vertigo." Types of events associated with "vertigo" are described. Suggestions are offered for clarification of the concept of "vertigo", and lines of further research indicated.

## CONCLUSIONS

1. The term "vertigo", as used by aviators, has no universally accepted meaning, but covers a wide variety of events occurring under many different conditions of flying.

2. An outstanding component of "vertigo", as used by aviators, is the mental hazard associated with conditions regarded as dangerous, confusing, or difficult.

3. A pilot's information about "vertigo" is derived not from careful, lucid, objective and standardized sources, but from diverse anecdotes, personal experience and observation, haphazard written descriptions, and heresay from other pilots.

4. The term "vertigo" should be accepted, as used by pilots, to refer to any sensation, or feeling, which does not accord with objectively correct environmental facts. On this basis, a systematic indoctrination of pilots with regard to what actually happens in such reported events, should supply the term with understood meaning, thereby reducing the mental hazard.

## Introduction:

During the past five or ten years aviation psychologists and flight surgeons have become increasingly concerned with problems of disorientation. Their interest stems from a realization that pilots experience a host of emotional, physiological, and perceptual phenomena about which little is known. From the earliest days of aviation it was recognized that flying an aircraft involves a set of conditions outside the realm of ordinary experience resulting in the occurrence of unusual sensations. One source of interest, therefore, in the behavior of the pilot comes from these "job-characteristics." Another source of interest in problems of disorientation arises from the study of aircraft accidents. A small proportion of such accidents has been attributed to some mysterious cause, variously described as "target-fixation," "vertigo," and, later, autokinesis.

Research has developed in a number of directions, in an effort to clarify the kinds of disorientation characteristic of flying under various conditions, and to elucidate the effects of disorientation upon the pilot. It soon became evident that most of the reported instances of disorientation were hearsay, and also that they were too small in number to constitute reliable data. For this reason, it was decided to conduct systematic interviews with a random sampling of pilots in order to assemble case-material relative to the disorientation problems of pilots as they themselves have encountered them. The present paper is a first report on these interviews as they bear upon the mental and emotional reactions associated with disorientation.

More particularly, an attempt will be made to clarify a term employed by pilots to describe these reactions. This term is "vertigo."

#### A Psychological Problem:

The interviews, as will be shown, indicate that "vertigo" is primarily a psychological problem. It appears to be associated with the mental hazards of flying, and with the "mysterious" events which sometimes happen in an aircraft. There is thus a two-fold source of emotional loading in the term "vertigo", i.e., dangerous conditions and unexplained, though actual, phenomena.

A pilot's job has many features different from more familiar tasks. In the first place, there are distinctive environmental cues upon which a pilot must depend. Moving or stationary lights at night (on another plane, or group of planes, or on the ground) are viewed from a considerable distance or height with an accompanying continuous movement of the aircraft. The pilot must translate terrain, altitude, position, speed, direction, and attitude into appropriate meaning through instruments or contact visual judgment. Many striking bodily and sensory responses are attendant upon the movement of the aircraft itself.

In the second place, the pilot's job is associated with detachment from the ground, which necessitates a personal adjustment to a new world. Although it is true that adaptation to this multi-dimensional world with its spatial freedom begins very early in an aviator's career, he may at any time be subject to its ultimate expression when he is required to fly on dark nights, or in clouds. Under these conditions--rare enough for most pilots that adaptation is seldom, if ever, complete--the familiar facts of horizon, height above recognizable reference points, and position of the aircraft are changed. It now becomes necessary to derive this information exclusively from a varied group of instruments without confirmatory visual data (or with conflicting visual data), and sometimes with simultaneous conflicting information from other senses.

In the face of these facts, it is not surprising that a term such as "vertigo" has arisen to account for a variety of deviations from normal--that is, familiar--responses and actions.

Aside from the psychologist's interest in the problem, it has a very practical importance. Since "vertigo" is clearly related to dangerous and unusual aspects of flying, it has great significance with reference to accidents. Apart from this, too, it bears upon the efficiency with which an aviator flies his aircraft, since it is evident that anything which interferes with--or conversely simplifies--his task is a vital matter.

The question of what is meant by the term "vertigo" may now be raised.

