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ABSTRACT

This handbook provides information on an airline pilot's physical and mental status and related medical factors which may affect his/her performance. Contents include information on the physical examination for pilots, the flyer's environment, hypoxia, hyperventilation, gas in the body, the ears, alcohol, drugs and flying, carbon monoxide, vision, night flight, cockpit lighting, disorientation, motion sickness, fatigue, noise, age, and some psychological aspects of flying. (CS)

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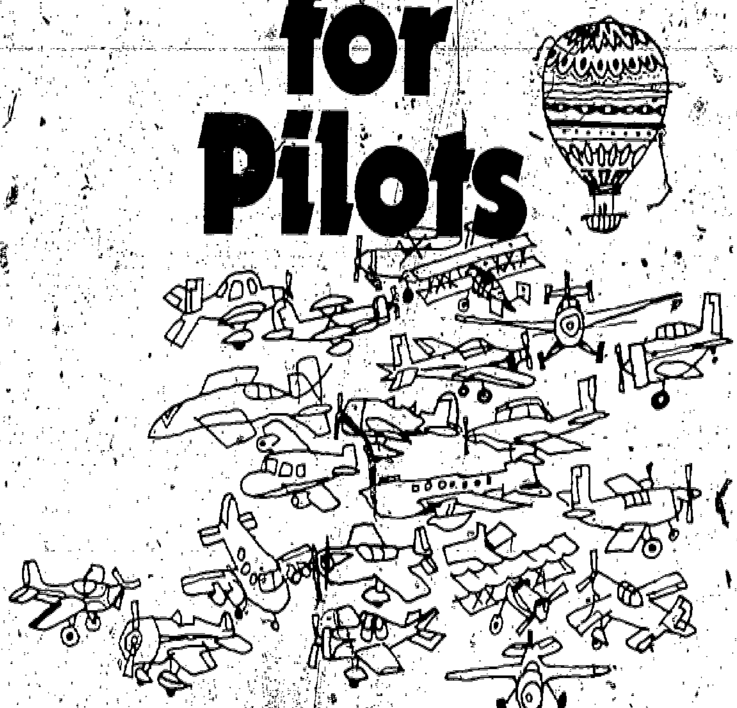
Medical Handbook for Pilots



U.S. DEPARTMENT OF TRANSPORTATION/FEDERAL AVIATION ADMINISTRATION

Medical Handbook for Pilots

MAY 1974

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EDITORIAL NOTE

This handbook has been reprinted with the following corrections:

Page 3, 2nd paragraph. A reference made to Federal Aviation Regulation § 65.45 has been deleted.

Page 13, 2nd paragraph. The reference to altitudes in excess of "28,000 feet" has been changed to read "38,000 feet."

Page 21, 2nd paragraph. In the wording "(the small tube leading down to your eardrum)," the word "down" has been deleted.

These changes are not substantive in nature and are primarily typographical corrections.

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FOREWORD

To become a safe pilot, it is not enough that you want to fly. You must also be physically fit, psychologically sound, and well trained. Most aircraft accidents are caused by pilot deficiencies in one of these areas.

Training procedures have been adequately covered in other publications, and must be learned from a certificated instructor before a pilot is licensed. But information on the pilot's physical and mental status has been left largely in limbo until now. Yet you, as a pilot, are only partly prepared for safe flight if you are unfamiliar with the medical factors which affect your performance. No matter how skillfully you have mastered the techniques of flying, if you suffer from blunted judgment, slowed responses, or inattention, you may fly your aircraft and its passengers to disaster.

This handbook is dedicated to the prevention of the tragic air accidents caused by human factors.

Contents


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1 The Physical Examination for Pilots

The FAA (Federal Aviation Administration) requires that you be properly certificated and physically able to operate your aircraft competently before you are licensed to fly. Periodic physical examinations are intended not only to evaluate your general health, but to help ensure that you will not suffer a medical emergency during actual flight. It is also necessary that you be free of conditions which dull your alertness and impair your ability to make quick decisions. As a pilot, you often hold the lives of others in your hands; it is crucial that you be able to instantly recognize and properly react to urgent situations.

The physician who examines you is, in many cases, a pilot himself. He is specially selected by the FAA for his knowledge of "flight medicine." Your examiner is just one of a network of AME's (Aviation Medical Examiners) located throughout the country. Whenever you have a question about a health problem which could affect flight safety, consult him—he is anxious to serve you. And he is as important to safe flight as the preflight check of your aircraft or the weather briefing.

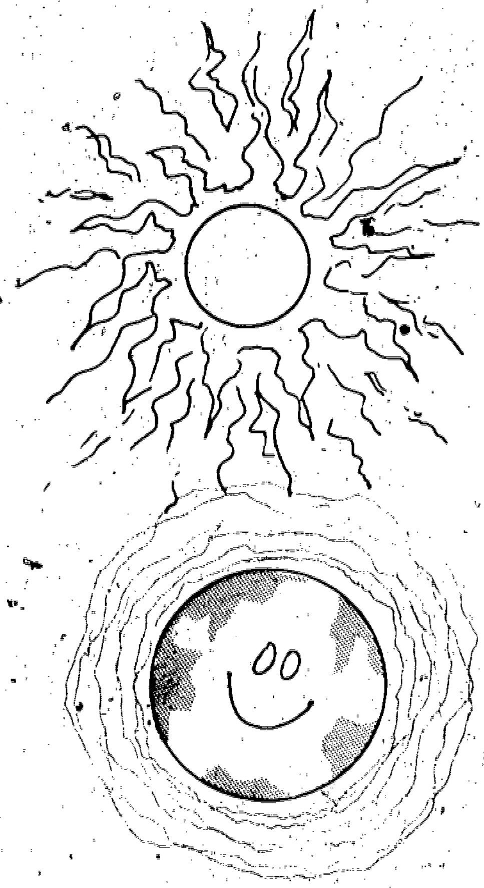
During the examination, special attention is focused upon correct functioning of the vital organs and parts of the body most critical to flying. These include the eyes, lungs, heart, ears, and the muscular and nervous systems. This doesn't mean that you have to be a perfect physical specimen. Some defects can be waived if your performance as a pilot is unimpaired.

Primarily, the AME wishes to discover any physical condition which could threaten safe flight by causing pilot disability—such as epilepsy, heart trouble, or diabetes. Disorders such as acute infections, anemia, and peptic ulcers may be only temporarily disqualifying. Generally, corrected vision, dentures, or certain minor ailments are not an obstacle to certification.

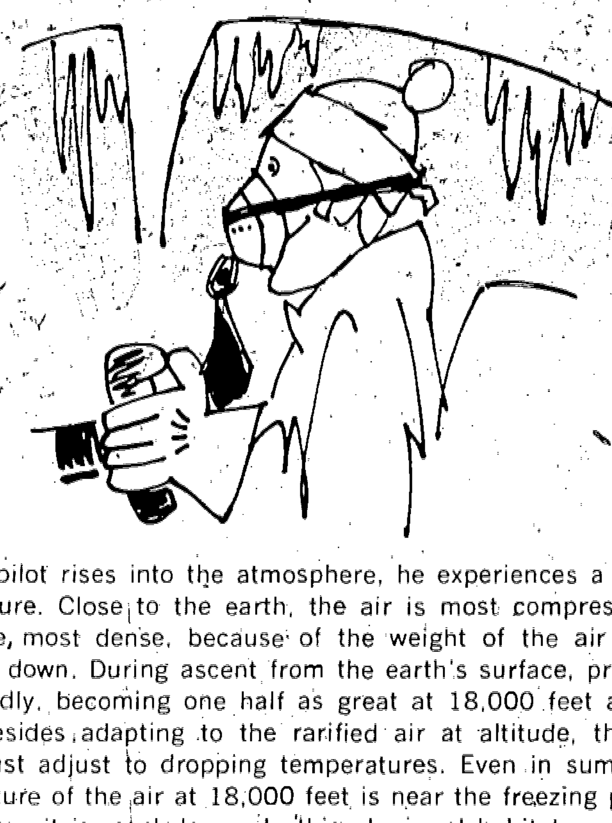
Unlike pilots in the military services who have flight surgeons monitoring their health regularly, or airline pilots with their own medical departments, you are largely on your own to judge when you should or should not fly. So, evaluation of fitness for flight becomes more of a personal matter in your case. The AME can find major problems only when your certificate comes up for renewal, or when consulted. The rest of the time, you alone must evaluate your flying capabilities.

Include in your occasional "required reading" list the Federal Aviation Regulations (§61.45 and §63.19) described on the back of your medical certificate (which has probably been tucked away in your wallet since its issue). These regulations place the responsibility for determining physical fitness upon the pilot. They state that no person may act as a pilot when he has a known physical deficiency which would make him unable to meet the physical requirements for his medical certificate.

In other words, if you can't pass the flight physical today, you shouldn't fly today! It is up to you to *know* when a physical deficiency or temporary illness might interfere with aircraft operation. If you are unsure, a brief consultation with the AME will quickly clear up any doubts.



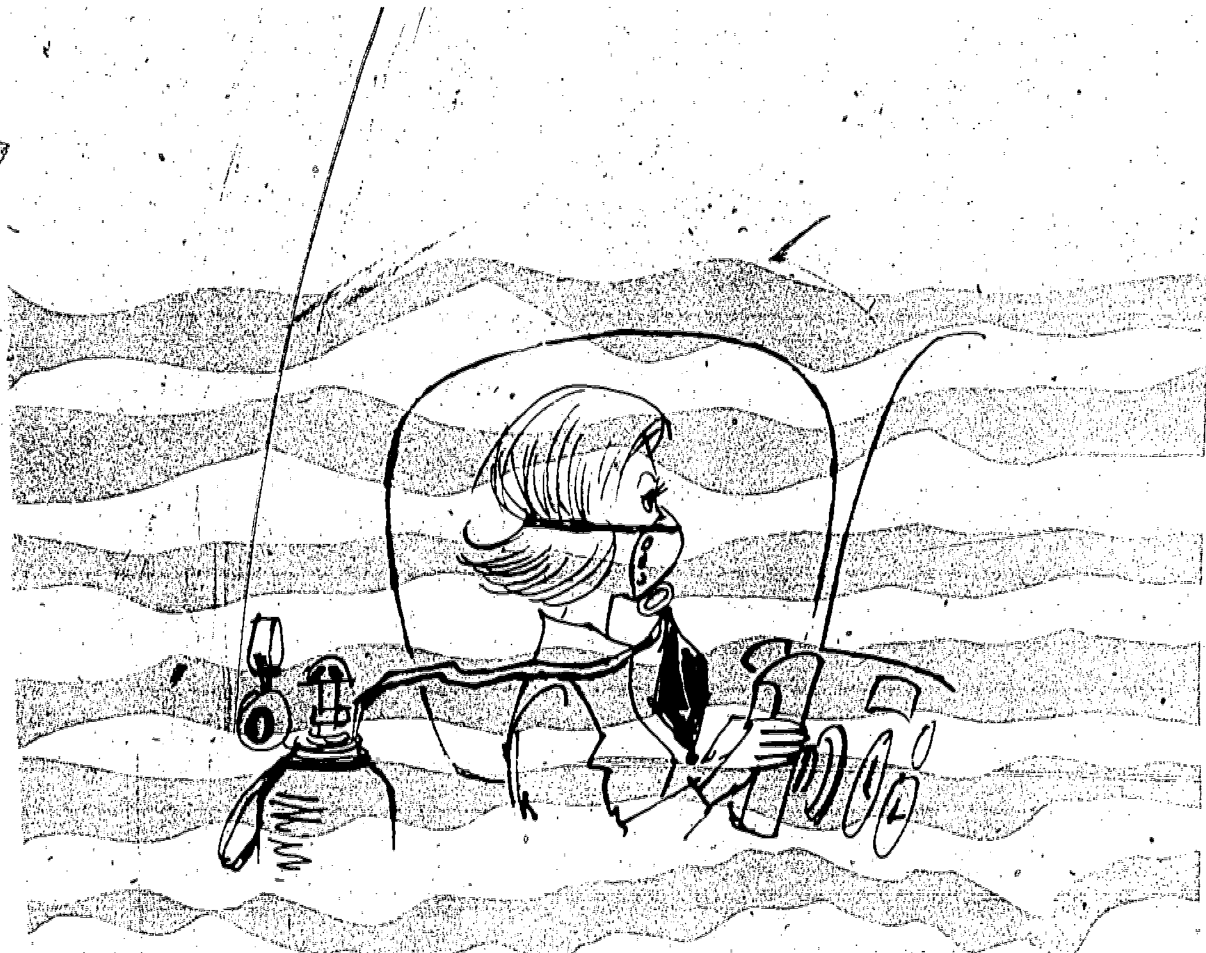
2 The Flyer's Environment



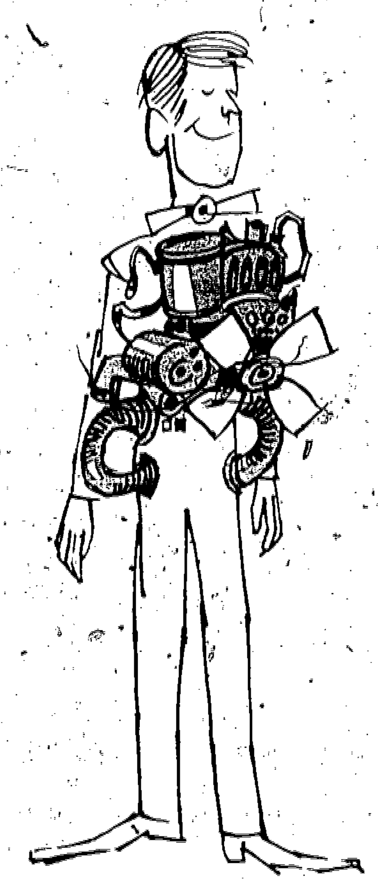
We live at the bottom of an ocean of air, the atmosphere, which is necessary to support life on earth. Not only does it provide oxygen, but it also filters out harmful radiation from the sun. The presence of the atmosphere prevents excessive heat loss in both plants and animals, and maintains their surface temperature within the range required for survival. The exact upper limit of the earth's atmosphere has not been determined, but estimates have varied from a few hundred miles to several thousand miles.

This large volume of air has tremendous weight. At lea level, it exerts a pressure of about 15 lb./in.^{2} (pounds per square inch) upon the body – or a total of about 20 tons for the average man. This weight sounds formidable, but at sea level it is quite compatible with man's existence because the body's inner pressure equalizes the surrounding outer pressure.

As a pilot rises into the atmosphere, he experiences a decrease in pressure. Close to the earth, the air is most compressed, and, therefore, most dense, because of the weight of the air above it pressing down. During ascent from the earth's surface, pressure is lost rapidly, becoming one half as great at 18,000 feet as at sea level. Besides adapting to the rarified air at altitude, the pilot's body must adjust to dropping temperatures. Even in summer, the temperature of the air at 18,000 feet is near the freezing point. On some days, it is much lower. In this abnormal habitat, survival depends upon the ability of the body to make adaptive changes.



3 The Pressure is On



About 175 years ago scientists first discovered that the prime purpose of breathing was to obtain oxygen needed by the body and to get rid of excess carbon dioxide, a waste product.

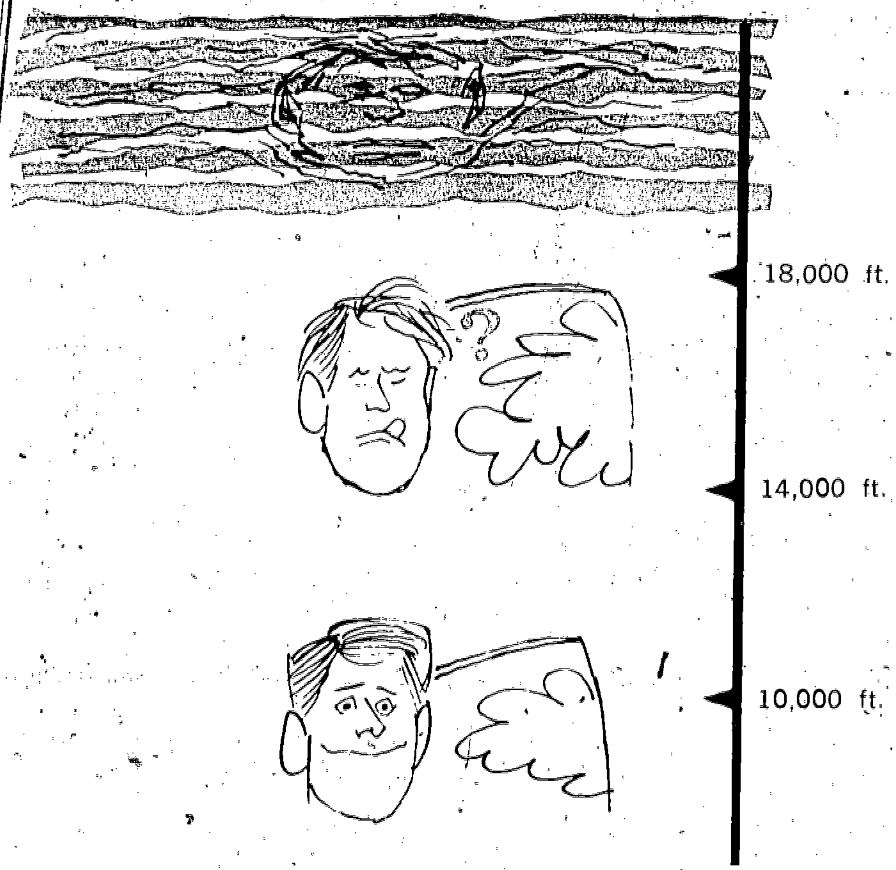
The human body is a heat engine which, like any engine, consumes fuel (the carbohydrates, fats, and proteins derived from food). This fuel is converted into the energy we need to live by a burning process called oxidation. As in any other burning process, a certain amount of oxygen is necessary. When the body is resting, it consumes approximately one-half pint of oxygen per minute. When given an added workload (such as walking or running), the body, like any other machine, will generate more heat and use more oxygen, perhaps as much as 8 pints per minute.

