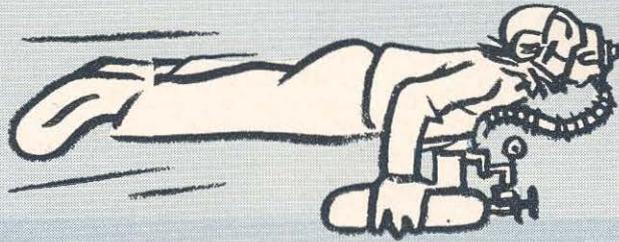


OXYGEN SENSE



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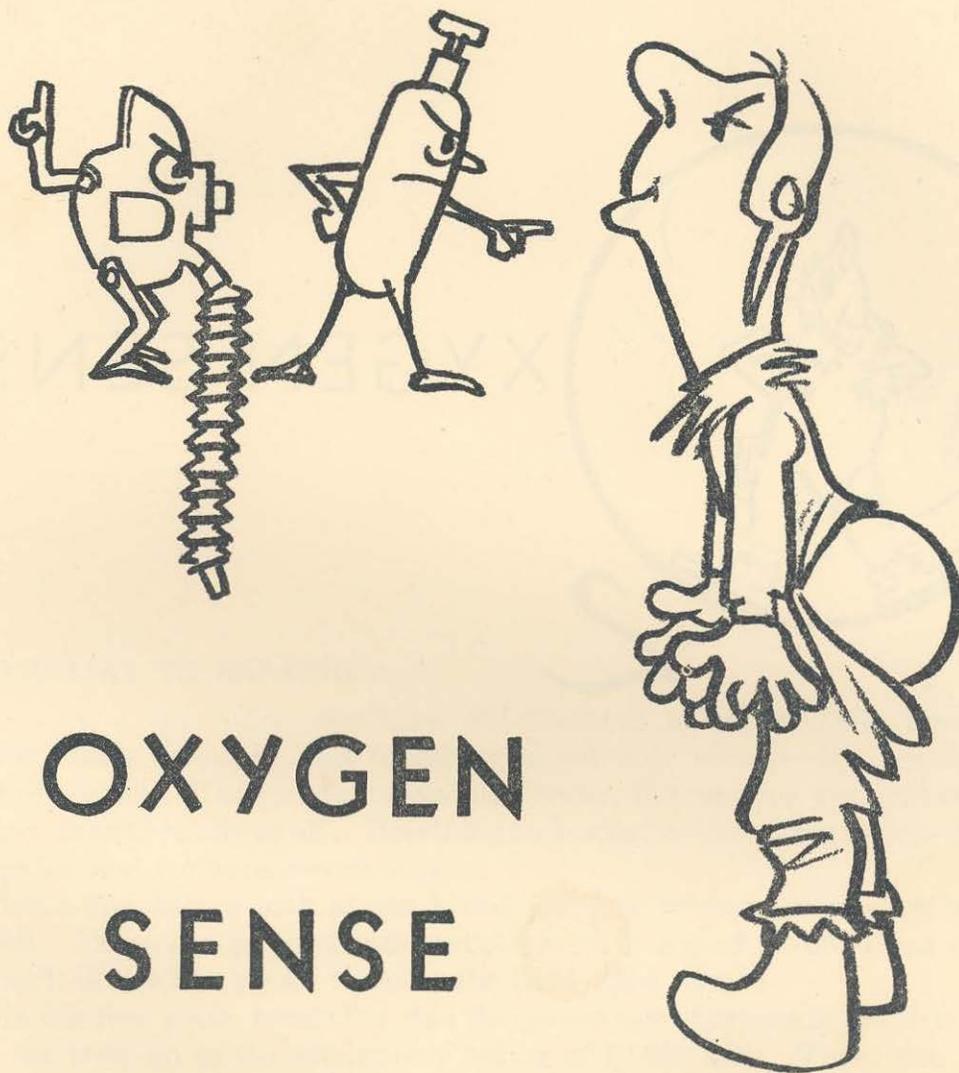
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OXYGEN SENSE

ISSUED BY

TRAINING DIVISION, BUREAU OF AERONAUTICS
UNITED STATES NAVY

1943



OXYGEN SENSE

2

TRAINING DIVISION BUREAU OF AERONAUTICS
UNITED STATES NAVY



IF YOU LIKE TO BREATHE

don't be self-conscious about it. The best medical opinion states definitely that breathing is not only normal—it's healthy. This has to be qualified, of course. Breathing water, illuminating gas, carbon monoxide, etc., is not healthy at all. Breathing air is what we're talking about—breathing *enough* air that contains *enough* oxygen.

