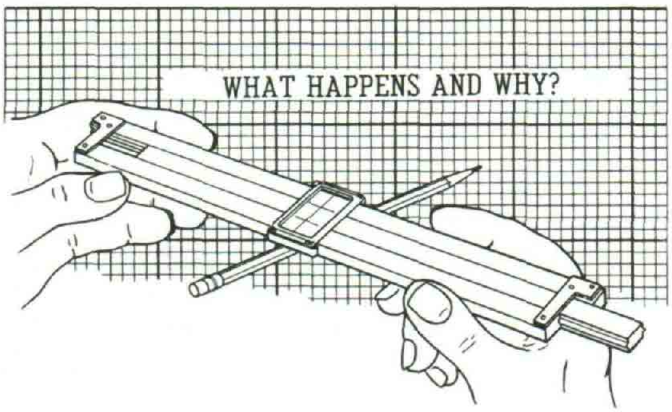

Can Air Carry Moisture?

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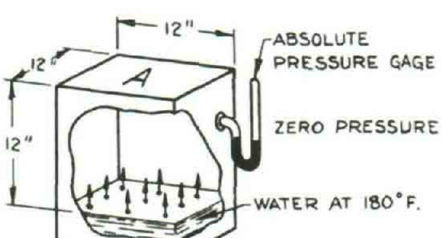
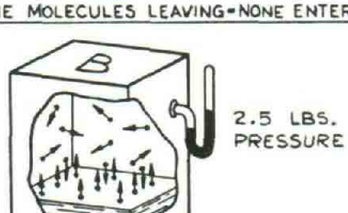
(Art work by Joseph M. Deady, EAA 3820)

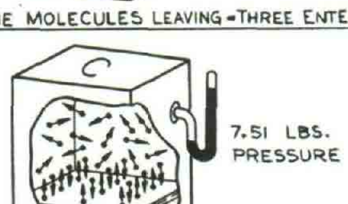
CAN AIR carry moisture? It seems like a foolish question. Is it not a matter of common everyday observance that air carries moisture? Does not the "sweat" on the outside of an intake manifold or a pitcher of ice water come from the moisture carried by the air?



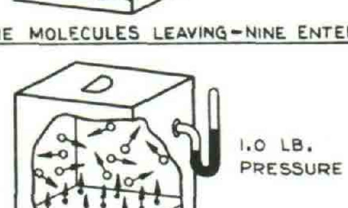
NINE MOLECULES LEAVING-NONE ENTERING



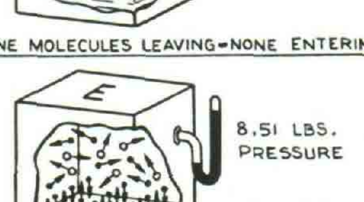
NINE MOLECULES LEAVING-THREE ENTERING



NINE MOLECULES LEAVING-NINE ENTERING



NINE MOLECULES LEAVING-NONE ENTERING



NINE MOLECULES LEAVING-NINE ENTERING

In spite of all the apparent evidence to the contrary, it is doubtful whether air can carry moisture, using the word "carry" in its precise meaning. We know that air is commonly found mixed with water vapor, just as in a crowd of people blondes are mixed with brunettes. But no one would say that the blondes carried the brunettes or vice versa.

This distinction may seem rather fine and of about as much practical importance as the arguments designed to prove that the tree goes around the squirrel when the squirrel goes around the tree. Yet, as a matter of fact, a clear understanding of this point is of practical importance in a study of carburetor icing. The commonly held notion that air soaks up moisture as a sponge soaks up water has led to many false conclusions in such practical matters as the drying of moist products and the condensation of moisture from exhaust gas. Consideration of a few demonstrable facts will show that the sponge analogy, like the sponge itself, is full of holes.

It is an observed fact that at a given temperature a given space will hold a definite weight of water vapor regardless of the amount of air present. For example, at a temperature of 75 deg. Fahrenheit, 1 cu. ft. of volume can hold 0.00128 lbs. of water vapor regardless of the weight of air present. If a little water is poured on the bottom of a container of 1 cu. ft. capacity from which all air has been removed, and if the temperature of the water and container is maintained at 75 deg., just 0.00128 lbs. of water will evaporate. If the space contained air at high or low pressure, there would be no change in the weight of the water evaporated.

How can the air be said to act as a sponge when it makes not the slightest difference how much air is present? Certainly, a big sponge will hold more water than a small one or no sponge at all. The figure 0.00128 was taken directly from the steam tables and is merely the weight of 1 cu. ft. of saturated water vapor at 75 deg.

We speak of air saturated with water vapor . . . what we mean is air mixed with saturated water vapor . . . that is all. Now why does it make no difference how much air is present? If the air does not really "soak up" moisture, why does it not do the reverse and cut down the amount of moisture by taking up good space? It must first be remembered that gases and vapors are mostly holes. They "inhabit" space as men inhabit houses, but they do not really fill the space in which they are confined.