To extract this oxygen from the air, the body is equipped with a respiratory system (lungs). The oxygen is then distributed through the body by a circulatory system (heart, arteries, veins, and capillaries).

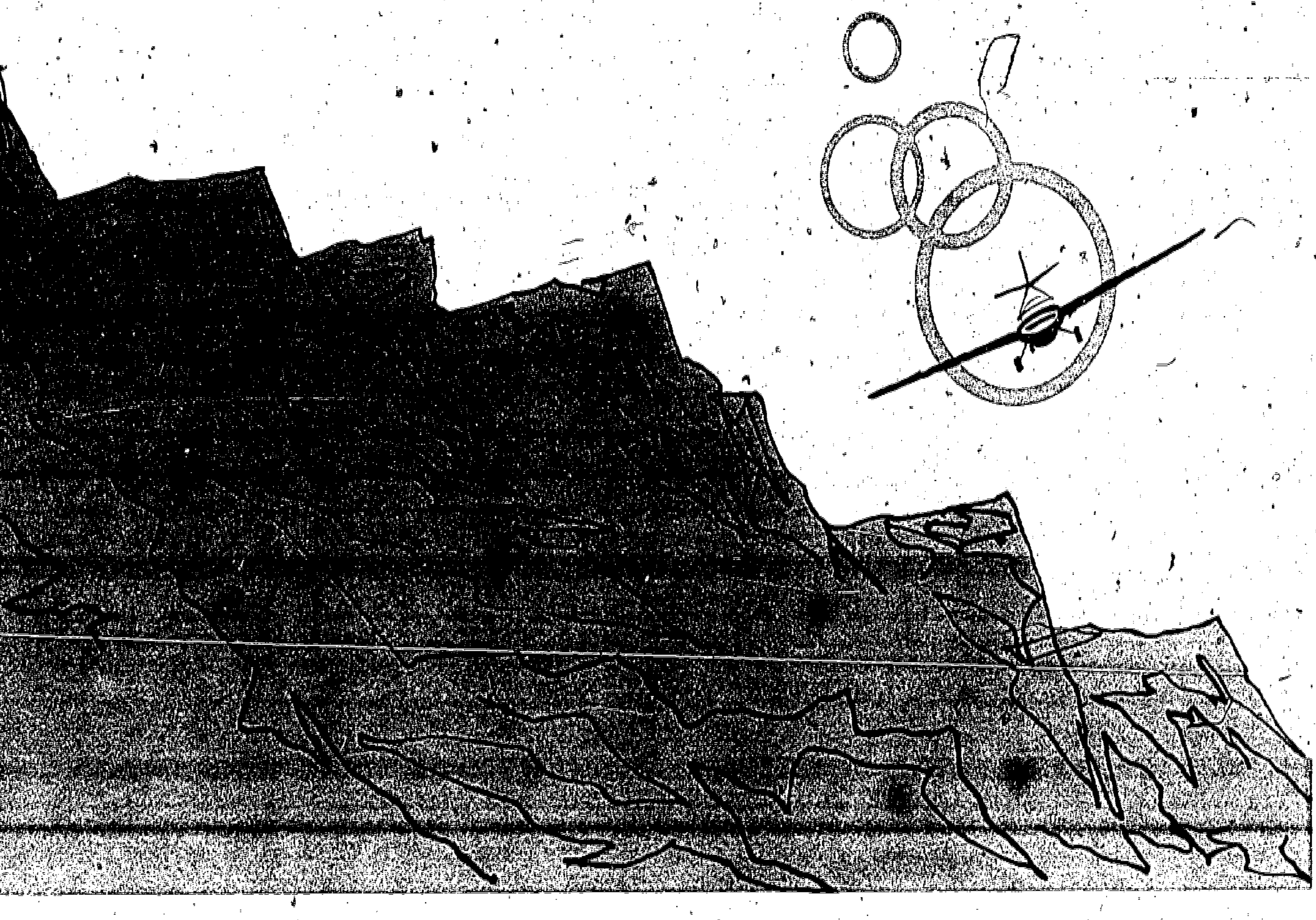
Air contains about 20% oxygen and about 80% nitrogen. At sea level, a healthy man can extract enough oxygen from the air to maintain his system and continue his normal activities. Above 8,000 or 9,000 feet, however, problems of oxygen shortage begin to appear. Because the air is less dense, it offers less actual oxygen per breath of air inhaled—even though oxygen and nitrogen are still mixed in the 20:80 ratio. The density of air is measured by barometric pressure, and it is on this principle that your altimeter is built.

Oxygen is transported throughout the body in the bloodstream which contains, among other things, the red blood cells. These cells contain a complex substance called hemoglobin. Hemoglobin picks up oxygen at the lungs and carries it to the tissues for use and picks up carbon dioxide at the tissues and transports it to the lungs for exhalation. Blood can be compared to a conveyor belt, constantly hauling oxygen in and carbon dioxide out. The amount of oxygen that can be carried in the blood depends, to a large extent, upon the *pressure* that the oxygen gas from the air exerts on the blood as it passes through the lungs. (Manufacturers of carbonated drinks take advantage of this pressure principle to dissolve large amounts of carbon dioxide gas in their beverages).

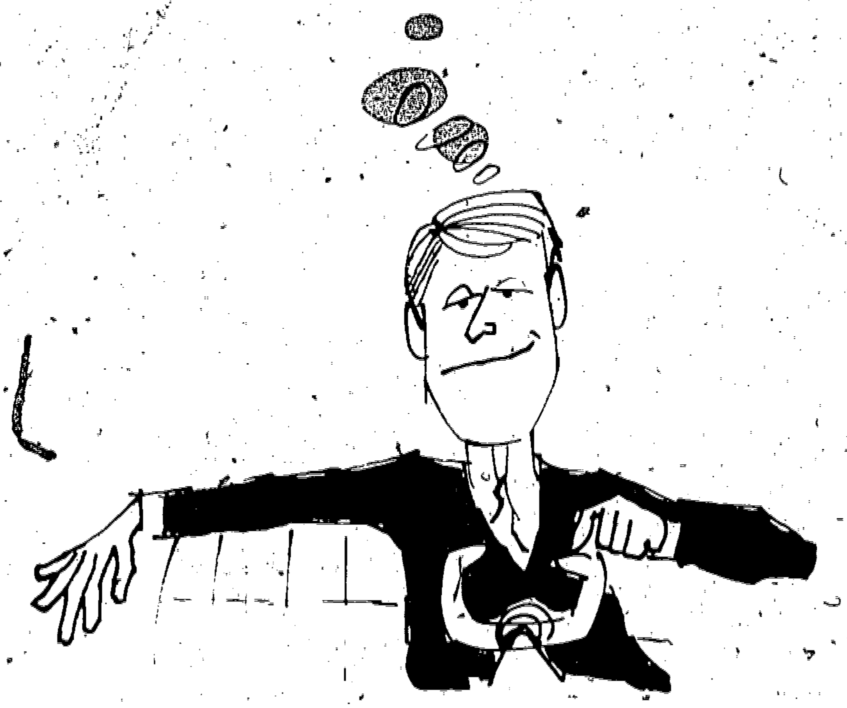
At 10,000 feet, the blood of a man who is exposed to outside air can still carry oxygen at 90% of its capacity. At this altitude, the flight performance of a *healthy* pilot is impaired only after some time, when he may find himself a little less dexterous than usual at tuning radios, slower at working navigational problems, and less able to sustain close concentration. At 14,000 feet, he may become appreciably handicapped—forgetting to switch tanks, flying off course, or disregarding hazardous situations. From 18,000 feet and beyond, exposure to environmental air will quickly cause total collapse and inability to control the aircraft.



This means that if you choose to fly at high altitudes, you must take along either oxygen *or* pressure. You have a choice, then, between pressurizing the cabin of the aircraft or breathing a mixture with more oxygen in it.



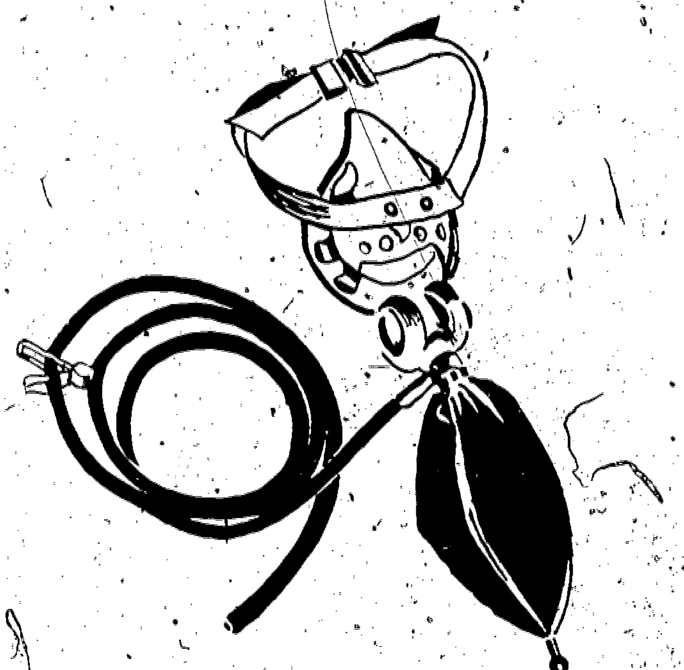
4 Hypoxia



Lack of oxygen is the greatest single danger to man at high altitudes, despite the importance of pressure and temperatures. The shortage of oxygen in the human body results in a condition called hypoxia, which simply means oxygen starvation. When a pilot inhales air at high altitudes, there isn't enough oxygen pressure to force adequate amounts of this vital gas through the membranes of the lungs into the blood stream, so that it can be carried to the tissues of the body. The function of various organs, including the brain, is then impaired.

Unfortunately, the nature of hypoxia makes you, the pilot, the poorest judge of when you are its victim. The first symptoms of oxygen deficiency are misleadingly pleasant, resembling mild intoxication from alcohol. Because oxygen starvation strikes first at the brain, your higher faculties are dulled. Your normal self-critical ability is out of order. Your mind no longer functions properly; your hands and feet become clumsy without being aware of it; you may feel drowsy, languid, and nonchalant; you have a false sense of security; and, the last thing in the world you think you need is oxygen.

As the hypoxia gets worse, you may become dizzy or feel a tingling of the skin. You might have a dull headache, but you are only half aware of it. Oxygen starvation gets worse the longer you remain at a given altitude, or if you climb higher. Your heart races, your lips and the skin under the fingernails begin to turn blue, your field of vision narrows, and the instruments start to look fuzzy. But hypoxia—by its nature, a grim deceiver—makes you feel confident that you are doing a better job of flying than you have ever done before. You are in about the same condition as the fellow who insists on driving his car home from a New Year's Eve party when he can hardly walk. Regardless of his acclimatization, endurance, or other attributes, every pilot will suffer the consequences of hypoxia when he is exposed to inadequate oxygen pressure.

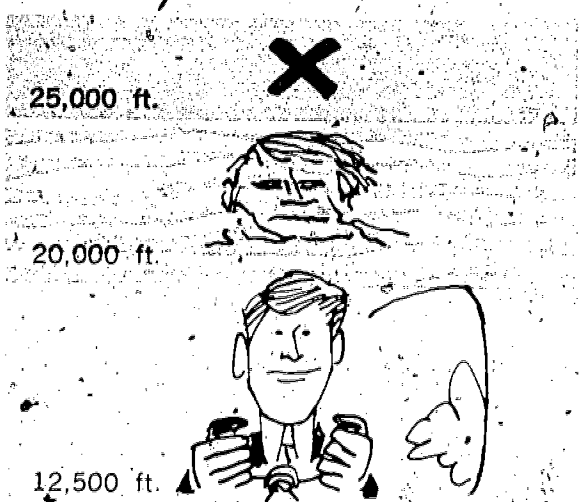


What do you do about it? There is one general rule: Don't let hypoxia get a foot in the door. Carry oxygen and use it ***before*** you start to become hypoxic. Don't gauge your "oxygen hunger" by how you feel. Gauge it by the altimeter.

Here are some general suggestions which apply to young, healthy flyers.

1. Carry oxygen in your plane or don't fly above 12,500 feet. If bad weather lies ahead, go around it if you can't get over it.
2. Use oxygen on every flight above 12,500 feet. You'll probably need it, and when you do, you might not realize it.
3. Use oxygen on protracted flights ***near*** 12,500 feet. It won't hurt you and you'll be a lot sharper pilot.
4. Use oxygen on all night flights above 5,000 feet. If you want to give your night vision the best protection, use oxygen from the ground up.
5. Breathe normally when using oxygen. Rapid or extra-deep breathing can cause loss of consciousness also. (See Chapter 5, HYPERVENTILATION.)

Flying above 12,500 feet without using oxygen is like playing Russian roulette—the odds are that you ***may*** not get hurt, but it's a deadly game! At 20,000 feet your vision deteriorates to the point that seeing is almost impossible. The engine sounds become imperceptible, breathing is labored, and the heart beats rapidly. You haven't the vaguest idea what ***is*** wrong, or whether anything is wrong. At 25,000 feet you will collapse and death is imminent unless oxygen is restored.



No one is exempt from the effects of hypoxia. Everyone needs an adequate supply of oxygen. Some pilots may be able to tolerate a few thousand feet more of altitude than some others, but no one is really very far from average. Remember this: Serious trouble is waiting for the pilot who tries to test himself to prove how much higher he can fly or how much longer he can function without supplemental oxygen. Pilots who are older, fatter, out of condition, or smoke heavily should limit themselves to a ceiling of 8,000 to 10,000 feet unless oxygen is available.

Many executive aircraft now have pressurized cabins and regularly operate up to 40,000 feet. Most of these aircraft are equipped with pressure-breathing oxygen systems which provide a supply of oxygen under a slight pressure. In case of a loss of cabin pressure at altitudes in excess of 38,000 feet, the oxygen pressure within the lungs cannot be maintained without an increase in the inhaled oxygen pressure, therefore, hypoxia will develop rapidly. The addition of positive pressure to pure oxygen is necessary in order to restore the body to a non-hypoxic state. Pressure breathing includes the reverse of the normal respiratory cycle, in that the lungs must perform work during exhaling instead of inhaling. Although pressure breathing can increase a pilot's tolerance to higher altitudes, it should not be considered for routine flights. The pressure-breathing installation is a back-up system only and should be reserved for the occasion when cabin pressurization fails. Oxygen would then be available during descent to lower altitudes where it would not be required.

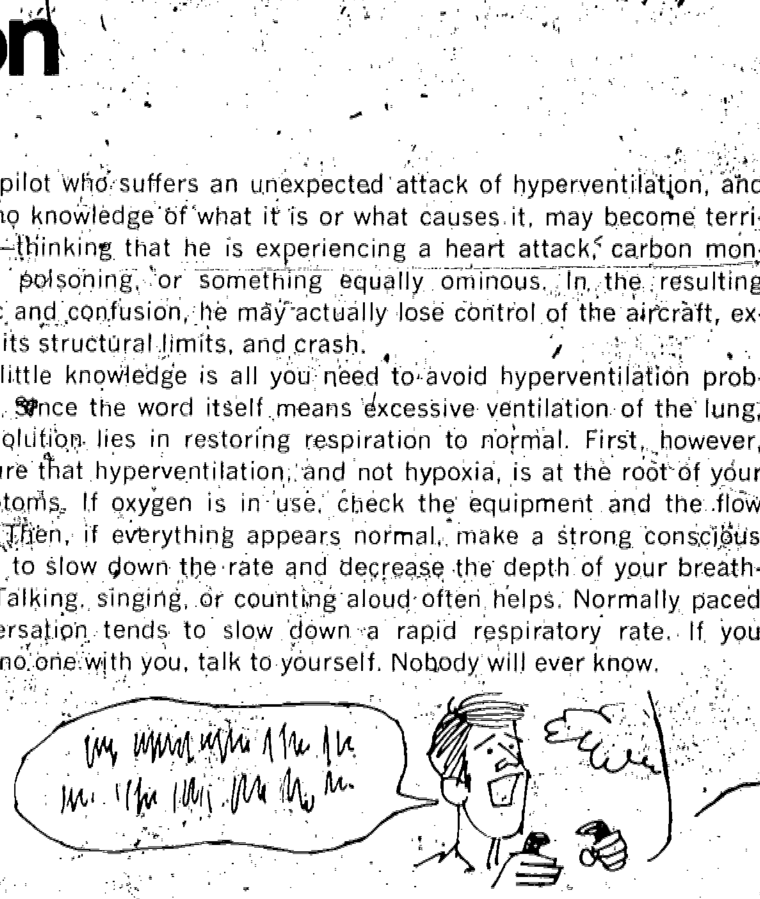
5 Hyperventilation

Some people believe that breathing faster and deeper at high altitudes can compensate for oxygen lack. This is only partially true. Such abnormal breathing, known as hyperventilation, also causes you to flush from your lungs and blood much of the carbon dioxide your system needs to maintain the proper degree of blood acidity. The chemical imbalance in the body then produces dizziness, tingling of the fingers and toes, sensation of body heat, rapid heart rate, blurring of vision, muscle spasm and, finally, unconsciousness. The symptoms resemble the effects of hypoxia and the brain becomes equally impaired.