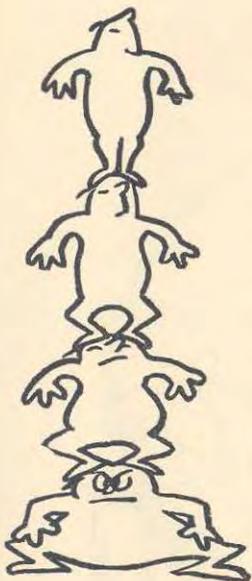
Let's first take a look at the broad principle behind the relation of air and oxygen. There are a lot of misconceptions with regard to breathing and air—and we'll do well to knock them in the head right away.

In the first place, remember that the percentage of oxygen in the air is the same from sea level up to the atmosphere ceiling of 70,000 feet. Then, you ask, why worry up to that height? Hold on to your oxygen masks, men, we're going to tell you.

Air is uniform—but air pressure is not, and that's the answer. Air is approximately 21 percent oxygen, 78 percent nitrogen, and 1 percent inert gases—at sea level or when you're chasing a Jap bomber formation at 30,000 feet. But air has weight—and air is compressible—so it's thicker near the ground. In other words, in any cubic measurement of space near the ground there is a greater quantity of

air than in the same area at high altitudes, although the *percentage* of oxygen, nitrogen, and other gases remains the same. **LESS AIR AT HIGH ALTITUDES**—that's what you want to remember. So, of course, less oxygen. *Not enough.*

To make the picture absolutely clear, imagine a huge pile of mixed straws, half of which are black and half white. The weight of the straws compresses those on the bottom more than those on the top—so a pitchfork full of straws from the bottom of the pile has many more straws in it than a fork full taken from the top—*although the proportion of black and white straws will remain the same.* Now, suppose you are going to stoke a fire with that straw and the white straws are the better and more important fuel. You'll have to add more white straws to a fork full from the top of the pile, to obtain the same amount of heat as you'd get from a fork full taken from the bottom.



That's what your oxygen apparatus does for you—it adds more oxygen to the insufficient quantity of air available to you at high altitudes. The basic problem is no more complicated than that. Your body is the fire consuming the straw—and it needs an increase in the white straws, oxygen—as soon as you fly for any length of time above 10,000 feet.

RESPECT IS A NICE QUALITY



AYE, AYE, SIR!



and you want to be sure you have plenty of it for your altimeter—a principle which you've probably already learned. So let your altimeter tell you when to turn on your oxygen supply, and don't rely on your own feelings in the matter. You can't feel the need for more oxygen as soon as it

occurs—no matter how bright a pupil you were at school—so start using your equipment when your altimeter reading says so—and don't sneer at it and say, "Go on—I'm a tough guy. I feel fine."



Sure you feel fine. So does your drunken friend when you tell him he's had too much of the old stagger soup and shouldn't drive his car. He says, "I feel fine." He doesn't feel so fine later when they pick him up off the road. And anoxia—lack of oxygen—like alcohol, gives you a false sense of exhilaration and self-confidence as one of its first symptoms. What it gives you later is a couple of cylinder heads between your vertebrae or a necklace made out of your landing gear. That's not good.



SO USE OXYGEN—

when you're going to be between 10,000 and 12,000 feet for 4 hours or longer.

when you're going to be between 12,000 and 15,000 feet for 2 hours or longer.

AT ALL TIMES WHEN YOU'RE GOING TO BE AT 15,000 FEET OR OVER—NO MATTER FOR HOW SHORT A TIME!

IN NIGHT FLYING USE YOUR OXYGEN FROM THE GROUND UP AT ALL ALTITUDES—ALL THE TIME—TO PRESERVE MAXIMUM VISION AND EFFICIENCY AND PREVENT NIGHT BLINDNESS.

