winds occur almost continuously and universally in the atmosphere, it is only logical to assume the bird is fitted to use these rather than depend entirely upon the very uncertain thermals and declivities.

Soaring will never be possible without the expenditure of power. In soaring, our only source of power is moving air. Regardless of the efficiency of a soaring machine, it cannot remain aloft in still air. The pinion drag reduction would allow soaring in thermals and declivities, but the bird would still possess a definite sinking velocity in still air due to parasite drag and extraction inefficiencies. Hence in static soaring the bird should not show too much efficiency over a high AR sailplane, and such is true[1]. If the bird could use the kinetic energy of the more prevalent horizontal winds for thrust power, dynamic soaring would be attained and the bird could fly level or even climb, remaining airborne indefinitely (as it now does).

Attempts to explain dynamic soaring by use of the pinion mechanism while still incomplete, have shown promise. No attempt will be made to discuss this work here but a few results will be stated. The energy which is expended by a wing due to induced drag is completely wasted as it eventually ends up as heat. Furthermore, there is no law which says induced drag is necessary for lift, even for a finite wing. Now if, for a given amount of available energy for flight, induced drag could be eliminated or reduced, a two-fold gain would occur. We would not only have less drag to balance with thrust, but would have the power thus saved available for use on other drags. If the pinion mechanism could conceivably extract energy from the wind, while at the same time reduce the induced drag, it would be possible to maintain level flight while flying into a wind. The essential element necessary is that the induced drag force experienced by the wing be reduced as the pinions extract power from the vortex air. This would furnish the necessary power for overcoming parasite and residual drags. Analysis of the problem proves extremely complicated, involving the absolute velocities of wind and wing, relative air speed, thrust and drag force components, energy interchanges, lift, and the pinion extraction efficiency. Results indicate that for a bird with a given slot opening a critical air speed exists to which the bird tends to adjust by regulating its own absolute velocity, for a given wind strength. There should then be wind velocities above and below which the bird could not move forward relative to the earth or not remain in level flight. This means that if the wing is placed in an air stream whose velocity lies within a critical range, the wing should actually accelerate forward into the wind until a certain equilibrium air speed attains where power available from the air equals power required for level flight. Of course, if the extraction efficiency is not great enough to create a net thrust then there will be no forward motion as a positive drag will exist. In any case, any degree of extraction will decrease the overall drag and result in a lower sinking velocity.

Much more detailed experimental and theoretical work will be required before the possibility of dynamic soaring by pinion action can be validated, but results to date are promising. It may prove that the true mechanism used by the bird is quite different, as a number of other possibilities exist.

As previously stated, the above are only suggestions. But they serve to illustrate the need for experimental consideration of natural flight. History has given little encouragement for accomplishing dynamic soaring by use of specialized wind waves. Thus we must direct our efforts to attain dynamic effects on ideas along aerodynamic lines as well as on flight techniques and atmosphere phenomena. The accomplishment of dynamic soaring, by any means, will revolutionize motorless flight and open a whole new world to the soaring movement. Even attainment of large drag reductions might ultimately lead to flight by human power.

Carefully designed and directed experiments performed on the existing problem areas will yield the answers to the mystery of birdflight. If we wish to approach perfection in soaring flight, we must learn from the masters and begin serving our "apprenticeship to the birds."

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INTERESTING GLIDERS

by PETER M. BOWERS

Figure this one out, you aircraft recognition experts! What US military glider ever looked like this? The answer is—none.

The glider illustrated is the result of combining a standard German primary glider that had been improved by installation of a pod, typical Yankee "Tinkeritis," spare time on the hands of US occupation forces in Germany, and a target drone powerplant.

The glider is the well-known German SG-38 primary, many of which were fitted with a streamlined plywood pod to enclose the pilot and improve the performance. Since primaries could by no means be con-

sidered as tactical military aircraft, it might seem unusual to see one in camouflage war paint, but such measures were a necessity in Germany during the latter part of World War II, when allied aircraft were able to cover the whole country.

The US national insignia on the pod does not indicate that the glider had been taken over officially by the USAF. For a while, quite a few "liberated" German aircraft were flown for purposes of amusement by the occupying forces before the practice was stopped, and the use of insignia was mainly to identify the occupants when the ship was flying and to distinguish it from the German types that were to be destroyed when on the ground.

As shown here, the SG-38 was converted to a powered glider by bolting a Drone engine to the top of the py-

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