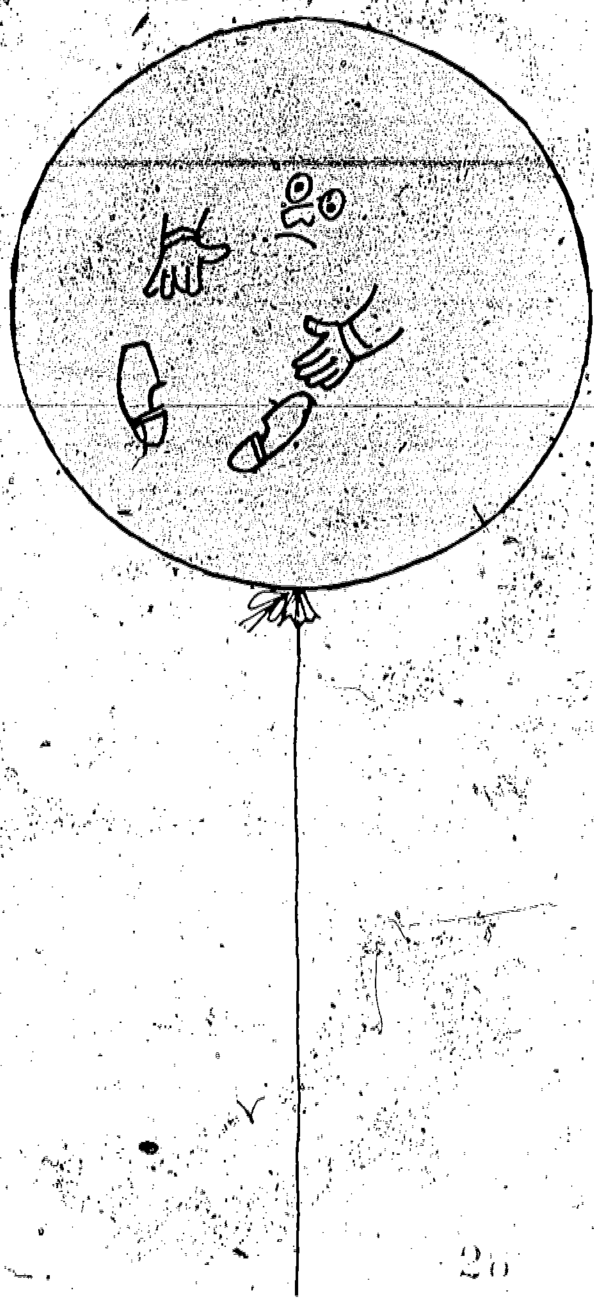
You are most likely to hyperventilate while flying under stress or at high altitude. For example, the stressful feeling of unexpectedly entering instrument conditions, noting both gas guages bouncing on empty, or developing a rough-running engine over water or mountainous terrain may make you unconsciously breathe more rapidly or deeply than necessary.

A pilot who suffers an unexpected attack of hyperventilation, and has no knowledge of what it is or what causes it, may become terrified—thinking that he is experiencing a heart attack, carbon monoxide poisoning, or something equally ominous. In the resulting panic and confusion, he may actually lose control of the aircraft, exceed its structural limits, and crash.

A little knowledge is all you need to avoid hyperventilation problems. Since the word itself means excessive ventilation of the lung, the solution lies in restoring respiration to normal. First, however, be sure that hyperventilation, and not hypoxia, is at the root of your symptoms. If oxygen is in use, check the equipment and the flow rate. Then, if everything appears normal, make a strong conscious effort to slow down the rate and decrease the depth of your breathing. Talking, singing, or counting aloud often helps. Normally paced conversation tends to slow down a rapid respiratory rate. If you have no one with you, talk to yourself. Nobody will ever know.



Normal breathing is the cure for hyperventilation. The body must be allowed to restore the proper carbon dioxide level, after which recovery is rapid. Better yet, take preventive measures. ***Know*** and ***believe*** that overbreathing can cause you to become disabled by hyperventilation.

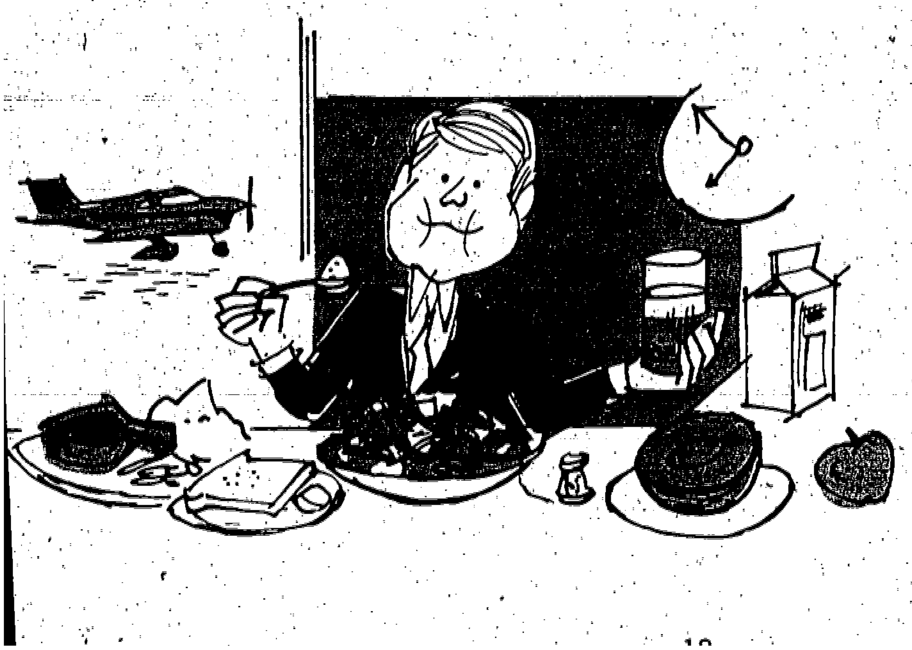


6 The Gas in the Body

In an unpressurized aircraft climbing to higher and higher altitudes, your body is exposed to less and less pressure upon its outer surfaces. Because the pressure inside your body is still the same as it was on the ground, strange things begin to happen. Gases trapped in the body cavities start expanding in an effort to equalize the pressure with that of the environmental gas (that is, air). This phenomenon can cause you some discomfort. Trapped in such places as the sinuses, behind the ear drum, and in the stomach the expanding gas may lead to a headache, ear pain, or a feeling of abdominal fullness.

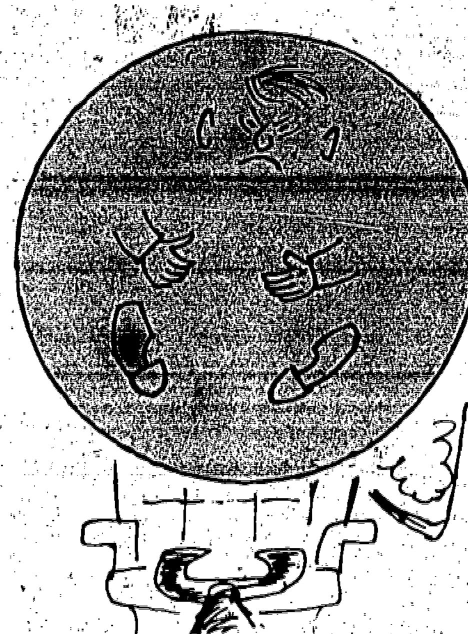
At 8,000 feet, the gases in your body expand to a volume of about 20% greater than that at ground level. If your rate of climb is gradual and your physical condition is good, you can usually adjust to this change easily and comfortably. At 18,0000 feet, the wet gas bubbles more than double their normal size and the expansion continues as the unpressurized aircraft gains altitude. A very rapid change of altitude is naturally more hazardous and uncomfortable than a slow change.

You can usually reduce the discomforts resulting from the expansion of trapped gases by slowing your rate of ascent. If they persist, descend to a lower altitude where the atmosphere is denser. Most of the gas in the intestines is swallowed air, but some is formed by the digestive process. The amount of gas varies with the individual and with the type of food eaten. If you expect to fly at high altitude, the following "Diet Don'ts" may help to minimize abdominal gas:

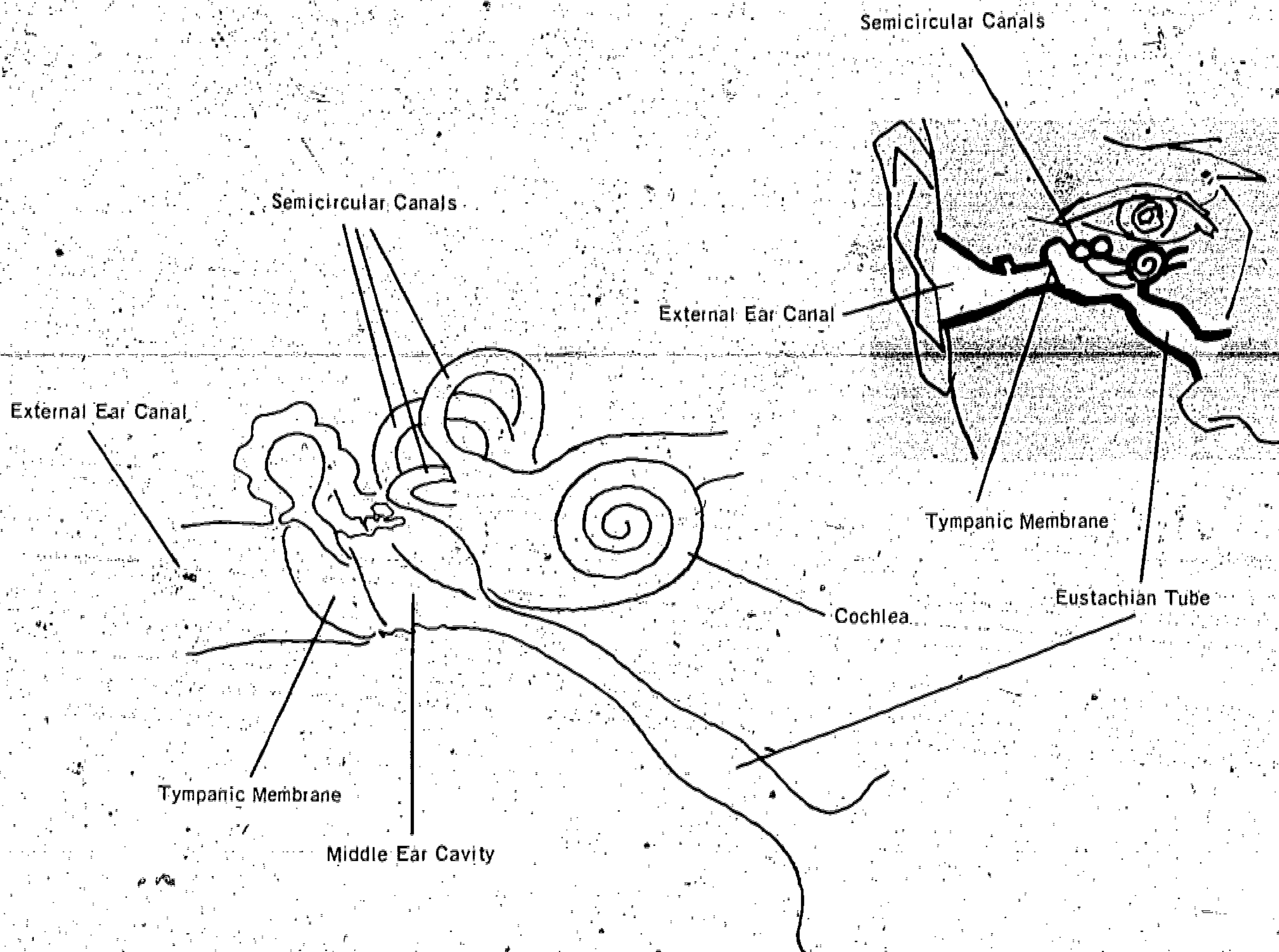


1. Don't eat too quickly before a flight!
2. Don't eat too much. (Swallowed air increases with each bite)
3. Avoid large quantities of fluid, especially cokes, pop, and beer.
4. Don't eat gas-forming foods. (Beans, cabbage, onions, raw apples, cucumbers, melons, or any greasy foods)
5. Avoid chewing gum on the way up—it may result in your swallowing a great deal of air.

In addition to gases trapped in the body cavitiies, a considerable volume of gas (primarily nitrogen) exists within the body, not in its normal state, but in solution. That is, it is dissolved in the blood and other body tissues, especially fat. When the outside pressure falls, these gases tend to come out of solution, forming gas bubbles—just as carbonated beverages release bubbles when you remove the cap and let the pressure escape. These bubbles can produce severe pain. Pain caused by bubble formation around the joints or muscles is called "bends." The same bubble formation in the lung tissue is called the "chokes" and is recognized by a burning sensation or stabbing pain in the chest area, a cough, and difficulty in breathing. Needless to say, the effects upon your ability to operate the aircraft can be disastrous.



These physical difficulties are seldom experienced below 25,000 feet so the low-alititude pilots need not be too concerned. If you should be operating a high-performance aircraft at higher flight levels and suspect that you might have the bends or chokes, the quickest relief can be obtained by lowering your altitude.



Semicircular Canals
External Ear Canal
Tympanic Membrane
Eustachian Tube
Semicircular Canals
External Ear Canal
Cochlea
Tympanic Membrane
Middle Ear Cavity

7 The Ears

If you fly an unpressurized aircraft, you are almost sure, eventually, to encounter the problem of ear discomfort during ascent or descent. To understand why this happens and how to counteract it, a simple grasp of the structure of your ear is helpful.

The external ear canal (the small tube leading to your eardrum) is always at the same pressure as the atmosphere surrounding the body. The middle ear, where pressure problems arise, is a small air-filled cavity situated within the bone of the skull and it is separated from the external ear canal by the eardrum—a thin membrane. The other side of the middle ear is connected to the nasal cavity by the eustachian tube.

As your aircraft gains altitude, the atmospheric pressure decreases and so does the pressure in the external ear canal. The middle ear, being an enclosed cavity, stays at ground-level pressure. When the pressure in the middle ear exceeds that of the external ear canal, your eardrum starts to bulge outward somewhat. The middle ear is sensitive to this change and requires only a slight excess of pressure to open the eustachian tube so that gas may pass by this route through the nose or mouth. In this way, pressure is equalized on both sides of the eardrum. You may be aware of this pressure change by alternating sensations of ear fullness and "clearing."

During descent, conditions within the ear are reversed. As the surrounding air pressure increases, the middle ear—which has accommodated itself to the reduced pressure at altitude by the process just described—is at a ***lower*** pressure than the external ear canal. Consequently, the outside air forces the eardrum to bulge ***inward***. This condition is much more difficult to relieve, since air must be introduced back up the eustachian tube to equalize the pressure. The partial vacuum in the middle ear also tends to collapse rather than inflate the walls of the eustachian tube. You can best remedy this by closing your mouth, pinching your nostrils shut, and blowing slowly and gently to build up pressure in your mouth and nose. At some point in this procedure, you will be able to feel air entering the middle ear, and you will notice an immediate improvement in your ability to hear. This will be followed by a relief in the sense of fullness and discomfort.