FURTHERMORE—

Turn that oxygen on at the *beginning* of the above-stated periods, not at the end. In other words, when you get to 10,000 feet start using it—*don't* wait until you've been there 4 hours. Ditto from 12,000 to 15,000. Over 15,000 you'll be using oxygen constantly anyway, unless you think this was written just to keep a printer working, and not for your information.

However, if you originally meant to be at 10,000 feet, let us say, for only a half hour or so, and conditions suddenly change so you know you're in for a much longer period—don't worry about the time you've lost. The use of your equipment will restore your complete efficiency in a very short time—a matter of minutes. (The same holds true all along the line of course.)

BUT—don't be sloppy and rely on this. Remember, over 10,000 feet, all the time spent *without* using your oxygen equipment keeps making you less and less efficient and more and more a sucker for any Nazi or Jap fighter who jumps you.

CHECK AND DOUBLE CHECK



your oxygen hose connection. Make sure it's connected—but also **MAKE SURE IT'S LOCKED**. It may look fine, but you may be flying a

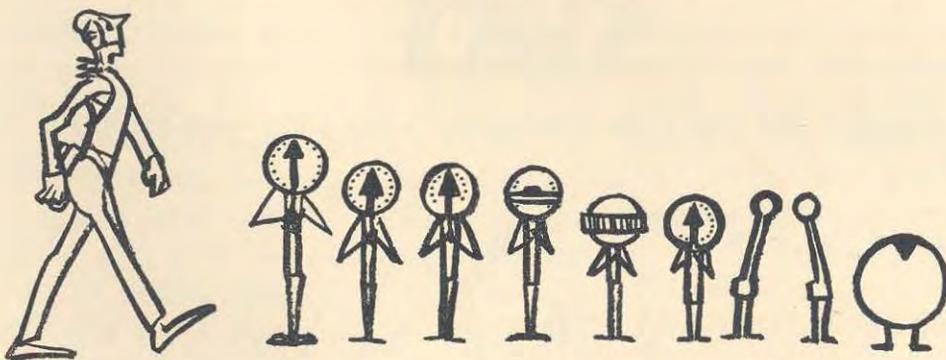


one hoss shay and the vibration of your plane can shake it loose, without your being aware of it. Remember—the first symptoms of anoxia are not apparent to you, and by the time you feel the lack seriously and fumble around with blurred vision and drunken hands trying to reconnect your hose—it's going to be too late.



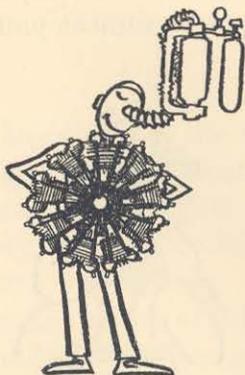
You won't make it. You won't make a three-point landing, either. And you won't make the ripe old age of 64 and retire for age.

You wouldn't think of taking off without checking your fuel and pressure gauges. You're careful to see that you have enough fuel—and that it's getting



into your cylinders under sufficient pressure. So make equally sure you have an adequate oxygen supply, and that the pressure gauge on the tank is working correctly. You're going to *look* ready for business with your mask snugly on your face—but you're not going to be ready for much of anything if there is insufficient oxygen, no oxygen, or if it isn't getting to you correctly.

Your body mechanism is not unlike your engine—it must have fuel, and it has to be fed smoothly and continuously. Gauges aren't put in planes for you to use



as mirrors to keep your hair parted. Use them only as such and you'll stumble on a quick time saver: the Japs'll part your hair for you, and you can give up carrying



a pocket comb. But read them intelligently—and often—and you'll give the Nip the slip.

YOU CAN'T TAKE IT



at high altitudes without adequate and properly functioning oxygen equipment. Nobody's going to think you're a sissy or overcautious if you get

that mask on at the very earliest moment it's necessary. If anybody does think so—you're probably going to outlive him. Just don't forget that you have to be in the best physical shape possible for high altitude flying—and that even your best isn't good enough without this added help. That's all there is to it. Believe it—and act accordingly.

IF YOU DON'T ACT ACCORDINGLY you're going to be in several kinds of trouble. First we'll tell you as graphically as we can about the troubles that come from lack of oxygen alone. Then we'll take up what happens to you if you haven't been living right in other directions.