### Origin of the Term:

Its origin, as used by aviators, is shrouded in obscurity. The term, of course, has a medical definition. Thus, vertigo is "dizziness; giddiness; disorder of the equilibrating sense, marked by a swimming of the head; a sense of instability and of apparent rotatory movement of the body or of other objects" (6). In aviation medicine it has essentially the same sort of technical meaning (2, 12), and psychologists have also defined the term in a similar manner (4,7). In all of these usages, the emphasis is on disturbances of equilibrium associated with the functioning of the vestibular mechanism in the middle ear. Out of this background, the term may easily have come to mean any sort of confusion during flight, which was otherwise incapable of definition. It is, however, certain that pilots mean something quite different from medical vertigo when they use the word. For one thing, the writer has never heard a single pilot describe symptoms of dizziness, giddiness, swimming of the head, etc., in his accounts of "vertigo" experiences. Apparently, these symptoms, if they occur, are not at all the outstanding ones. Rather, aviator's "vertigo" is marked by emotional and perceptual responses of an abnormal sort. Probably confusion is closer than "dizziness" to describing what happens. Furthermore, "vertigo" is used to cover a wide variety of disturbances which do not involve vestibular factors, or only involve them secondarily; for example, the primary etiology may be visual. More than that, it is frequently used to refer to paramnesic symptoms, or imaginary disturbances, or any emotional state. Even almost "official" descriptions do not adequately clarify the concept. Thus, pilots can read in a book on instrument flying that vertigo is "a kind of mental confusion--whenever the conflict between (a pilot's) interpretation of his instruments and the sensation he feels leaves him in doubt as to the true attitude and performance of his airplane." (8) This definition applies



only to the "vertigo" experiences during instrument flight, which is certainly one of the most important conditions under which it occurs, but does not begin to include all situations to which the term is applied. True, it would be desirable to limit the concept to this situation; but this is essentially fruitless since it is already in wider use. This is recognized in current discussions of the problem (e.g., 9,16,17).

The next question that arises deals with how pilots get their ideas about "vertigo." They are usually sure they have had it; without exception, they have explanations and theories about it. These notions represent an odd result of personal reflection, experiment, and experience combined with information conveyed in night flying lectures, in instrument courses, and various written sources discussing the autokinetic illusion, accidents, sensations of flight, etc. In addition, most pilots have participated many times in "bull-sessions" on the subject of "vertigo". There is no given condition under which these discussions occur. Some unusual event (when the trouble is attributed to "vertigo") often prompts interpretation and a swapping of anecdotes. During that stage of training known as Instrument Squadron, there is naturally much talk about "vertigo." The problem also comes up at other times, among them those occasions when an instructor (or fellow-student or fellow-member of a formation) may query a pilot about some unusual occurrence. (For example, a student may indulge in some "loose" formation flying, or may pull out of a dive later than he should, or may go into a progressive spin or an unplanned spiral, which is often called a "graveyard spiral.") From the foregoing, it is evident that ample opportunity is present in a pilot's career for misconceptions, superstitions, and fears to arise in connection with "vertigo".

The confusion inherent in the concept is patent in the statements made by pilots in the interview situation. Thus, for nearly any assertion made by one aviator, a contradictory one is made by another. Again, during the course of the first 62 interviews, "vertigo" was attributed to more than 25 fairly distinct causes. And this is in addition to the fact mentioned above; namely, that many different sorts of events are given the name of "vertigo."

The foregoing discussion has been presented to point out the circumstances which form the background for the use by aviators of the term "vertigo." These may be summarized as follows:

1. Aviators are subject to unpredictable, strange, and dangerous flying conditions, of which they are keenly aware.

2. The world to which they must adjust differs in many significant respects from that of ordinary experience.

3. A term with an accepted, technical meaning has been used to cover a wide variety of events, not covered by the definition.

4. Each pilot bases his conception of "vertigo" upon personal experience, and information derived from many different sources. Both types of information are passed from one aviator to another in a random fashion.

#### The Mental Hazard:

In the opinion of the author, therefore, "vertigo" can best be understood with reference to the mental hazard associated with it. It is undoubtedly true that "vertigo" may be of different degrees. That is, a pilot may have only a "slight touch" of it. Under these circumstances, the mental hazard, or emotional response to a realization that the pilot has "vertigo" may be mild. When, however, "vertigo" occurs as a serious influence on behavior, then the attendant anxiety, or fear, assumes exaggerated proportions--beyond those one might expect from a cool appraisal of the situation. It is this anxiety which, in the opinion of the author, constitutes the mental hazard of "vertigo"; pilots are afraid of getting it; they believe they will get it in situations regarded as dangerous, such as night-flying, flying wing in formation, or under instrument conditions; and if they think they have it, they become more upset than is objectively warranted.