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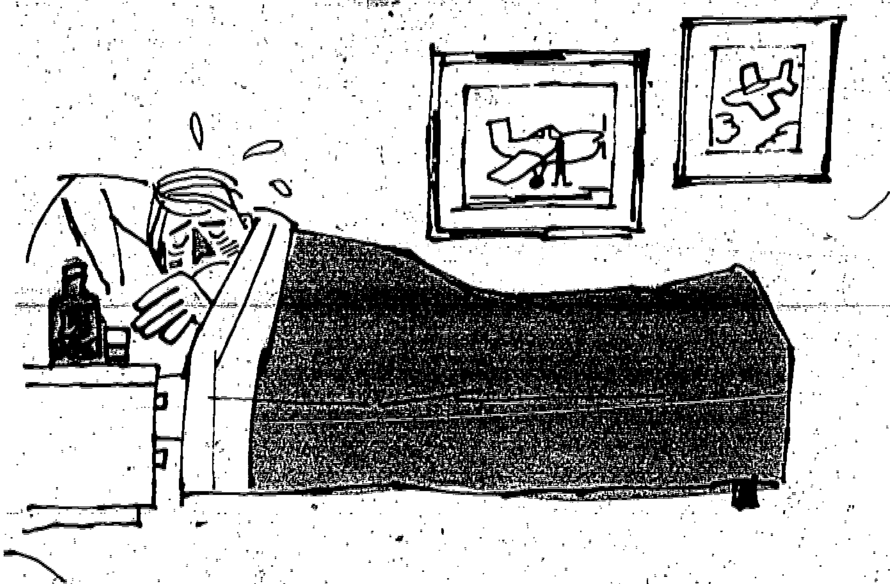
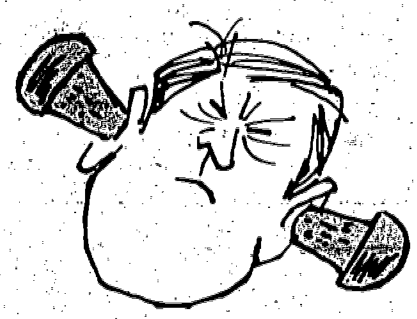


If you have a cold, the tissue around the nasal end of the eustachian tube will probably be swollen, and you can expect ear problems to be aggravated in flight. The best advice is to ***stay on the ground.*** If you must fly, do so at lower altitudes. This precaution may prevent a perforated or painful eardrum. Although a perforated eardrum generally heals rapidly, in some cases hearing is impaired permanently or the middle ear becomes infected and causes prolonged disability.



Should you find that you cannot clear your ears in flight, as just described, consult a physician immediately after landing. It may save you weeks of trouble. The AME can quickly and painlessly solve the problem.

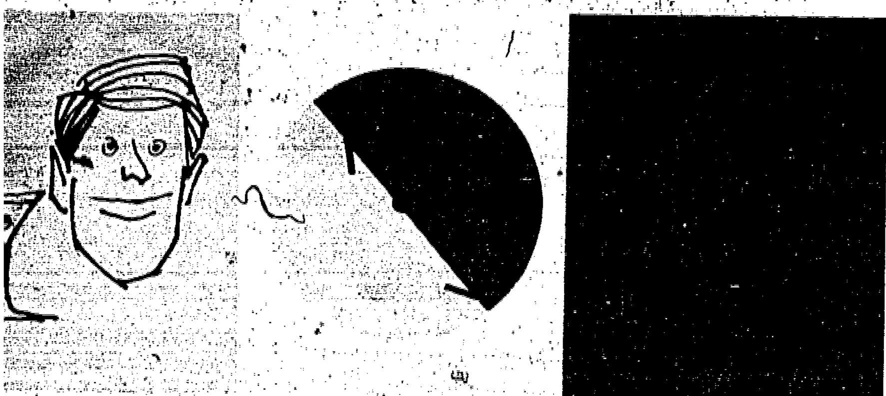
33

8 Alcohol

Everyone knows that alcohol impairs the efficiency of the human mechanism. This fact has been emphasized again and again—in newspapers, magazines, television, and other media throughout the world. Studies have positively proved that drinking and performance deterioration are closely linked. Estimates indicate that alcohol is a major factor in nearly 50% of all automobile accidents. Analyses of aircraft accidents over the past several years implicated alcohol as a contributing factor in almost 40% of the crashes in the early 1960's. Discovery of the problem, education, and regulation had decreased this factor to around 20% in the late 1960's and early 1970's.

In "hangar sessions" among experienced pilots, there is almost 100% agreement that drinking and flying don't mix. Yet, the accident record shows that far too many pilots have ignored their own better judgment and paid with their lives. An automobile moves in only two dimensions. An airplane moves in three, making its safe operation infinitely more complex. Therefore, any pilot who is not in top condition is severely handicapped. Even straight-and-level flight from one point to another requires a high degree of judgment, attention, coordination, and skill. Hundreds of decisions must be made, some on the basis of incomplete information (adverse weather, etc.). Obviously, then, anything which detracts from your ability to make successive decisions which are correct will increase your chances of having an accident.

What is alcohol, and how does it affect your performance as a pilot? The alcohol you consume in beer and mixed drinks is simple ***ethyl alcohol***, a central nervous system depressant. From a medical point of view, it acts upon your body much like a general anesthetic (ether, chloroform, etc.). The "dose," of course, is generally much lower and more slowly consumed in the case of alcohol. But the basic effects on your system are similar.



Alcohol is easily, and quickly absorbed by the digestive tract. Your blood stream absorbs about 80% to 90% of the alcohol in a highball within 30 minutes after you have drained your glass. Beer works a little slower, but not much.

You have undoubtedly heard time and again that alcohol is a depressant, not a stimulant. Yet after one or two drinks you certainly *feel* stimulated. This sensation is misleading and occurs because part of the depressant action of alcohol, working on the brain, brings about a release from the usual restraints and inhibitions. You may enjoy a feeling of security, well-being, confidence, and freedom from pressure. In reality, however, your thinking has become sluggish, you respond to urgent situations less efficiently, and your ability to perform simple tasks with speed and accuracy is hampered. If, in addition, you happen to be fatigued, hungry, or under stress, these handicaps will be compounded.

The effect of alcohol is greatly multiplied when a person is exposed to altitude. Two drinks on the ground are equivalent to three or four at altitude. The reason for this is that chemically alcohol interferes with the ability of the brain to utilize oxygen. And the effects are rapid—first because alcohol passes so quickly into the bloodstream, and second because the brain is a highly vascular organ, immediately sensitive to changes in the blood's composition. For the pilot, then, the lower oxygen availability at altitude, along with the lower capability of his brain (under the influence of alcohol) to use what oxygen *is* there, adds up to a deadly combination.

Your body requires about 3 hours to rid itself of all the alcohol contained in ***one*** mixed drink or ***one*** beer. The Federal Aviation Regulations make it illegal to fly for at least 8 hours after taking a ***single*** drink. Most wise pilots allow a minimum of 12 hours between "the bottle and the throttle." The general rule for commercial airlines is 24 hours.

The subtle effects of a hangover can be just as hazardous as the state of intoxication itself. Morning-after weariness dulls your system and detracts from peak efficiency. Recent research by the FAA's Office of Aviation Medicine indicates that some functions may require up to 2 days for complete recovery following a "binge."

Do not drink alcohol in any form during the 8-hour period preceding flight, and do not overindulge during the 24 hours before flight. Don't invite disaster by letting alcohol and hypoxia gang up on you!

9 Drugs and Flying

The word "drug" evokes an image in the minds of many people far different from its actual medical meaning. Because of current concern over drug abuse, the term "drug" is often interpreted to mean marijuana, heroin, LSD, barbiturates, or amphetamines. Actually, a drug is any chemical compound administered to produce a specific effect on the body.

The illicit use of the "psychoactive drugs" (mentioned above) which distort the mental process, hardly needs to be discussed here. Certainly no responsible pilot would consider mixing any of these drugs with flying.

However, legitimate medications taken for minor ailments can also jeopardize safe flight by their subtle or unpredictable effects on the pilot. This includes both prescribed medications and over-the-counter medicines. Even the simplest of home remedies should be suspect, including aspirin, cold tablets, cough mixtures, and laxatives.

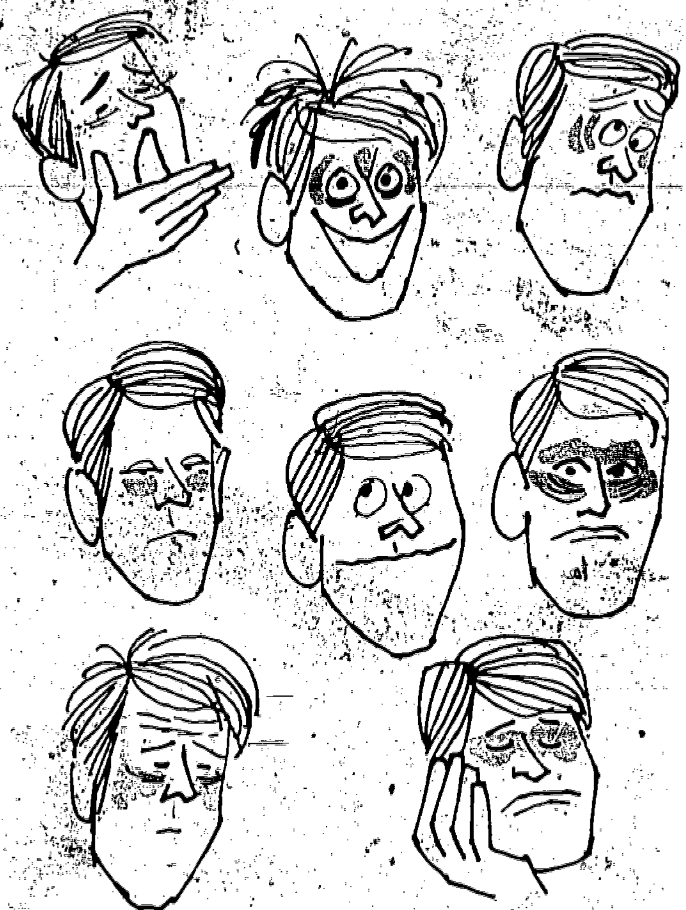
Recent studies of aircraft accidents suggest that certain categories of drugs may have side effects which contribute to pilot error, and hence to accidents. These are:

1. ***Antihistamines:*** a group of drugs widely prescribed and readily available for sufferers of hay fever and other allergies. Drowsiness is a common side effect.

2. ***Tranquilizers:*** a variety of agents usually prescribed for nervousness and hypertension. These, too, may reduce alertness.

3. ***Reducing agents and "pep" pills:*** a class of drugs generally containing amphetamines. They can produce a feeling of high spirits and false confidence, while actually crippling one's judgment and leading to reckless errors.

4. ***Barbiturates, nerve tonics, and pain killers:*** a broad category of medications intended primarily to relieve anxiety or reduce pain. These drugs generally suppress mental alertness.



Some other dangers which may accompany pill taking are:

1. ***Drug allergies:*** An allergic response to a drug can arise unexpectedly and dramatically, disabling a pilot in flight.

2. ***Unexpected side reactions:*** Different people may react in different ways to the same medication. For example, a drug which has no significant side effects in most individuals may, in a few, produce nausea or vertigo.

3. ***Change of effect:*** High-altitude flying or "G" forces have been observed to change the effect of some medications.

4. ***Effect of drug combinations:*** Two drugs taken at the same time occasionally cancel each other out, render each other more potent, or cause a side reaction not experienced with either medicine alone. For example, dangerously high blood pressure has resulted from the use of nose sprays by person taking antidepressants at the same time. Even eating some foods in combination with certain medicines has produced dangerous conditions.

You should be just as cautious with over-the-counter remedies as with prescription medications. If you are uncertain about taking a particular medicine before or during flight, ***consult your AME or your personal physician.***

Remember, too, that the need for medicine implies the presence of an illness. And if you are ill, you have no more business in the air than a rough-running engine. The safest rule is to take ***no*** medicine before or during flight without consulting your AME. Not only might the medication dull your alertness—it might suppress the symptoms of your illness, making you feel better than you really are. No pilot flies as well when his system is run down, even by a cold.

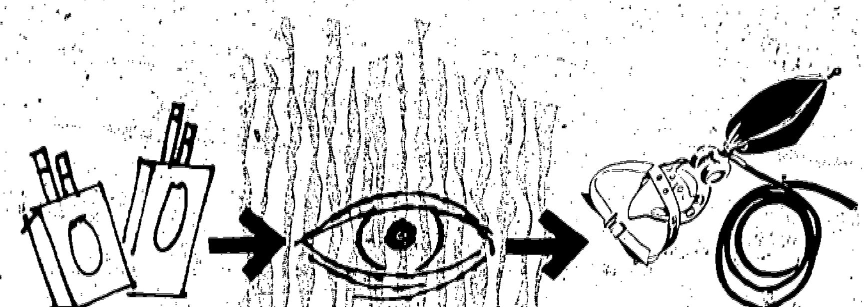
The pilot who flies while ill or while taking disqualifying medication is violating FAR Part 61.45. Most important, however, he is unnecessarily jeopardizing his own and his passengers' safety.

10 Carbon Monoxide

Pilots tend to think of carbon monoxide gas as something produced by a defective muffler, a faulty exhaust system, or a heater leak in the aircraft cabin. When they perform their preflight check of the aircraft and find no breaks or cracks, they feel reassured.

Yet, one of the more common sources of carbon monoxide intoxication in an aircraft is tobacco smoke. Carbon monoxide makes up about 3% of cigarette smoke and from 5% to 8% of cigar smoke. A one-pack-a-day cigarette smoker is walking around with about 4% to 8% of his blood saturated with carbon monoxide. At ground level, he may be untroubled by this, but altitude flying changes the picture.

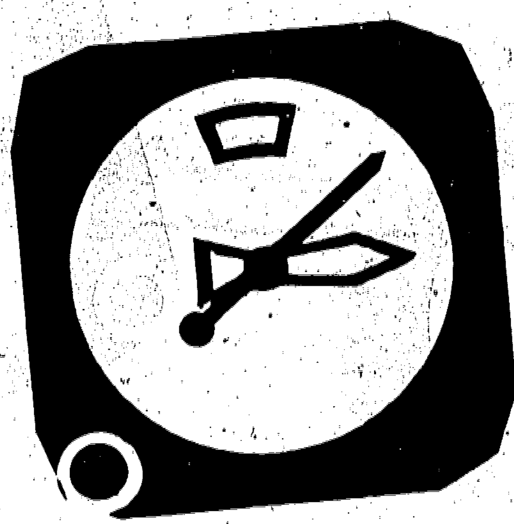
Carbon monoxide has an attraction for the red blood cells which is 200 times greater than that of oxygen. If a molecule of carbon monoxide unites with a molecule of hemoglobin, which ordinarily carries oxygen, they stick together like glue. Oxygen doesn't stand a chance in the competition for hemoglobin. Thus, the red blood cell cannot again carry oxygen into the system until the carbon monoxide is expelled. For the pilot at altitude, whether he is hypoxic because of low oxygen availability or whether he is poisoned by carbon monoxide, ***the effect is the same.***



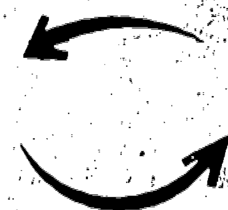
Tobacco does more than deprive the body of oxygen because of the carbon monoxide content in smoke. It lowers the sensitivity of the eye and cuts night vision by approximately 20%. Moreover, nicotine increases the body's heat production 10% to 15% above normal creating added oxygen demands. Ironically, the same cigarette that increases the demand for oxygen also reduces the supply.

Careful tests have shown that the carbon monoxide in tobacco smoke can lower the pilot's tolerance to altitude by as much as 5,000 to 6,000 feet. In other words, medically speaking, pilots who smoke are already "at altitude" before they ever leave the ground. If you smoke, you will need to use your oxygen systems earlier than a nonsmoker would during ascent. If you classify yourself as a moderate-to-heavy smoker, use your oxygen at *all* altitudes during night flying. You will find day flying more comfortable and safer—if you use oxygen above 5,000 feet.

In any given concentration, carbon monoxide is just as lethal to the system whether it is inhaled from exhaust fumes or from cigarette smoke. If you have any doubt at all about your oxygen requirements as a smoker, take oxygen with you to altitude—and ***use*** it.



11 Vision



Vision, even under instrument conditions, is perhaps your single most vital faculty in flying. Yet, the best eyes in the world—with 20/20 sight, good depth perception, and well-developed color vision—can play unexpected tricks on the most experienced pilot.

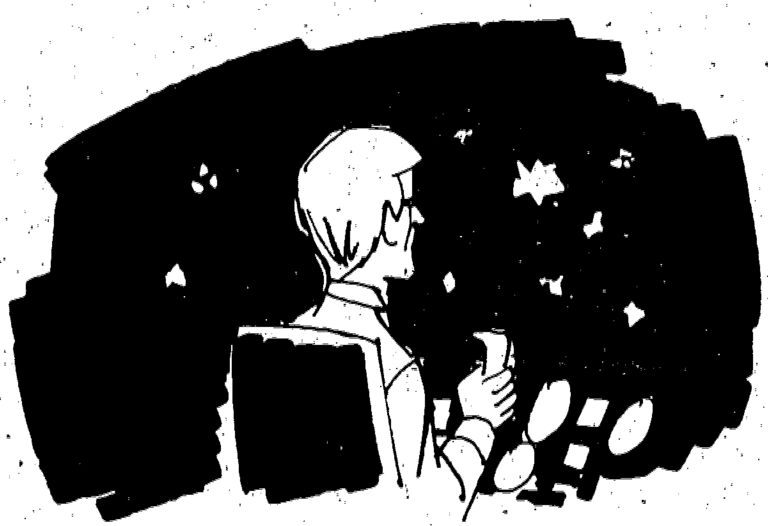
The eyes and brain cooperate closely to produce the sensation of sight. Illusions can arise from the eye alone, from the brain alone, or from a combination of the two. For example, when a bright light temporarily "blinds" you on a dark night your eyes may take several minutes to recover, during which time you "see" an after-image. This illusion, arising in the eye itself, is quite common and rarely causes persistent problems unless the central point of vision is affected or the light is unusually bright. The brain can create illusions by misinterpreting images which the eye reports correctly, i.e., you might misjudge the horizon because of slanted banks of clouds.