BETWEEN 10,000 AND 12,000 FEET—after the safety point without using your oxygen equipment is passed—you get a headache and your reflexes and processes are dulled. You don't think very clearly, you don't see your dials very clearly. The beautiful coordination between your mind and your hands and feet on the controls begins to break down. You're a little clumsy and inefficient—*although you may not be aware of it.* This condition gets more aggravated and more severe as you stay there too long or move on up.

AT 15,000 FEET you get in the giggly, giddy stage of drunkenness—you react like a silly girl in a juke joint. Your heart pounds, your lips and fingernail



roots are blue, your eyes blur—but you probably feel great and hilarious. You're a killer—you're a hot shot. Unfortunately you won't be a killer of Japs or Nazis in this condition—but you're a setup to do a swell job on yourself or your crew. Not that that will bother you at the moment—any more than it bothered your gurgling friend who insisted on driving his car (part way) home.

WE'RE AT 20,000 FEET—and brother, you're really a mess now. Your vision is thick and dark—the little you can see is blurred and foggy and makes no



sense. You can barely hear your engine—your breathing is a struggle, your pulse is racing. **BUT DON'T THINK THIS IS GOING TO WARN YOU TO SHOVE THAT STICK FORWARD AND DIVE OUT OF DANGER.** Because your judgment and perception of what's wrong are about as sharp and intelligent as those of a 5-year-old idiot. You don't know there's anything wrong—and if you have a faint idea something is not strictly on the level—you don't care very much. You want to sleep, if you want anything. Sleep—feels—so—fine. Good night, brother.

AT 25,000 FEET this is the story: You collapse and will probably die in half an hour. If you're a fighter pilot and spin out of control while unconscious, it *is* barely possible for you to recover consciousness and pull out. But emphasize the word "barely" in that sentence—not the word "possible"—and don't place any bets.

SO YOU SEE

the effects of anoxia are very definite. The data on them has been carefully gathered by the best scientific minds in aviation, both here and abroad. The

RAF boys could tell you plenty about their early days high over London; they were fighting Nazi bombers and fighters thoroughly trained in and equipped for high-altitude flying—and the RAF boys weren't. A lot of our information today has come from the interviews which Medical Officers had with pilots, tests they made, things they discovered. Our own Naval Flight Surgeons have done plenty of work, too—in action and in training, and they know what it's all about. Here are a few related facts

FOR YOUR INFORMATION:

1. The cells of the brain and nervous system are generally affected by lack of oxygen before any symptoms appear—so that while you may *think* you are functioning 100 percent you may not be.
2. Results of not following instructions: (a) You begin losing efficiency at 10,000 feet; (b) Your mental functions are impaired above 15,000 feet; (c) You are likely to faint over 20,000 feet; (d) You will definitely pass out over 25,000.
3. YOU HAVE ABSOLUTELY NOTHING TO FEAR IN HIGH ALTITUDES IF YOU FOLLOW INSTRUCTIONS COMPLETELY AND INTELLIGENTLY. HUNDREDS OF PILOTS ARE UP THERE EVERY DAY
4. Careful experiment and research has proven conclusively that there are no harmful effects from the use of oxygen at high altitudes.

DON'T WORRY ABOUT THE DANGERS OF HIGH-ALTITUDE FLYING IF YOU'VE OBEYED THE RULES. 'FOREWARNED IS FOREARMED'. YOU'RE FOREWARNED—YOUR GUNS ARE LOADED WITH AMMUNITION MARKED "PRECAUTION." ALL YOU HAVE TO DO IS FIRE THEM!

"I'D LIKE SOME BEER,

some of those frankfurters, boiled cabbage, and—*kerchoo!*—
some of those fine baked beans."



That's one thing you don't ever want to hear yourself saying to a waitress if you're due for a high-altitude trip in the next day or so. Or—"Let's have just one more drink before we turn in."

Because why?

Because—

1. Let's take the beer and the "one more drink." They're bad on two counts. First of all it's cold up there. It's about 55 below zero at 30,000 feet, and remains at 55 all the way to 70,000. You wear special cold weather flying clothes, shoes, etc.—but besides that your physical condition has a lot to do with your ability to resist those subzero temperatures. Alcohol breaks down your resistance to cold, even though it may make you feel warmer, and you'll be a lot more subject to frostbite, chills, numbness and so on if YOU'VE BEEN DRINKING the night before than if you haven't.