To illustrate the principle that the weight of vapor a given space can contain depends only on the temperature and is not affected by the presence or absence of air, the diagrammatic sketches A, B and C picture the process of saturating a space with water vapor. The water and container, in the case shown, are maintained at 180 deg., and the 1 cu. ft. space is assumed to be a complete vacuum at the start.

Now, molecules of water or any other substance are always in motion. The higher the temperature, the more rapid the motion. In the liquid state the molecules are so close together that they have considerable attraction for one another. Yet, some approach the surface of the liquid with sufficient velocity to break loose as free molecules of vapor which continue to bounce around in the container like balls on a billiard table. The number breaking loose per square foot of liquid surface per second will depend only on the temperature. The higher the temperature, the more will break loose.

Take an infinitesimal unit of time so small that nine molecules break loose per square foot in each such unit as shown in A. At the start, all are leaving, none returning. Gradual-

(Continued on bottom of next page)

Winter has descended upon EAA Headquarters and has made progress of our building program a bit more difficult. However, by not establishing a firm completion date we have found it easier for all concerned . . . including the expenditure of funds.

True, it would be of little problem obtaining a sizable mortgage to rush things to completion, however since 1953 we have always been able to pay cash for the items purchased and maintain a suitable treasury for operation. Using this philosophy and buying a little time we will remain on solid ground and with the financial assistance of our members, friends of EAA and income from publication sales, etc., we will succeed.

"FLYING" Looks At EAA

"O wad some power the giftie gie us,
To see oursel's as others see us!"
—Robert Burns

THE WAND wished for in vain by the imminent writer of days gone by, Robert Burns, that would give a true insight to ourselves has been graphically given to the Experimental Aircraft Association by Dick Bach, editor of the "Antiquer", and James Gilbert, associate editor of "Flying", as they present views of the EAA and the Rockford "Rumble."

"Mavericks of sport aviation", "Mad men" that probably are not so "mad" are described in 12 pages of the January issue of "Flying" magazine.

Quoting Paul Poberezny, Editor Bach says: "We are a last frontier in the freedom of expression. We offer a way to something self-created with which we can ascend into the ocean of air above us."

The challenge of building and restoring is pointed out in the "Maverick" story and practically every builder of an airplane can see himself in this description of sport aviation. Concluding his article, Bach says:

"Biplanes in pastures; homebuilts in garages; a reaction sooner or later, somewhere or other. That's sport aviation today. Little old outcast sport aviation."

Jim Gilbert tries to tell the story of sport flying using the backdrop of the Rockford convention of EAA. He describes EAA as follows:

"Paul Poberezny, Paul, Lieutenant Colonel Poberezny, fifteen thousand hours, holder of seven military ratings, seems a pleasant enough, down-to-earth enough, sane enough fellow when you meet him. You would never guess the guy is mad.

"And yet he is, he must be. For he offers his followers a crazy dream, the sort of dream that you and I used to have when we were children — the dream that we could somehow sprout wings from our shoulders and fly, float about in the air over the countryside. Not just Supermen, not just engineering geniuses, not just wealthy playboys, but anybody, you or even I, we can sit down and build a real airplane, he suggests, and then go and fly in it . . . "

Get your copy of January '66 "Flying" . . . see yourself as others do!

Can Air Carry Moisture? . . .

(Continued from preceding page)

ly, the space above the water fills up with vapor molecules.

At the moment pictured in B, nine are leaving per time-unit, but three are returning, giving a net evaporation of six molecules.

Finally, enough water molecules are present above the liquid to keep nine plunging back into the water for every nine that leave, as shown in C. In other words, a state has been reached where condensation exactly equals evaporation, so that apparent or net evaporation ceases. Everything is now in balance and the vapor is said to be saturated. For a given water temperature, this will occur when the vapor contains a definite number of molecules per cubic foot. This means a definite weight per cubic foot (vapor density). With definite weight and definite temperature (hence definite velocity), the pounding of the molecules on the walls of the container must also produce a definite pressure, called the vapor pressure. For a given temperature of 180 deg., the vapor density will be 0.01994 lbs. per cu. ft. and the vapor pressure will be 7.51 lbs. (absolute) per sq. in.

That the presence of air has no effect on either vapor density or vapor pressure is shown at D and E. Suppose that 0.00422 lbs. of air per cu. ft. is present at the start. It will produce a pressure of 1 lb. per sq. in. The air molecules will continually strike the water, but can neither enter the water themselves, nor affect the water molecules leaving or entering. So, 9 water molecules will leave each unit of time, and the amount of vapor will increase until there are 0.01994 lbs. of vapor per cu. ft. which will be sufficient to return nine molecules to the water in each unit of time. This amount of vapor will produce a pressure of 7.51 lbs. per sq. in., which will be automatically added to that due to the air, so that the gauge will read $7.51 + 1 = 8.51$ lbs. per sq. in. Vapor and gas pressures always add up in this way.

(EDITOR'S NOTE: Reprinted from Tulsa, Okla. Chapter 10 newsletter).