Pilots true vertigo, experienced as a feeling of dizziness and imbalance, can create or increase visual illusions. Vertigo resulting from rapid rotation of the body may be so severe that it causes quick, jerky, side-to-side movements of the eyes (a condition called "nystagmus"). This makes the surroundings appear to revolve in a direction opposite to the body's former rotation. If you have an attack of vertigo in flight, you may find yourself unable to read your instruments because they seem to be constantly moving.

During night flying, especially in extreme darkness, very little rotational movement of the body is needed to induce vertigo. Forewarned is forearmed!

However experenced you are, other types of illusons may occasionally prevent you from recognizing familiar terrain over which you are flying. Your eyes may deceive you into mistaking farm land or populated areas for landing fields—leading you to undertake a normal descent and landing approach into a hazardous area.

Remember that illusions seem very real, and that they occur in pilots from every level of experience and skill. Recognizing the fact that your brain and eyes can play tricks on you in this manner is your best protection.



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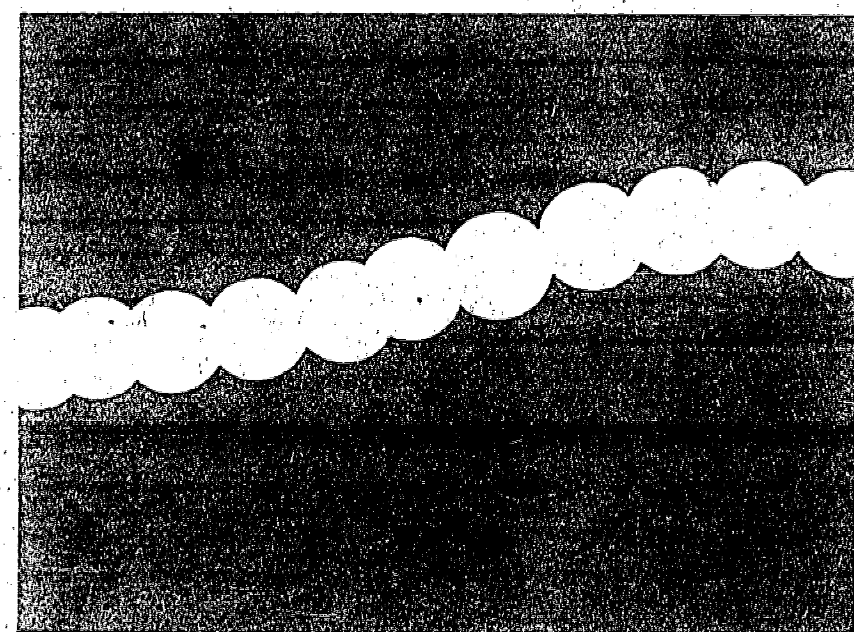
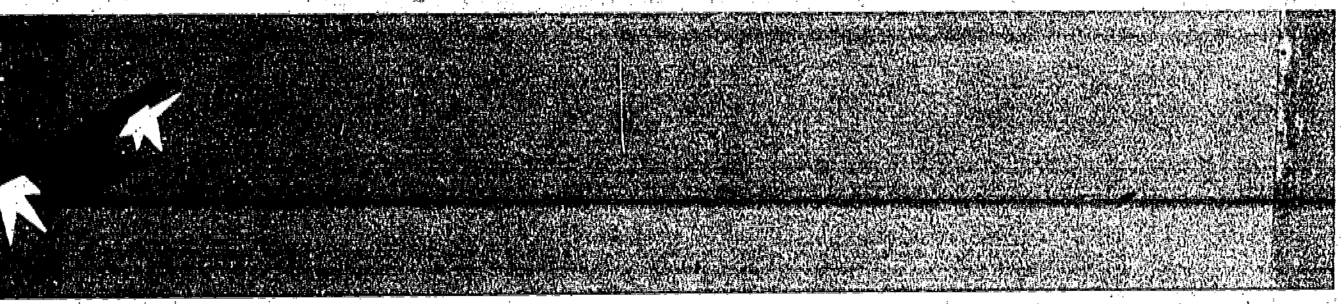
12 Night Flight



A veteran pilot once remarked that night flying is no different from day flying—it's just that at night you can't see anything. Although his statement carries a good deal of truth, you can usually see ***something***. To compensate for what you can't see, you need proper instrumentation. To make the most of your vision at night, you need to understand how the eye operates in darkness.

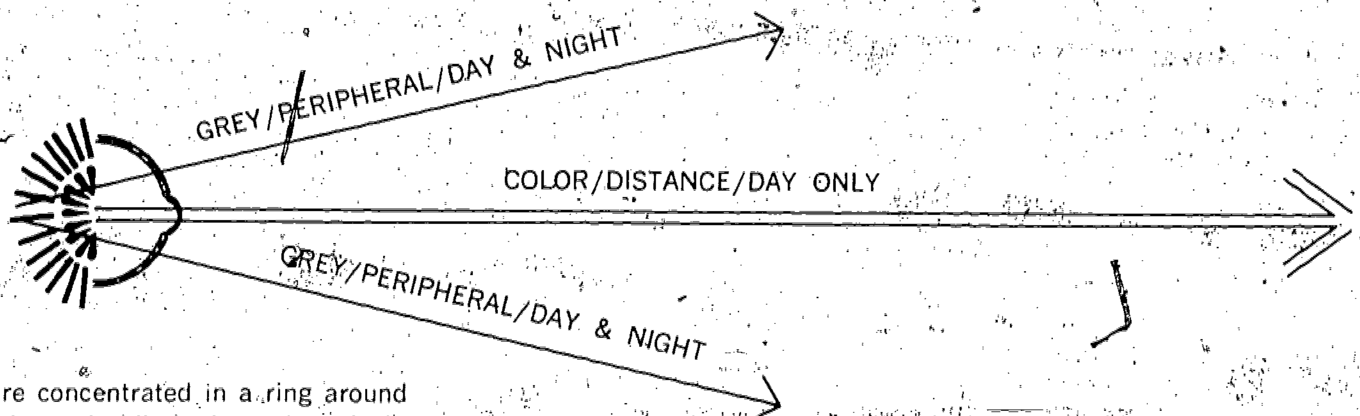
"Autokinesis" (short for autokinetic visible light phenomenon) is one of the special visual hazards of night flying. It resembles vertigo in some ways. Autokinesis occurs when you stare at a pinpoint of light in a dark sky. After a while, you get the feeling that either you or the light is in motion. To prevent this from happening, keep your eyes moving. Don't stare at a single light too long. Autokinesis used to be responsible for numerous aircraft disasters, until we discovered the cause for this optical illusion.



Night flying requires a different visual technique than day flying. You can see an object best during daylight by looking directly at it. At night, however, a scanning procedure is more effective—to permit "offcenter" viewing of the target. In other words, you will find after some practice that you can see things more clearly and definitely at night by looking slightly to one side of them, rather than straight at them.

The explanation for this lies in the dual structure of your eye. There are two kinds of light-sensitive nerve endings at the back of your eye: (1) the cones, which distinguish color and require considerable light to function, and (2) the rods, which detect objects only in shades of gray but can operate in very dim light.

The cones, because they need greater intensity of light to function, are used in day vision. In fact, the cones stop working altogether in semidarkness. Millions of these tiny structures are clustered at the back of the eyeball, directly behind the pupil. Not only do they distinguish colors, they pick up distant objects.



The rods are concentrated in a ring around the cones. Being colorblind, they see only in grays and are used in peripheral vision during the day—that is, to perceive objects in motion out of the corner of the eye. Because the rods can still function in light of 1/5,000 the intensity at which the cones cease to function, they are used for night vision. These structures are 100,000 times as sensitive in the dark as they are in sunlight. However, they do need more time to adjust to darkness than the cones do to bright light. Your eyes become adapted to sunlight in 10 seconds, whereas they need 30 minutes to fully adjust to a dark night.

The fact that the rods are distributed in a band around the cones, and, therefore, do not lie directly behind the pupils, makes "offcenter" viewing important to the pilot during night flight. If, in your attempts to practice the scanning procedure mentioned previously, you find that your eyes have a tendency to swing directly toward the target, force them to swing just past it so that the rods on the opposite side of the eyeball pick up the object.

Rods lose their sensitivity after short exposure to a light source, but regain it quickly after a moment of "rest." Consequently, a prolonged blink may be enough to renew the effectiveness of your vision if you are simply using the "offcenter" technique, without scanning. Remember, too, that rods do not perceive objects while your eyes are in motion, only during the pauses.

Good sight depends upon your physical condition. Fatigue, colds, vitamin deficiency, alcohol, stimulants, smoking, or medication can seriously impair your vision. Keeping these simple principles in mind, you should be able to safeguard your night vision.

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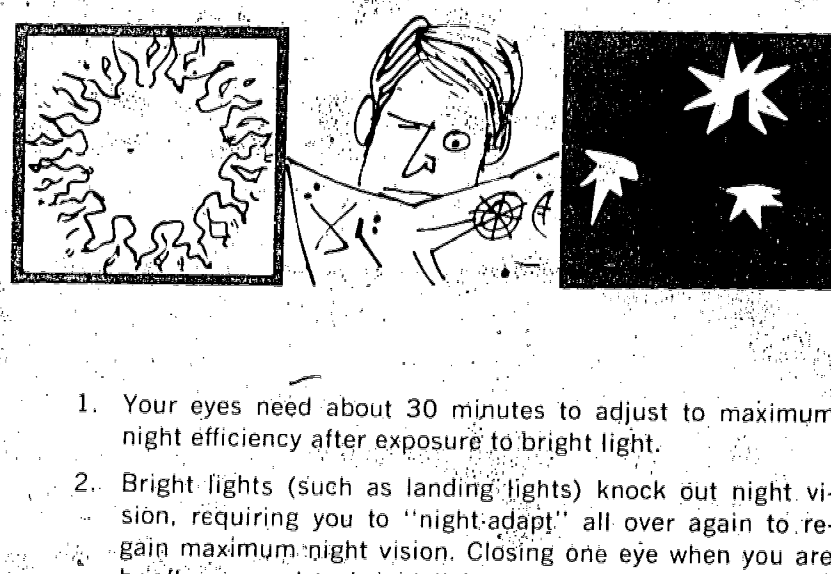
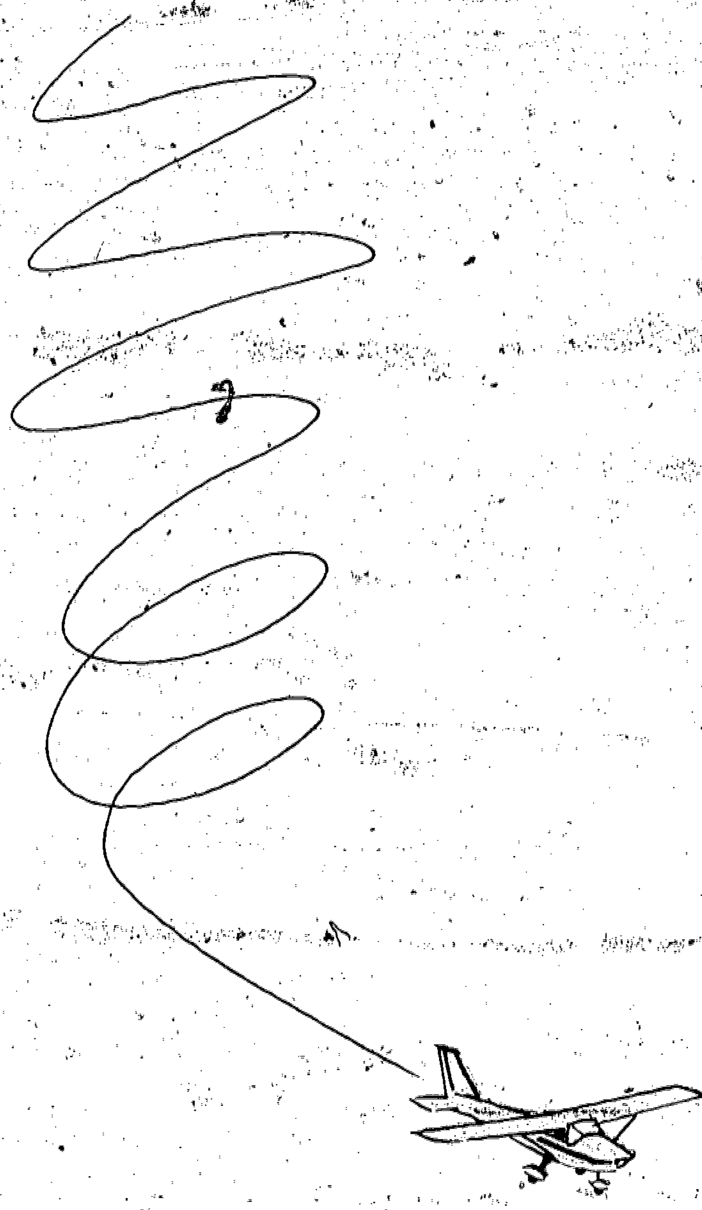
13 Cockpit Lighting



Cockpit lighting has been the subject of considerable discussion. In military aviation, red lighting was long used in the cockpit and pilots were required to wear red goggles for a certain period of time before night flight. These precautions for night adaptation were necessary because pilots who needed to spot enemy aircraft frequently flew from inadequately lighted airports and navigated by vision more than by instruments.

With the advent of adequately lighted airports and the general use of radio for navigation, "night vision" actually became less important. The tendency now is toward more complete illumination of the cockpit, with white light used more than red. Problems such as improper fuel selection and errors in course plotting or chart reading are much more significant now than the loss of night vision. Still, you should be familiar with a few facts about visual adaptation during night flying.

1. Your eyes need about 30 minutes to adjust to maximum night efficiency after exposure to bright light.
2. Bright lights (such as landing lights) knock out night vision, requiring you to "night-adapt" all over again to regain maximum night vision. Closing one eye when you are briefly exposed to bright light (while map reading, for instance) may protect that eye so it need not re-adapt.
3. Lightning flashes knock out night vision. Therefore, near storm clouds, turn up the cockpit lights to see your instruments properly.
4. Remember to remove your sunglasses after sunset, or you may find yourself flying in "instrument conditions" when actually the ceiling and visibility are normal.



14 Disorientation (Vertigo)

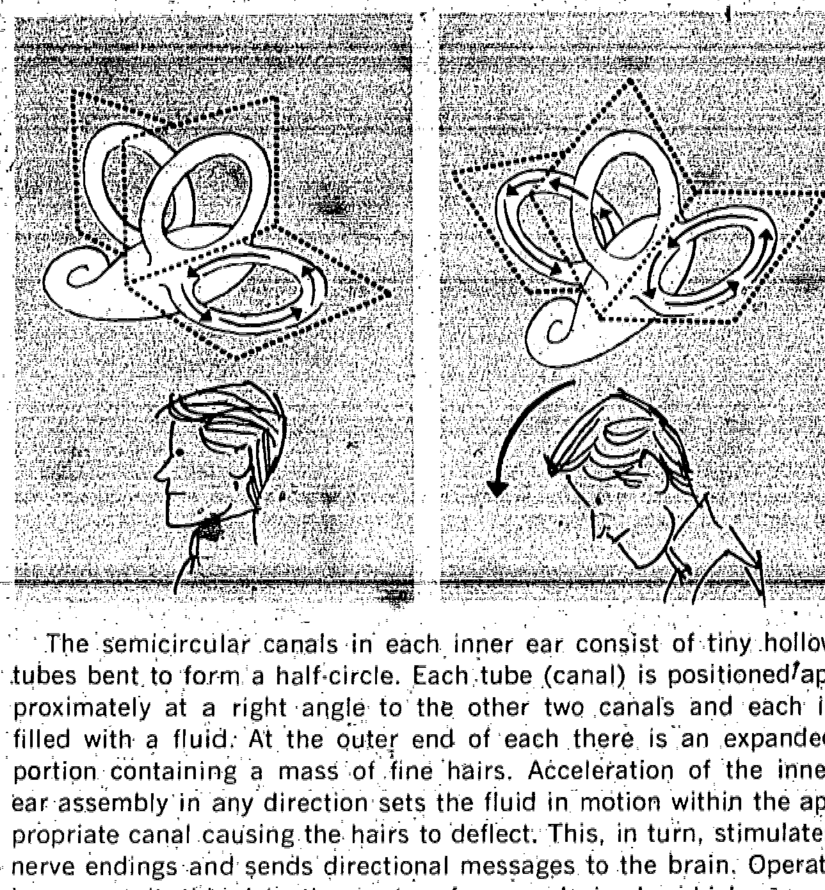
An archaic definition of disorientation literally meant "difficulty in facing the east." To the pilot, it more often means "Which way is up?". Disorientation, or vertigo, is actually a state of temporary spatial confusion resulting from misleading information sent to the brain by various sensory organs. The body's elaborate navigational system was superbly designed for locomotion on the ground at a normal gait, but in an aircraft, during sudden acceleration or radial flight, it can trick you.