Pilots do not have sufficient information about phenomena of disorientation, and, as a corollary, are given considerable disorganized, incomplete, and inaccurate information. They are largely dependent upon their own experience, which must supplement and interpret the traditions about "vertigo" which are passed on to them. When a concept thus grows out of anecdotes cemented together with practical necessity, it is bound to acquire elements of mystery. So far as "vertigo" is concerned, no one really knows more than a small part of the facts, but a great deal of the peril. Since aviators are not skilled observers of human behavior, they usually have only the vaguest understanding of their own feelings. Like other naive persons, therefore, they have simply adopted a term to cover a multitude of otherwise inexplicable events.

The conclusion appears justified that the word "vertigo" belongs in a category of terms in common use which have numerous connotations, a heavy load of erroneous or irrational impressions, and considerable confused emotional tone. (Other terms possibly similar in this respect are "insane", "genius", and "fatigue.")

If this is so, then it is pertinent to inquire just what sorts of events are ascribed to "vertigo".



## Classes of Events:

In the first place, the majority of pilots differentiate between two major classes of incidents. One of these can be subsumed under the title of "vertigo" and the other under "target-fixation," "target-hypnotism," or "fascination." The second of these is cited comparatively rarely as a personal experience, and rather often is attributed to others--especially to men who have "gone on in" without attempting to recover. Of course, when this happens, the victim is killed, and no accurate information is available as to what actually prevented the man from recovering from his dive in time. However, a sufficient number of men do recover to convince the author that some phenomenon such as self-hypnotism is actually involved. (See, for example, 15.)

Although this phenomenon is most often cited in relation to bombing runs, it is also mentioned in other connections; e.g., occasionally when landing (intent concentration on the ground or water, particularly smooth water when depth perception is poor), sometimes with reference to gunnery runs or in formation (intent concentration on the sleeve or plane ahead), and somewhat more often with regard to lights at night when interpretation varies from inaccurate use of the term "autokinetic illusion" (the fixation aspect of which is actually related to the "fascination" phenomenon) to any erratic behavior because of over-attentive watching of a light or plane ahead. As a rule, this class of events is considered to be different from "vertigo" but it is every bit as important, and, because of the almost magical quality attributed to it, is an even greater mental hazard.

"Vertigo" itself covers most of the other sensory and psychological disturbances felt by pilots. It should be noted, however, that "doping off," "fatigue," and "confusion" form another, but related, class of interpretations. The difference in the use of these terms is chiefly that they have become almost expressions of ridicule for making small errors, whereas "vertigo" is a serious proposition. Occasionally, one of this group of terms may be employed as an excuse for "vertigo", or as a rather ironical explanation for it. A few men equate "vertigo" with this behavior.

The most outstanding feature of the concept of "vertigo" is that pilots experience it under unusual circumstances ranging from bad weather to the effects of a hangover. Beyond this no definite statements can be made. Thus, "vertigo" is reported on solo hops, on formation flights, by day and by night, in all types of aircraft both land and sea, single and multi-engine, in clouds and out, during contact as well as instrument flight, upon entering instrument conditions, and at any time after transferring to the use of instruments. Any objective definition of "vertigo" as a word in the aviator's vocabulary is certain to involve numerous exceptions.

Perhaps the clearest case for "vertigo" could be made out in the field of illusions.\* There is no doubt that it is precisely in this respect that the most definite indoctrination of aviators occurs. "You must believe your instruments" is the inflexible rule which is impressed upon them. Following this advice to the letter strongly mitigates the possibility of suffering from "vertigo." It follows from this that "vertigo" is often closely related to the use of instruments, and the conditions where they should be used. A valuable forward step would be to limit the concept to this aspect of flying.

#### A Pragmatic Approach:

The fact remains that it is not now so limited, as pointed out above. As a result, it is the belief of the writer that a strictly pragmatic approach is necessary. To begin with, all experiences which pilots label as "vertigo" should literally be called "vertigo." In this manner, it will be seen that "vertigo" is any sensation, or feeling, which does not accord with objectively correct environmental facts. This would include confusion between differing sensory impressions, as well as paramnesic incidents, imaginary cues, illusions, etc. At the same time, it separates "target-fixation" and other possible manifestations of auto-hypnotism into another class of events.

