RESEARCH INFORMATION NEEDED FROM SOARING PILOTS

Despite all the research that has gone into cloud physics and cloud seeding, one fundamental problem remains unsolved: *How is natural rain produced?* For a few special cases the problem may already be solved, and it is probable that some combination of existing theories may actually give the solution in the rest of the cases. But people concerned with weather modification are continually hampered by the lack of fundamental knowledge of the precipitation process.

Sailplane pilots, during their ordinary flying, are in a unique position to supply some answers for this problem. The upcurrent which carries a sailplane up into a towering cumulus cloud is the "busiest part" of the cloud which squeezes rain out of the air. The sailplane pilot can note quantitatively how the upcurrent strength increases with altitude, how large the core diameter seems to be, how much turbulence there is at various altitudes, where icing begins and ends, what sort of particles are encountered (fog size particles, freezing rain, soft hail and rain mixed, light hail, etc.), and any other items of interest such as electrical phenomena.

The greatest interest is in the region from the freezing level up for about 5,000′. On some record flights in full scale thunderstorms pilots have reached extreme altitudes, but this is not a recommended type of flying. If you get into a large fully developed cumulonimbus lightning or hail can damage the sailplane structure, and worst of all you may be carried uncontrollably beyond oxygen altitude limits (some thunderstorms reach 70,000 feet). For an experienced pilot, towering clouds contacted during the growing stage are exciting, fun, and safe to fly in; the upcurrent strength often exceeds 2,000 feet per minute. Valuable information can be obtained even from clouds not reaching the freezing level, if they are over 5,000 feet thick. Knowledge about the presence or absence of droplets a millimeter or more in diameter in such clouds is needed.

At present there are no research funds available to sponsor these research flights. However, in various countries around the world such glider flights are being made for sport and in contests. It is hoped that after making such a flight the pilot would write some notes about it and send the information to me:

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I learned a great deal about the precipitation process during my two thunderstorm flights at the International contest in France. I was unhappy to realize several days after the flights were over that I did not remember the exact sequence of events while inside the storms. I should have written the notes immediately after landing. If someone had had the time, he could have gotten the thunderstorm story from at least a dozen pilots each thunderstorm day; as it is, the data are now lost.

Two principal mechanisms are considered responsible for precipitation from towering cumulus and thunderstorm clouds:

1.) Some tiny liquid fog droplets which form on particularly good condensation nuclei grow larger than their neighbors, begin falling through and collecting the smaller fog droplets, and eventually get large enough to constitute rain.

2.) Assume a supercooled (below 0°C) fog cloud exists with the droplets still being liquid while below freezing temperatures, and an ice crystal (or freezing nucleus) is introduced. The ice crystal grows rapidly at the expense of the moisture in the fog particles, gets large enough to start falling and collecting fog particles, and grows by coalescense to form graupel (snow pellets), or even small hail, and then melts into a raindrop at warmer temperatures. The beautiful large symmetrical snowflakes of winter storms presumably occur in less dense clouds wherein the crystal growth has time to continue without the coalescence growth becoming important.

The actual mechanism for precipitation in a given case can be a combination of the above two, or some modification of one of them. The technique of particle growth depends on the time available for growth, the rate at which moisture is being supplied, and the condensation and freezing nuclei.

Most cloud seeding is concerned with the ice crystal effect; silver iodide nuclei (acting like tiny ice particles but offering advantages of easy

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Meteorology Research, Inc., is a small (10 person) company performing work in fields involving meteorology and aeronautics. Its primary interest is in doing fundamental research on cloud seeding, to see what really can or cannot be done in this vital field; it does no commercial cloud seeding. Results of all its research are available to anyone. These cloud physics — cloud seeding research projects are continuing on an expanded scale.

The company has completed projects on atmospheric turbulence and a study of contrails. A new contrail program is now being initiated.

The company has accented equipment development and occasionally sells equipment developed during its research project.

The company owns a Cessna 195 five-place airplane, and is acquiring a radar set for weather studies.

Dr. Paul B. MacCready, Jr. spends half time as president of the company; the other half time he acts as Research Associate to the Munitalp Foundation. Director of Research for the company is Dr. Theodore Smith.

It is of interest to note that much of the development of this company is due to the research aspects of gliding. For the turbulence measurements and some of the cloud seeding research, flights were actually made in sailplanes since they offered certain advantages over power planes. The study of upcurrents for glider utilization was what gave Dr. MacCready the background and stimulus to get into research on cloud seeding (most rain is a result of the upcurrents of interest to the glider pilot).