The most difficult adjustment that you must make as you acquire flying skill is a willingness to believe that, under certain conditions, your senses can be wrong. When you are seated on an unstable moving platform at altitude (and your vision is cut off from the earth, horizon, or other fixed reference) and you are exposed to certain angular accelerations or centrifugal forces (which you cannot distinguish from gravity forces), you are susceptible to innumerable confusing, disorienting experiences.

5.

In a level turn, you may think you are in straight flight or climbing. In a coordinated, banked turn you may believe yourself to be in straight and level flight. In recovery from a level turn, you may feel as though you are diving. In a left turn—if you suddenly bend your head forward—you may think you are *falling* to the left.

These alarming sensations are due primarily to misinterpretation of messages sent to the brain by the two primary sensory organs: (1) the semicircular canals of the inner ear, and (2) groups of pressure-sensitive nerve endings located mainly in the muscles and tendons. These organs tell you where you are in relation to the *ground*, your normal environment. When your eyes are open and your feet are on the ground, they serve you well. You have little trouble deciding which direction is up or down. In an airplane, though, these organs may send your brain inaccurate reports.



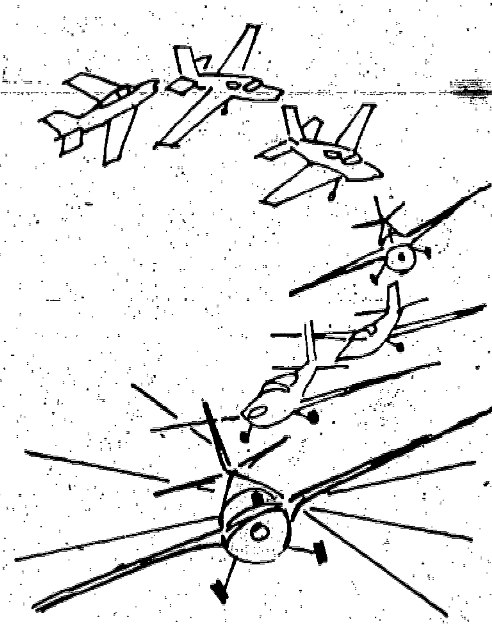
The semicircular canals in each inner ear consist of tiny hollow tubes bent to form a half-circle. Each tube (canal) is positioned approximately at a right angle to the other two canals and each is filled with a fluid. At the outer end of each there is an expanded portion containing a mass of fine hairs. Acceleration of the inner ear assembly in any direction sets the fluid in motion within the appropriate canal causing the hairs to deflect. This, in turn, stimulates nerve endings and sends directional messages to the brain. Operating as a unit, this detection system forms a device by which we can readily identify "yaw," "pitch," and "roll."

With this perfect arrangement, it appears that you should never have the least bit of difficulty ascertaining your direction and attitude. However, as in all complex systems, there is a certain amount of built-in error. In aviation, we sometimes refer to this type of a problem as "instrument lag." If the *rate* of directional change is quite small—and not confirmed by the eyes—the change will be virtually undetectable and you probably will not sense any motion whatsoever.

In straight and level flight the fluid in the semicircular canals is sting and the little hair detectors alert and ready for action. Any rectional change of your airplane will cause a reaction in the proper canal and signal to the brain which direction the aircraft has oved.

As you enter a constant-rate turn (such as a standard rate /second turn), the system goes to work; the hairs bend over and the proper signal travels to the brain indicating the direction of rning. Continuing the same turn for about 30 to 45 seconds will ow the fluid in the canal to catch up with the pilot and aircraft d the hairs will be pushed back to their upright position.

Here's where trouble begins! Inside the airplane, if you are unle to see the ground and establish a visual reference you are just conds away from the famous graveyard spiral. You're in a turn t your inner ear machinery tells you that you're straight and vel. Now, as the airspeed builds up in the turn you may think you e in a level dive and pull back on the control column. Increased ck pressure on the controls will only tighten the turn and cause uctural failure or a curving flight path into the ground. But suppse, by either a glimpse of the horizon or a recall of some "nee-e-ball-airspeed" technique, you are able to get the airplane uared away again to straight and level flight.

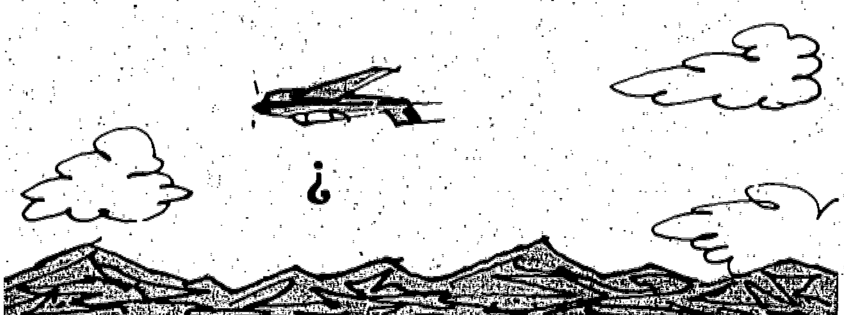


The fluid, which continues to turn while you are returning to level flight, begins to creep back to neutral after you level the airplane. Because of its momentum, the fluid continues to flow after the canal has come to rest—bending the hairs along with it. You really are straight now, but you have the sensation of turning in the OPPOSITE direction from which you have just recovered. You instinctively bank away from the imaginary turn—and the cycle starts all over again.

Without instrument training, the chances of maintaining normal aircraft attitude in limited visibility are extremely rare. Repeated small control movements may eventually create a sensation of gradual turning. You may misinterpret the degree of bank and have a false impression of tilting when in a skid or a slip.

Spatial disorientation occurs most often in instrument conditions created by rain, fog, clouds, smoke or dark nights. It is aggravated by other factors such as lack of recent instrument experience or training, attempts to mix VFR and IFR, unfamiliarity with the aircraft or flight situation, fear or worry, and excessive head movements.

You can overcome the effects of vertigo by relying upon your aircraft's instruments. ***Read your instruments!*** They are the best insurance you will ever have. Remember, though, that the time required to shift from VFR to IFR may be long enough for the aircraft to enter a dangerous attitude.



Bear in mind that vertigo can occur ANYTIME that the outside visual reference is temporarily lost—during map reading, changing a radio channel, searching for an approach plate, fuel managing, computing a navigational problem, or whatever else you might need to do inside the cockpit. Nearly all experienced pilots have had a brush with vertigo, usually minor and of short duration. It CAN be disastrous, however. "Pilot error," resulting from vertigo, has been identified beyond any doubt as the direct contributing cause of many accidents.

To become familiar with disorientation symptoms, ask your AME or nearest GADO (General Aviation District Office) specialist to arrange a brief demonstration in a Barany (rotating) chair. This will quickly and safely show you how overwhelming vertigo can be. It would be to your advantage to attend any of the FAA Accident Prevention Programs which are presented frequently throughout the country. Your GADO inspector can advise you of the time and location of the next program in your vicinity. Disorientation is also included in the FAA-coordinated Physiological Training Course. Complete information regarding this training may be obtained by contacting any of the addresses listed in the back of this handbook.

The danger of vertigo may be reduced by:

1. Understanding the nature and causes of the condition.
2. Avoiding, if possible, the flight conditions which tend to cause vertigo.
3. Obtaining instrument flight instruction and maintaining proficiency.
4. Having faith in the instruments rather than taking a chance on the sensory organs.
5. Remembering that it can happen to ANYONE!

Finally, you should be constantly aware of the danger in shifting between the instrument panel and the exterior visual field when the latter is poorly structured or obscured. Avoid sudden head movements, particularly when the aircraft is changing attitude. Don't fixate too long on the instruments. And, *most important,* when your senses seem to disagree with the instruments, *trust the instruments*—they may save your life.

15 Motion Sickness

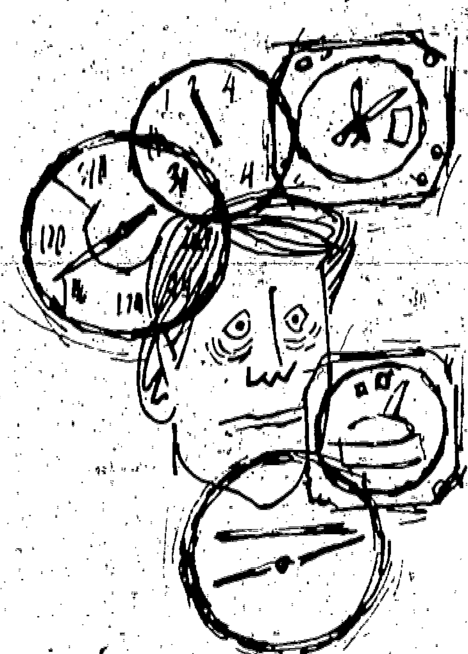
Although motion sickness is uncommon among experienced pilots, it does occur once in a while. If you have ever been its victim, you know how uncomfortable it is. Most important, it jeopardizes your flying efficiency—particularly in turbulent weather and in instrument conditions when peak skill is required. Student pilots are frequently surprised by an uneasiness usually described as motion sickness. This is probably a result of combining a bit of anxiety, unfamiliarity, and the bit of bumping received from the airplane and is quickly overcome with experience.

Motion sickness is caused by continued stimulation of the tiny portion of the inner ear which controls your sense of balance. The symptoms are progressive. First, you lose your desire for food. Then saliva collects in your mouth and you begin to perspire freely. Eventually, you become nauseated and disoriented. Your head aches and you may have to vomit. If the air sickness becomes severe enough, you may become completely incapacitated.

If you are susceptible to airsickness, do not take the preventive drugs which are available over the counter or by prescription (unless, of course, you are a passenger in someone else's airplane). These medications may make you drowsy or depress your brain functions in other ways. Careful research has shown that most motion sickness drugs cause a temporary deterioration of navigational skills or other tasks demanding keen judgment.

If you suffer from airsickness while piloting your aircraft, open up the air vents, loosen your clothing, use oxygen, and keep your eyes on a point outside the airplane. Avoid unnecessary head movements. Then cancel your flight plan and land as soon as possible.

Remember, terra firma is the best cure for motion sickness!



16 Fatigue

Fatigue is a general term which is difficult to define medically. Usually thought of simply as "tiredness," fatigue may be more aptly described as a depletion of body energy reserves, leading to below-par performance. Because fatigue lowers your efficiency as a pilot, you should understand its causes and prevention.

Fatigue falls into two broad categories: (1) ***acute fatigue*** (short-term), and (2) ***chronic fatigue*** (long-term).

Chronic fatigue, extending over a long period of time, usually has psychological roots. (An underlying disease is sometimes responsible, however). Continuous strain on your job, for example, can produce chronic fatigue. You may experience this condition in the form of weakness, tiredness, palpitations of the heart, breathlessness, headaches, or irritability. Sometimes chronic fatigue even creates stomach or intestinal problems and generalized aches and pains throughout the body. When the condition becomes serious enough, it can lead to emotional illness. If you suspect that you are suffering from chronic fatigue, consult your doctor. Self-help cures are rare. Above all, ***don't fly!***

Acute fatigue, on the other hand, is short-lived and is a normal occurrence in everyday living. It is the kind of tiredness you feel after a period of strenuous effort, excitement, or lack of sleep. Rest after exertion and 8 hours of sound sleep ordinarily cures this condition.

A special type of acute fatigue, called "skill fatigue," is worth mention here because pilots are especially susceptible to it. Skill fatigue has two main effects upon your performance:

1. *Timing disruption*—You appear to perform a task as usual, but the timing of each component is slightly off. This makes the pattern of the operation less smooth, because you perform each component as though it were separate, instead of part of an integrated activity.
2. *Disruption of the perceptual field*—You concentrate your attention upon movements or objects in the center of your vision and neglect those in the periphery. This may be accompanied by loss of accuracy and smoothness in control movements.

Acute fatigue has many causes, but the following are among the most important for the pilot:

1. ***Mild hypoxia*** (oxygen deficiency).
2. ***Physical stresses*** produced by the aircraft, such as fighting severe turbulence, icing conditions, malfunctioning of the equipment.
3. ***Psychological stress,*** some of it emotional and some resulting from the demanding intellectual activity required for successful flight operations.
4. ***Depletion of physical energy*** resulting from psychological stress. Sustained psychological stress accelerates the glandular secretions which prepare the body for quick reactions during an emergency. These secretions make the circulatory and respiratory systems work harder, and the liver releases energy to provide the extra fuel needed for brain and muscle work. When this reserve energy supply is depleted, the body lapses into generalized and severe fatigue.

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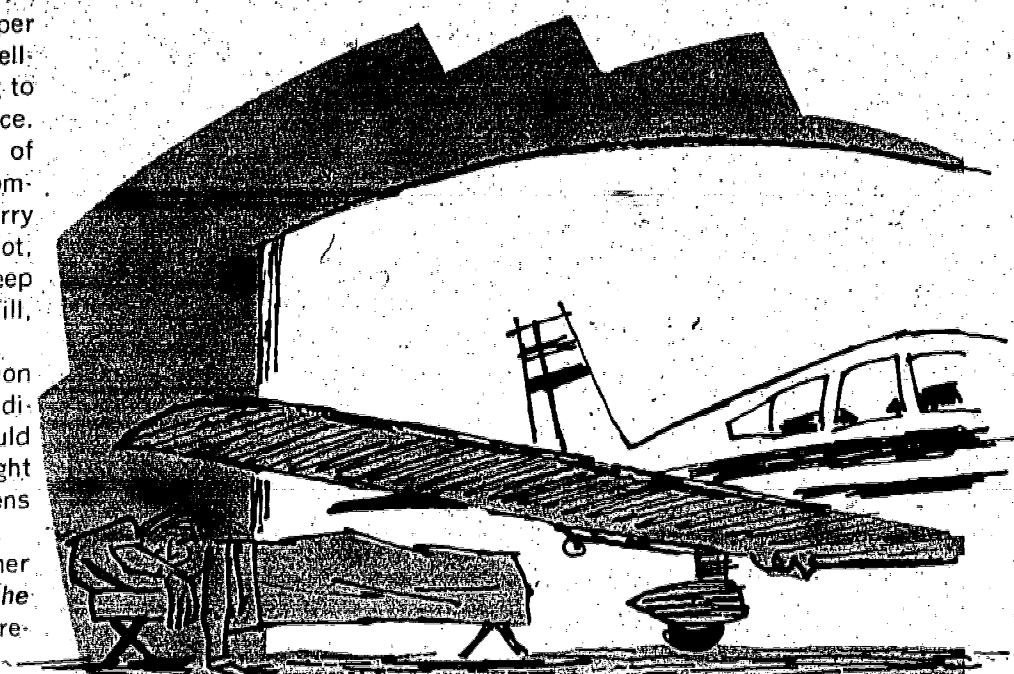
Acute fatigue can be prevented by a proper diet and by adequate rest and sleep. A well-balanced diet prevents the body from having to consume its own tissues as an energy source. Adequate rest maintains the body's store of vital energy. You can sleep best in quiet, comfortable surroundings. Excitement and worry will diminish the benefits of sleep. As a pilot, you should get approximately 8 hours of sleep a night. If you are especially tired, tense, or ill, you will need more.

Keeping your body in top physical condition makes you less susceptible to fatigue. In addition to getting regular exercise, you should avoid overweight. Obesity lowers your flight performance, taxes your body, and shortens your life.

If you find yourself suffering from either chronic fatigue or acute fatigue, ***stay on the ground*** until your alertness and energy are restored!