Alcohol, of course, has a lot of other effects which don't help you under conditions such as you face in high altitude flying: your vision is not as keen; your heart and breathing are accelerated (and remember you're on oxygen!); your pores are opened due to raised skin temperature; and your whole general body adjustment is depreciated.

Alcohol lowers your "service ceiling" anywhere from 3,000 to 6,000 feet. *War is no time for that.*

2. Now the frankfurters, cabbage, and beans. These are all foods which create gas in the digestive tract, intestines, and stomach. (The gas in the carbonated highball and beer are just as harmful.)

Why avoid excess gases in the abdomen and intestines?

A fair question—here's the answer.

AIR EXPANDS AT HIGH ALTITUDES. AIR IS A GAS. THE SAME PRINCIPLES THAT APPLY TO AIR EXPANSION APPLY TO GAS EXPANSION. SO GAS EXPANDS AT HIGH ALTITUDES, WHETHER IT'S IN YOUR BODY OR A BALLOON.



At 35,000 feet, for instance, any gas in your stomach or intestines occupies about five times as much space as it does at sea level. Obviously the wise thing to do is to avoid anything in the way of food or drink that tends to increase the natural gases already present. There is nothing very dangerous in this gas expansion—unless carried to absurd excess—except severe abdominal cramps and extreme discomfort. These can be relieved by emitting the gas in either direction.

But—you asked the last question—now answer this one: wouldn't you consider acute physical discomfort and pain a real danger when you're trying to outmaneuver a Messerschmitt or Zero, or pick off a couple of them with your gun? Wouldn't you consider it dangerous to try solving a tricky navigation problem if you were doubled over with cramps?

OKAY. WATCH YOUR DIET AND AVOID ALL OF THAT.

3. You got rid of a fairly impolite *kerchoo!* while you were giving your order. Besides being bad manners, it's bad preparation for high altitude flying—this cold of yours.

FOR MAXIMUM EFFICIENCY AND MAXIMUM SAFETY,
YOU MUST BREATHE NORMALLY. ANYTHING THAT
DISRUPTS NORMAL BREATHING WORKS AGAINST
BOTH.

Obviously, a cold interferes with normal breathing. Also, it clogs your sinuses and ear passages, which in high altitude flying must be kept free of any obstructions.

You won't find much difficulty with these passages during ascent—it's when you're on the way down that the trouble starts. And, you may find yourself headed *straight* down!

During descent air pressure outside your body increases—which means that pressure on your eardrums and sinuses becomes greater. This pressure increase



works faster than the *interior* pressure can change to equalize it. So to keep your ears clear your instructions are to yawn, swallow frequently, or blow your nose with your nostrils pinched together as pressure builds up during the descent. Keep doing it. If your passages are free you'll undoubtedly have no trouble, as the air you are forcing through them by these methods will equalize the outside pressure. But—if your passages are clogged, due to a cold,—*you will not be able* to force this equalization, and ruptured eardrums or sinus infections may result.

One other thing you can do, if yawning and swallowing is not giving you adequate relief during descent, is to stop that descent for a couple of minutes, climb one or two thousand feet, and then come on back down. This should work although the Jap will probably get away.

So when you find yourself going *kerchoo* at a pretty waitress, do two things: First, apologize, because you're in the Navy and supposed to be well-mannered; second, report to the Flight Surgeon as soon as possible. He'll advise you with



regard to measures you can take to relieve your condition if you *must* fly before your cold can be completely cured. (The waitress can wait!)

And this is a good place to correct another popular error. Hyperventilation—forced breathing—is never the answer to lack of oxygen, or lack of air. Whether you're at 5,000 feet or 35,000—**BREATHE NORMALLY**. Don't knock yourself out trying to breathe *more deeply* than normal or *faster* than normal and think you're making up for any deficiency in your breathing apparatus or the atmosphere. If you don't think it's harmful, stand up in your room tonight, and take nothing but deep, exaggerated breaths for a few minutes. If you keep at it here's what you'll get: first, a light-headed feeling; second, a peculiar sensation of faintness and dizziness; third, a characteristic feeling of numbness and tingling of your hands and feet.

Keep it up and you'll get the actual symptoms of collapse. Keep it up longer, if you can, and you *will* collapse.