There is no reason why such a procedure, accompanied by objective descriptions of the various kinds of behavior reported by pilots, cannot put definite meaning into the concept. The auto-kinetic illusion is a case in point. This illusion is the apparent movement of a point of light, when it is fixated against a uniform background. The majority of pilots (especially younger ones, who have had the proper instruction) know this phenomenon, and recognize its potential danger in night-flying. They know what precautions to take to minimize the chances of its occurring. There is no doubt that this knowledge is the result of the widespread, objective descriptions of the term (See 1,3,5,9,10,11,14.)

In short, the salient feature of "vertigo" is the mental hazard associated with it because of its mysterious causes and the emotional correlates of danger.

A presentation to aviators of full descriptions of just exactly what has happened to other pilots when the event is attributed to "vertigo" will have two related effects. In the first place, it will help to clear up the lack of understanding about it; i.e., definite characteristics will have been described - the noun "vertigo" will acquire vastly more precise adjectives

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\*An analysis of the interviews in terms of reported illusions is now in progress; these constitute a large proportion of the incidents ascribed to "vertigo."

whereby to define and recognize it. In the second place, the mental hazard will be reduced, as the mystery is resolved. There is no reason why "vertigo" cannot eventually be placed on a common-sense basis, or series of situations, as the autokinetic illusion has been. Indeed, this very suggestion has been made by many pilots upon termination of the interview. Furthermore, many aviators express a keen desire to see the results of the interviews made available to them.

#### Further Research:

It may prove fruitful at this point to discuss several lines of further investigation of aviator's "vertigo". The study of illusions reported by pilots has already been cited. It will result in a classification of the types of perceptual error encountered in flight, together with a description of them.

A second outcome of the interviews will be a detailed analysis of "susceptibility" of pilots to "vertigo." Since this can only have value within the limits of the presently obtained interviews, it will doubtlessly best serve to clear the ground for further work. Although the interviews were planned with this as a secondary objective, it is evident that, lacking any notion of what to look for that might be indicative of "susceptibility," the present study had to be content with a good deal of groping in the dark. Here, nevertheless, is an important area for further research.

A third outcome will be an analysis of the instances of "target fixation" reported by aviators.

As a consequence of data obtained in the interviews, another research has been planned to determine the relationship between conditions in which pilots feel that "vertigo" is likely and those in which they feel safe.

Finally, much work remains to be done in an area which might be labelled "prevention and cure of vertigo." This is still a field in which comparatively little is known--especially by pilots. Certain precautions are now widespread in relation to such factors as dark adaptation, the autokinetic illusion, and to some degree the use of instruments. Is it too much to hope for the same thing in regard to the various manifestations of "vertigo?"

The concept of aviator's "vertigo" has a long history in aviation, but only recently has systematic effort been expended to determine exactly what is meant by the term. This paper has attempted to show that it has no universally accepted meaning, but that it covers a multitude of situations in a wide variety of conditions. Its most significant component is believed to be

the mental hazard associated with these conditions, resulting in great emotional loading, and lack of understanding. The suggestion is made that the term "vertigo" be accepted, as used by pilots, to refer to any sensation, or feeling, which does not accord with objectively correct environmental facts. From there, the clarification of what actually happens in the reported situations will go a long way towards removing the mystery and fear attached to the concept.

This procedure may follow either of two lines. On the one hand, as additional research succeeds in clarifying aspects of "vertigo," the body of mysterious (to pilots) events attributed to "vertigo" will be reduced. This "chipping off" process may ultimately banish "vertigo" entirely from the vocabulary of aviators, until it again applies only to the medical symptoms of dizziness. The work which has been done in the field of autokinesis, for example, has removed one small part of the unknown from the concept. The description and naming of other phenomena will have the same effect. On the other hand, as subsequent elucidation develops, the term "vertigo" may remain to cover a whole series of precisely defined and well understood phenomena--just as aerology includes air masses, fogs, winds, etc. It is this latter alternative which appears the more likely, since "vertigo" is now firmly entrenched in aviation. It will, in this sense, retain a meaningful place in the general field of disorientation, a term which includes the various events attributed to "vertigo", "target-fixation", "doping off", and many other atypical aspects of behavior of the pilot.



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