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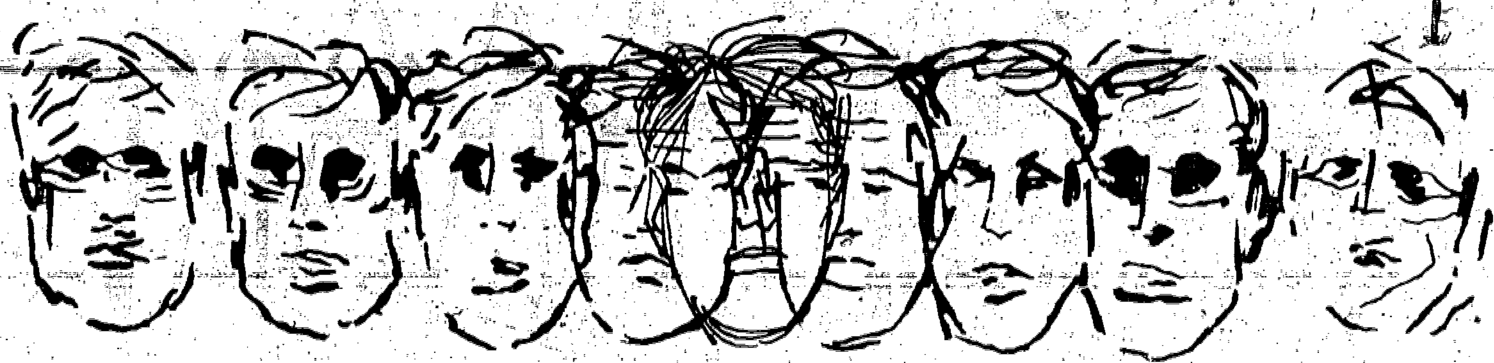
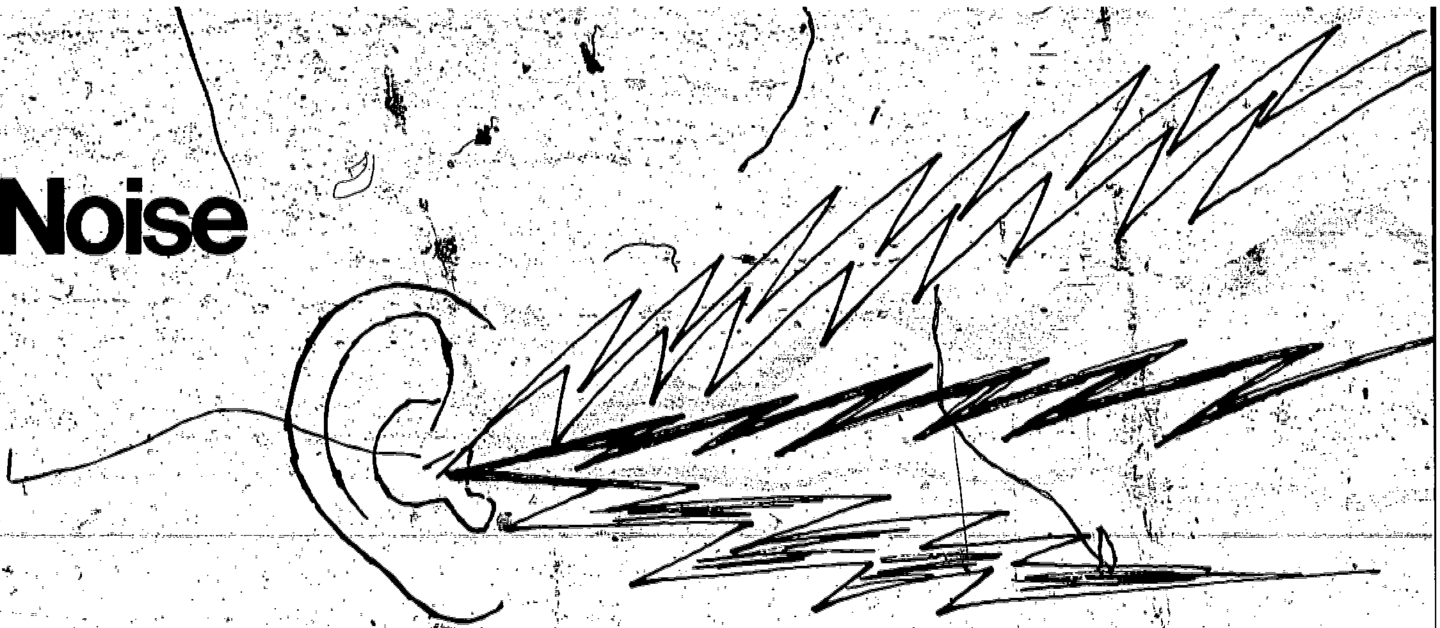


17 Noise



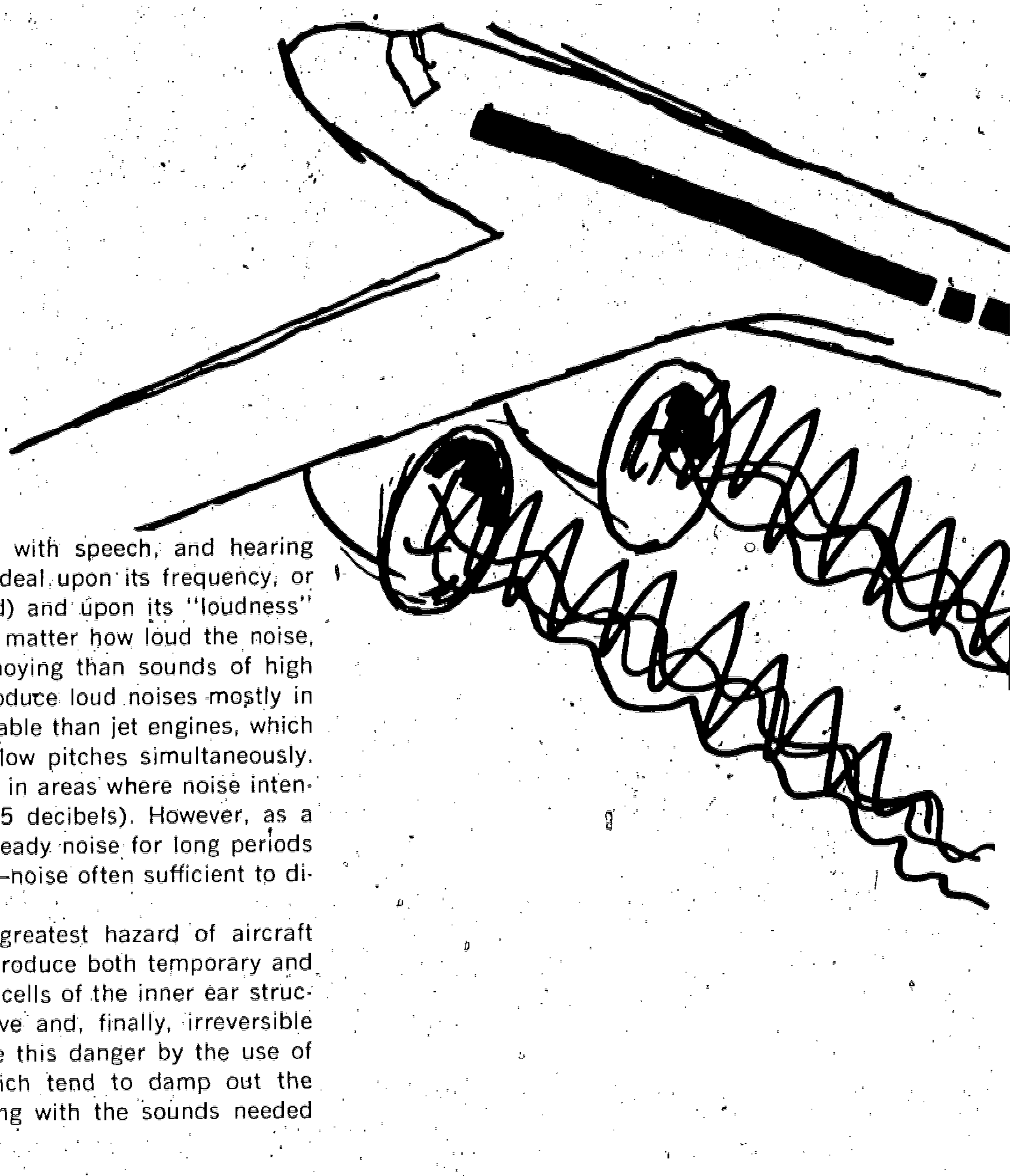
Noise has always been accepted as one of the prices to be paid for the pleasure and convenience of flying. However, if you are not armed with the knowledge of certain facts about aircraft noise, the price may be high. Your hearing may become permanently impaired.

Aeronautical engineers have attempted to cut down aircraft noise at the sources, but the loss of power remains a mechanical dilemma. Mufflers on the exhausts of jet and reciprocating engines illustrate the success of sound reduction at the sacrifice of power. Propeller blades, the second main noise source, create a tremendous sound buildup when their tips reach a speed near Mach 1. This sound buildup can be lessened only by slowing the propellers thereby reducing power.

Other noise sources also pose problems for the pilot and his passengers. In jet aircraft, airflow noise is considerable although it diminishes with altitude. In helicopters the cockpit is often poorly sealed or it is flown with doors and windows open, exposing the occupants to intense noise from the engine, rotor blades, and rotor transmission assemblies.

The main concern about noise is its long-term effect on hearing. Short-term impairment of hearing after a flight is common and usually benign. It is the gradual deterioration of hearing that you must guard against.

No set rules can be given about such hearing loss. Individuals vary widely in their response to the same noise for the same length of time. After a 6- to 8-hour cruise in a light aircraft, you are likely to experience a slight hearing loss, with full recovery within 1 to 2 hours. The much louder noise of a jet engine may cause very rapid hearing fatigue, often within a few minutes. Under these conditions, your ears may require anywhere from several hours to several days for full recovery. In some severe cases, the damage is permanent.



The annoyance, fatigue, interference with speech, and hearing losses caused by noise depend a good deal upon its frequency, or "pitch" (measured in cycles per second) and upon its "loudness" or intensity (measured in decibels). No matter how loud the noise, sounds of low pitch are much less annoying than sounds of high pitch. Reciprocating engines tend to produce loud noises mostly in the lower pitches, and so are more tolerable than jet engines, which produce sounds of high, medium, and low pitches simultaneously. Fortunately, cockpits are usually located in areas where noise intensity is tolerable during cruise (85 to 95 decibels). However, as a pilot, you are unavoidably exposed to steady noise for long periods of time and for many years of your life—noise often sufficient to diminish the acuity of your hearing.

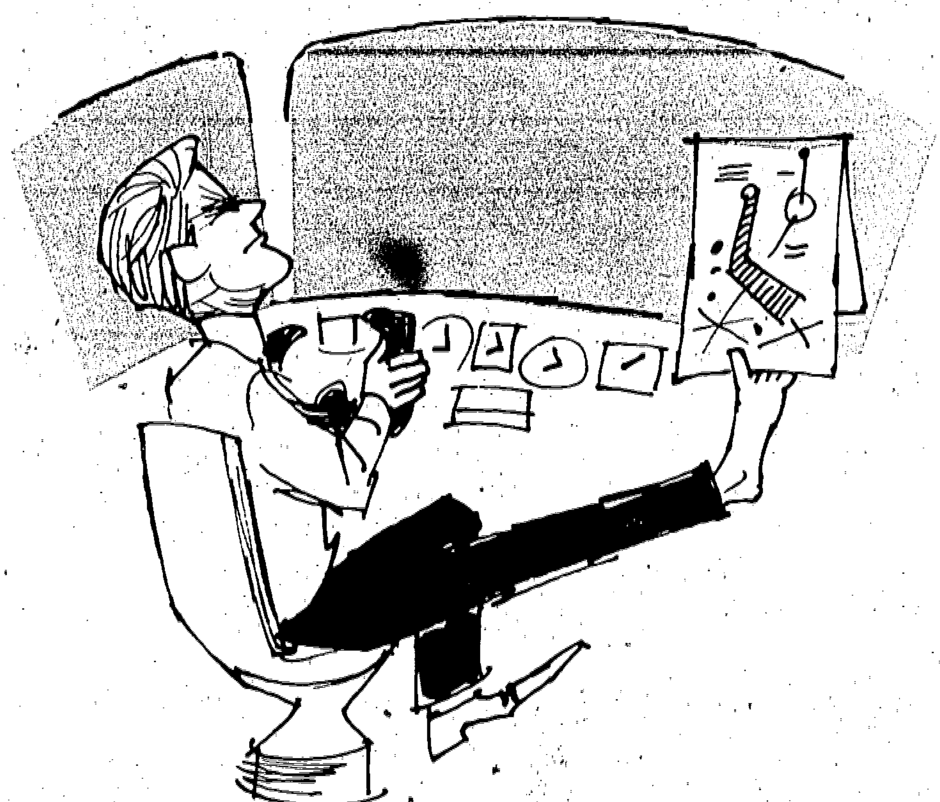
High-pitched sounds constitute the greatest hazard of aircraft noise, because they are most likely to produce both temporary and permanent damage to the fine, hair-like cells of the inner ear structures. This, in turn, leads to progressive and, finally, irreversible deafness. Fortunately, you can minimize this danger by the use of ear defenders (plugs, muffs, etc.), which tend to damp out the higher pitched sounds without interfering with the sounds needed for communications and navigation.

The first signs of permanent deterioration of hearing can be detected only by special testing with an audiometer in the frequency ranges which are above the pitch of the human voice. You may be able to hear conversation quite well and not even be aware of any hearing loss due to noise, unless you are specifically tested. Eventually, however, the permanent loss may move down into the voice frequency range unless you take steps to protect yourself against further deterioration.

With increasing age, a certain degree of "normal" deterioration in hearing can be detected by careful testing and should not be a cause for alarm. If repeated testing at intervals reveals a loss more rapid than your physician considers normal, he can advise you of suitable precautions to observe.

Some simple tips will help you guard against hearing loss:

1. Use ear defenders (such as plugs or muffs) whenever possible. Plugs will actually improve your hearing in a noisy environment with no sacrifice of acuity.
2. Protect yourself against any noise which produces pain in the ears. This signals the beginninng of damage to the delicate structures within the ear.
3. Avoid unnecessary exposure to all noise. Lower the volume on your earphones or speaker when possible, especially the tone signals of navigational aids and heavy static.



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18 Age

At what age are you considered an "undependable" pilot?

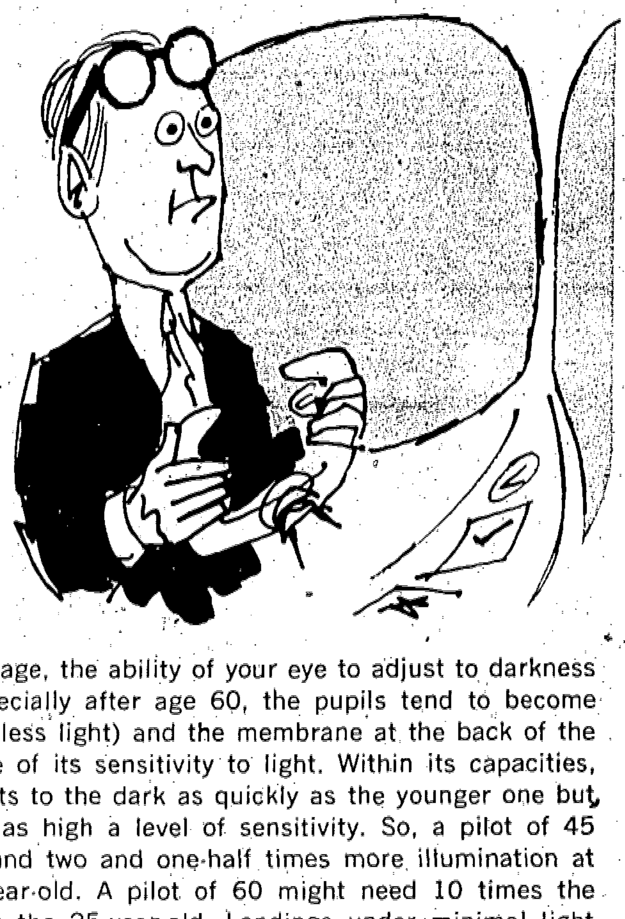
The natural process of aging is of more interest to you as a pilot than for most other groups because of the exacting demands on individual abilities and capacities. It is natural and expected—that some physical components and sensory functions will deteriorate somewhat as you grow older. The degree of deterioration varies greatly from person to person, therefore, a general rule of thumb might be based on skill and judgment levels as physical and mental changes take place through the years.

The first of these changes which becomes evident is the decreased ability to handle certain bodily stresses, especially the increased difficulty in fighting fatigue. The stresses of extensive military flying usually establish the taper-off age for combat flying to be about 45. On the other hand, airline pilots are often considered at their peak about this time because of the experience and skill gained over the years.

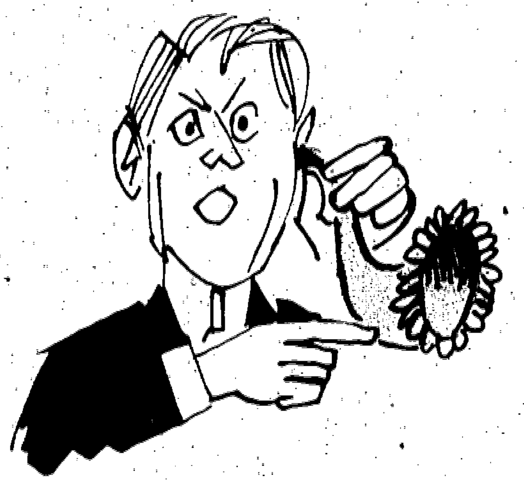
As you grow older your body has a tendency to "slow down" in reaction time, efficiency, and recovery from climatic extremes. A young individual can react more quickly and strongly to urgent situations than can his older counterpart. Manual dexterity involving muscle coordination is affected by age, but not to any predictable degree. Although quickness of response increases through childhood and youth, it gradually decreases with maturity. Older persons who do retain quickness of response continue to compete well with much younger individuals. It may be true, however, that a slower reaction time might be critical in landing procedures where a large number of actions must be carried out rapidly.