So all the time you're flying—but particularly at high altitudes and when you're on oxygen—keep those inhales and exhales at a regular, normal beat.

WITH MEN WHO KNOW TOBACCO BEST



it's a matter of simple record that *excessive* use of it is bad in relation to high altitude flying. This is only natural, of course, in the

light of the considerations we've covered thus far. Tobacco fouls up the breathing tubes, tends to aggravate any minor bronchial, nasal or laryngal irritations, and thus would make breathing itself more difficult.

It dries out the nose and throat.

It increases the pulse rate.

It interferes with the function of digestive juices.

It prevents proper oxygen absorption by carbon monoxide poisoning in small doses, if inhaled (which it nearly always is).

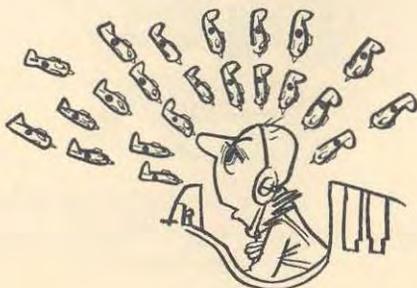
All this tends to increase nervous instability and tire the mental processes.

THIS DOES NOT MEAN YOU HAVE TO GIVE UP SMOKING. IT REFERS TO *EXCESS* ONLY. IF YOU CAN'T DETERMINE FOR YOURSELF HOW MUCH SMOKING CONSTITUTES EXCESS—CHECK WITH THE FLIGHT SURGEON.

NOW ABOUT THAT ASPIRIN—

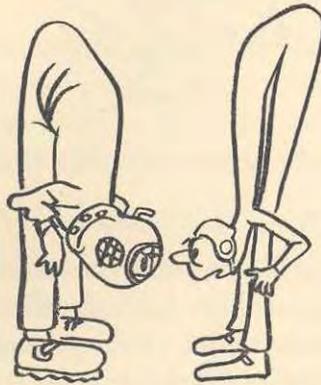
or any similar product containing acetanilide, phenacetin, or other coal-tar derivatives. Skip them. Skip *any* coal-tar product—and if you're not sure whether any medicine you take *is* a coal-tar product, or is satisfactory, again check with the Flight Surgeon. Coal-tar derivatives cause a condition of the blood that prevents oxygen from being readily absorbed—and over a period of time makes you extremely susceptible to the insufficient oxygen of high altitudes.

While you're crossing medicines off your list—draw that line through all the sulpha-group you've read so much about—sulphanilamide, sulphathiazol, sulphapyridine, and the rest. While their action on the skin and mucous membranes has been observed, the main manner in which they are harmful to you as a high altitude flyer is that they impair mental functions—sometimes developing hallucinations.



In all cases, however, remember you're a layman, and your fellow flyers are also laymen. Don't rely on your own judgment or theirs when it comes to medical problems. You have easy access to highly trained medical flight personnel. Don't be shy—consult them on all these matters that involve medicines and drugs. Your grandmother may have used home remedies and lived to a fine old age—but remember she lived on a farm and was miles from a doctor. If you walk slowly you may be as much as 5 minutes from a Flight Surgeon. He was trained to answer your questions, consult with you, prescribe for you. So consult him and **FOLLOW HIS INSTRUCTIONS!**

DIVERS HAVE NO PRIORITY ON "THE BENDS"—



you can get all you want—but you don't want any. In aviation medicine the bends are called "aero-embolism"—and are defined as the disability arising from bubble formation in the blood stream, caused by reduction of barometric pressure.

The highly technical processes that result in aero-embolism shouldn't matter very much to you. Suffice it to say that in your blood are nitrogen, carbon dioxide, water vapor and oxygen—with nitrogen amounting to about four times the total of the other three. When barometric pressure is greatly or quickly reduced (which occurs in climbing to high altitudes) this nitrogen forms gas bubbles which are liberated into the blood stream just as opening a bottle of carbonated water charges it with escaping gas.

This causes pain and discomfort—particularly in joints and muscles, although occasionally there is a feeling of oppression in the middle chest. There also may occur an itching of the skin. Brother, did you ever wear the old-fashioned woolies?

If you start to itch under layers of heavy flying clothing—how are you going to scratch? And, how are you going to stay in formation, outfight an enemy, sight a gun, or plot a course? Do we have to say more? The pain you get in your muscles and joints is enough in itself to keep you from moving freely or doing your particular job—but throw in that itching and you really have something!



These symptoms often make themselves felt at 28,000 to 30,000 feet,

UNLESS

you turn on that oxygen supply from the take-off and keep it on all the way up. Remember, it's *rapid* ascension to high altitude with insufficient oxygen that can give you the bends. So—don't make rapid ascents to high altitudes without sufficient oxygen—which in this case means pure oxygen from your equipment. Breathing oxygen washes out nitrogen from the blood and tissues, and decreases the likelihood of "bends."

AND IN CONCLUSION—

remember this very important point: the foregoing is a definitive outline of the various things that can and almost surely will happen if you ignore the basic needs of your body with relation to oxygen. They *will not occur* if you follow outlined procedures, and you can make your take-offs with no feeling of uncertainty whatsoever.

One of the most important assets that you can have with you in your plane is AN UNTRoubLED MIND. You haven't time to worry or be apprehensive. You haven't time to sit there wondering if you're going to feel badly or be unable to perform any one of the number of split-second tasks that come up in operational flying.

THE WAY TO AVOID WORRY—the way to make sure of being alert, feeling your best, and 100 percent capable of functioning no matter what you're called on to do, is to follow instructions. You don't have to be a monk in your



living. You don't have to concentrate all the time on whether or not you're getting enough oxygen. If you're faced with sudden emergencies—caught off guard—do what you'd normally do—react to the best of your ability, your intelligence, and your sense of self-preservation. You'll come out all right.

You've Been Trained by the United States Navy

You know the value of discipline and teamwork. You *must* realize that if you function below 100 percent for any of the reasons given in this booklet, you're not the only one who suffers. For instance—

If you're a member of the crew of a big boat, the lives of the other members depend on your ability, just as your life depends on theirs.

If you're alone, the lives of other members of your squadron or formation still depend on you—and you depend on them.

If you're one of nine planes sent out to do a job—and you can't do your part—eight planes are trying to make up for your deficiency while fulfilling their own missions. That's serious.

If you weren't fully prepared to do your part—you shouldn't have come along. All might very easily fail because an enemy fighter got through you—just as you've seen happen a hundred times in football games. Expand that—and realize that an air mission failure might mean a surface mission failure to fleet units, to Marine landing parties, or to troops. Your carrier might be sunk—because of your carelessness.

YOUR RESPONSIBILITY IS SO GREAT that you must not fail to take advantage of every piece of mechanism given you!



As a *pilot*—in command—you must be able to think and plan clearly and fly your plane as well as you possibly can.

If you're a *gunner*, your vision, timing, and physical coordination must be as perfect as you have trained them to be.

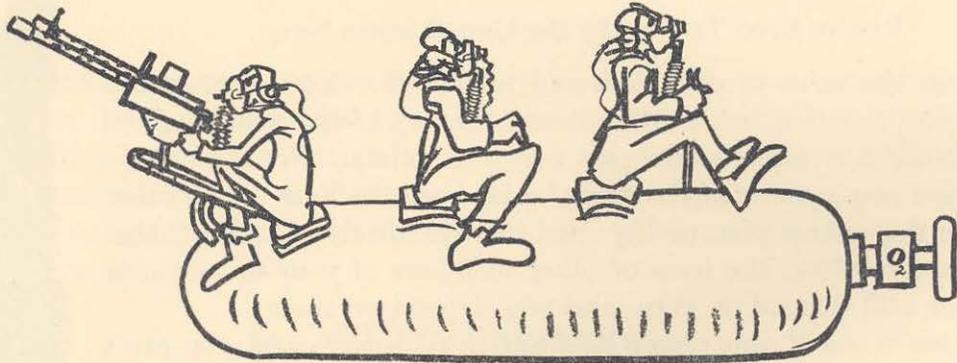
As a *radio man* you must be able to hear faint signals as well as clear ones.

As a *navigator or bombardier* you have to be clear-headed and cool to handle the mathematical problems which are part of your job.

The boys are depending on you—the squadron is depending on you—the Fleet is depending on you—the Nation is depending on you.

In high altitude flying, YOU depend on OXYGEN.

IT'S THERE. USE IT!



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