Aging also has some specific effects on the circulatory system, eyes, and ears, and the results of these effects are of great importance to the pilot. The circulatory system is fairly well monitored as a result of renewing the Airman Medical Certificate. Changes or trends toward deterioration are detectable, and performance decline or risk may be discussed with your AME.

As you approach 45, the lens of the eye may no longer be able to focus properly on near objects because of the gradual loss of its elasticity. Thus, you may find that reading instruments, charts, or radio controls may be a bit more difficult. In partial compensation for this, the eye becomes more far-sighted making it easier for the older pilot to scan the sky in search of other aircraft. Bifocal lenses, while helpful, are not always satisfactory because you have to tilt your head back to see overhead objects. If you think your vision isn't what it used to be, ask your AME to arrange an eye test. Correctable vision is no deterrent to certification.



With increasing age, the ability of your eye to adjust to darkness also declines. Especially after age 60, the pupils tend to become smaller (letting in less light) and the membrane at the back of the eyeball loses some of its sensitivity to light. Within its capacities, the older eye adapts to the dark as quickly as the younger one but it does not attain as high a level of sensitivity. So, a pilot of 45 might require around two and one-half times more illumination at night than a 25-year-old. A pilot of 60 might need 10 times the amount of light as the 25-year-old. Landings under minimal light conditions could profitably use the eyes of a younger pilot.



Hearing, a less critical factor to safe flight :han vision, also becomes less acute with age. [he impairment is most marked in the higher requency ranges, above 2,000 Hertz. Normally, the ear remains sensitive to the range of voice frequencies and to the frequencies used or Navigational Aids identification.

A pilot is as "old" as his vision, his muscuar coordination, and his skill as well as his nental adaptability to flight conditions and problems. The pilot's individual ability to perorm his duties can be the determining factor vhen weighing flying activity and age.

All-in-all, everything considered, 60 seems o be about the logical cutoff age for profesionals since most mental and physical abiliies hold up well into the late fifties. Dark adiptation of the eye decreases quite rapidly ifter reaching age 60.

In view of the progessive problems of age, the older pilot should gracefully acknowledge the ravages of time; check himself out on cockpit procedures often and faithfully; learn new material and techniques; and consult his AME if the least bit in doubt about his capabilities. **But, when physical deterioration outstrips piloting skills —it's time to quit!**


ANGER!
FRUSTRATION
WORRY
FEAR
ANXIETY

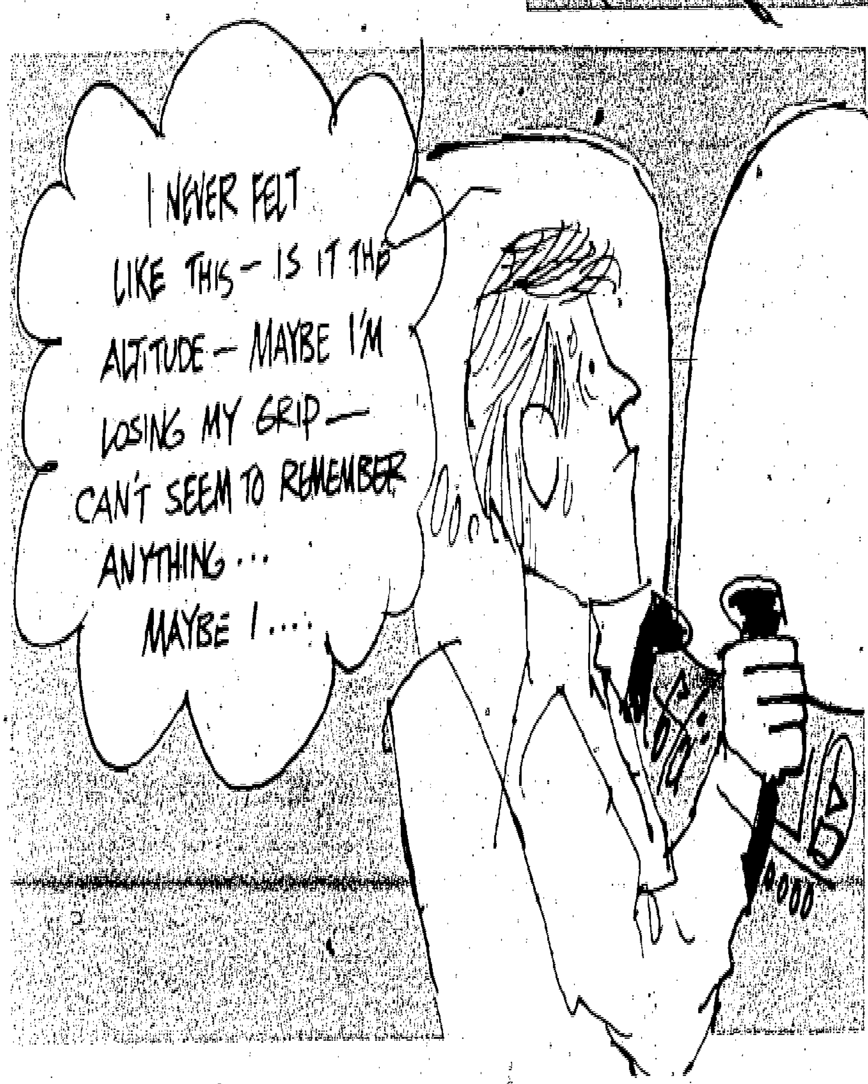
19 Some Psychological Aspects of Flying

Your attitudes and general mental state are just as important to safe flight as the condition of your aircraft. Any disturbing feelings which affect your ability to concentrate are a potential threat. These include anger, fear, frustration, depression, worry, and anxiety.

A certain amount of anxiety is inevitable in flying. In small amounts, anxiety is even desirable. It is nature's way of keeping you slightly keyed up for your task and alert to danger. But excessive anxiety, like other troubling emotions, can detract from your ability to concentrate in the cockpit—and perhaps lead to disaster.

If you bring your problems from the ground into the air, you are not only more easily distracted from the job at hand, your body becomes less able to adjust to various stresses. Memory, judgment, and presence of mind are crucial during flight and, surprisingly, muscular skills are closely linked with mental capacity. When one becomes defective, the other usually does, too. For example, if you are disturbed and preoccupied about something, you may lose some of your ability to time movements accurately, or your brain may fail to interpret what your eyes see on the instrument panel into a meaningful message. Research from the FAA's Civil Aeromedical Institute shows that emotional disturbances can even hamper the body's adjustment to altitude.

The pilot who flies just after a fight with his wife may mentally re-create their argument with such clarity during the flight that he forgets to switch fuel tanks or inadvertently moves his mixture control to idle cutoff instead of pulling the carburetor heat control.



Occasionally, a pilot who has family or job problems on his mind starts to carry his worries over into flying. In other words, he may become preoccupied with fears about flying or possible physical reactions at altitude. If this happens to you, be honest with yourself and get the professional advice of a doctor. Although anxiety of this sort is usually temporary, it can dangerously affect your flight performance and cause you further emotional problems if it is ignored.

The "compulsive flyer" has a special psychological quirk. He can't stand to turn back. He has a tendency to stretch his skills beyond safe limits, rather than change his flight plan. Whether pride or simply an inflexible personality is at fault, he is the pilot who continues ahead in marginal weather—sometimes at the cost of his life.

When you are under a strain of any sort—when you don't feel "good"—***don't fly.*** If your concerns are only of the mild, everyday sort, at least recognize that they exist. Then make an extra effort to concentrate on flight planning, to focus all your attention on aircraft operation, and to leave your other concerns behind you—***on the ground.***

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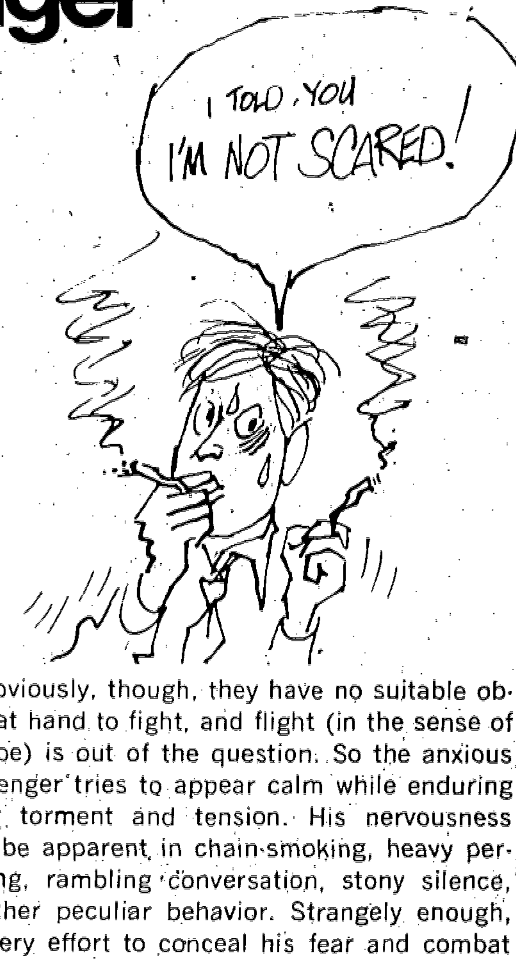
20 The Flying Passenger



Passengers come in all sizes, shapes, and temperaments. It is not uncommon for a pilot to take up a friend who is ordinarily calm and relaxed, only to find that he becomes completely unnerved and panicky during some incidental flight mishap.

All of us operate at two levels: the rational and the emotional. Our daily activities are regulated by the rational forces—logic, knowledge, experience, and goal-seeking. But under this exterior, strong emotions lie dormant—fear, anger, and love, for example. Fear, or more accurately, anxiety, is the emotion most often encountered in flying. Many passengers have some vague, weakly formulated anxiety about "what might happen up there." Then, if some minor mishap occurs, they experience a natural "fight-or-flight" response (the instinctive reaction of a human being to danger).

Obviously, though, they have no suitable object at hand to fight, and flight (in the sense of escape) is out of the question. So the anxious passenger tries to appear calm while enduring inner torment and tension. His nervousness may be apparent in chain-smoking, heavy perspiring, rambling conversation, stony silence, or other peculiar behavior. Strangely enough, his very effort to conceal his fear and combat his growing tension just leads to greater anxiety.

If you are carrying several passengers, one of them can quickly infect the others with his anxiety. And a group of panicky passengers can be a threat to safe flight. Bear in mind that others may not be as confident in the air as you, and take precautions to minimize their discomfort and worry. Keep flight maneuvers smooth and professional. Avoid sudden control movements, uncertainty in selecting your course or destination, requests for radio assistance, or any behavior which might undermine your passengers' faith in your skill and self-confidence.

All the medical problems discussed previously in this handbook apply to passengers as well as to pilots. The remedial steps suggested for you as the pilot should be the same for your passengers, and should be taken before any difficulty magnifies itself. However, a few medical situations apply soley to passengers.

Before allowing a pregnant woman to fly in your aircraft (especially if she has a history of miscarriages), have her check with her physician. The decreased pressure at altitude may be inadvisable. If a passenger has brought an infant along, the baby should either be made to cry or be given a bottle during descent to keep the eustachian tubes open.

If a passenger shows signs of airsickness during flight, encourage him to look out the window at a fixed, definite object; the horizon, faraway clouds, or a distant object on the ground is suitable. The commonly available motion sickness medications are also useful for relieving the discomfort. Persons who are bothered with nasal congestion associated with altitude may obtain effective remedies from their physician or pharmacist.

If you are transporting a sick person, keep in mind the effects of altitude on his particular condition. Those with a history of cardiovascular or pulmonary problems should be very closely observed. Bowel obstructions may become aggravated by the expansion of trapped gas. Some types of hernia may worsen for the same reason.

Your own confidence and control of the aircraft, along with an awareness of your passengers' needs, will help ensure a relaxed and safe flight for everyone.

Conclusion

The fact that an individual holds a pilot's license does not guarantee that he is a good pilot. Nor does the fact that he has managed to survive a number of years of flying. We all know pilots who have been living on borrowed time.

The good pilot is well trained, familiar with his aircraft, physically and mentally fit, and of sound judgment. Safe flight depends upon all four of these factors:

1. ***Training:*** Adequate training is the most important single element of pilotage. An unskilled pilot exposed to unfamiliar circumstances is a certain candidate for trouble. Skill-building should never stop. Each flight is a new training experience. Most accidents are a direct result of pilots who overstep their skills in a particular flight situation.
2. ***Aircraft familiarization:*** Airplanes, like people, take some getting used to. Each has its own idiosyncracies and functional differences. Any pilot, regardless of his training and experience, is courting trouble if he fails to check out and familiarize himself with the aircraft he is operating.
3. ***Physical and mental fitness:*** The good pilot must remain slightly superior physically to his friends on the ground. His brain, circulatory system, lungs, eyes, muscles, and nerves must be not only in excellent condition, they must coordinate smoothly together. In addition, the pilot must be temperamentally stable and in control of his emotions.
4. ***Judgment:*** The intangible factor, without which training, familiarization, and personal fitness are of little avail, is judgment. This is nothing more than plain ***common sense***. A pilot's judgment ultimately determines the safety of his flight because all of his decisions rest upon it—flight planning, preflight organization, alterations in course, fuel management, *ad infinitum*.

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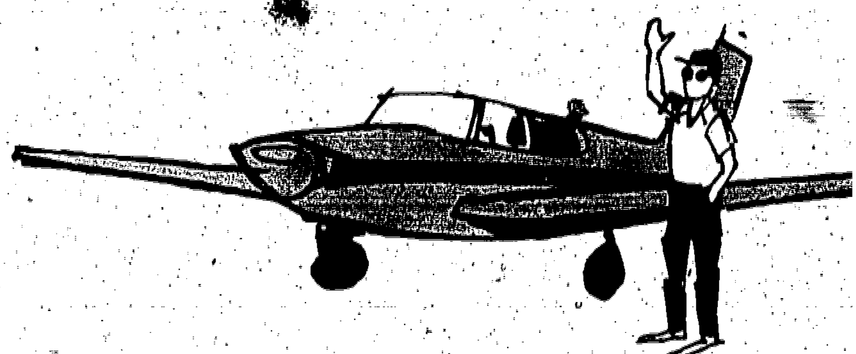
Use this check list as a guide to safe and pleasurable flying:

- ☒ Give yourself a personal "preflight" before takeoff. Are you in top physical and mental condition?
- ☒ If you suspect you have a physical ailment, see your AME or your personal physician.
- ☒ If you have been under unusual physical or mental strain, don't fly. Consult your AME or your personal physician.
- ☒ Don't fly within 8 hours (minimum) after drinking alcoholic beverages, or with a hangover.
- ☒ Practice good physical and mental hygiene. Exercise, eat properly, and try to minimize psychological stress.
- ☒ If you are over 35, realize your limitations.
- ☒ Be honest with yourself and your AME about the state of your health.

Many pilots have survived years of flying without observing these precautions. But many more have not. Visit your nearest FAA GADO sometime and ask to see their accident statistics. If they seem dry and undramatic, remember that each statistic involves the twisted wreckage of an aircraft and the body of its pilot.

Now—it's up to you!



The Physiological Training Program

The FAA's Office of Aviation Medicine coordinates and conducts a highly comprehensive physiological training program designed to advance the pilot's knowledge of aeronautics and improve general aviation flight safety.

This program is available to all interested pilots and flight crew members. Many wives accompany their husbands and find the training to be very enjoyable. The only prerequisite is a valid Airman Medical Certificate, Class III, or better. Parental or guardian consent is required for student pilots under the age of 21.

Training is presented at the Civil Aeromedical Institute in Oklahoma City, Oklahoma, and at many U.S. Air Force, U.S. Navy, and NASA installations throughout the United States. There is no charge for the program in Oklahoma City. The other facilities require an administrative fee of $5.00. The training is identical at all facilities.

Anyone wishing to participate in the program should contact the Civil Aeromedical Institute for application forms and the directory of military locations. You will be notified by return mail as to where and when to report. The applicant's preference of location and time will be considered when scheduling the instruction.

The course includes a full day of activity. Experts in the field of aviation physiology present classroom lectures on disorientation, hyperventilation, vision, hypoxia, medications, illness, stress, smoking, and other physical problems which might threaten safe flight. Indoctrination in the operation of oxygen equipment is followed by an altitude chamber flight to 29,000 feet. The chamber flight enables each trainee to actually experience the symptoms of mild hypoxia climaxed by simulated rapid decompression. The training is invaluable and every pilot, whether flying professionally or for pleasure, should take advantage of the opportunity to participate in the program.

Inquiries should be directed to:

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
AERONAUTICAL CENTER
THE CIVIL AEROMEDICAL INSTITUTE
PHYSIOLOGICAL OPERATIONS & TRAINING SECTION, AAC-143
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