HELICOPTERS ARE QUEER CRAFT
—But New Zealand Might Find Uses for Them

WHEN the ships of the Byrd Antarctic Expedition were in port recently, the people of Wellington saw helicopters for the first time. Naturally there was a lot of interest aroused by them, and the mere spectator, in addition to the people who were taken for flights by the expedition pilots began to think of how these machines might be useful to New Zealand. Demonstrations were given for a number of people connected with aviation in New Zealand, on the technical and administrative sides, and these people saw how the helicopter can come in and land, under quite windy conditions, on a piece of deck that is smaller than the area swept by its rotors; how the pilot, when he wants to run up his motor before a flight, commonly lets the machine rise about nine inches from the ground (or deck) and then perhaps moves a few feet to one side, turns the machine round a bit, and settles again, to take his passenger on board. They also saw the helicopters flying at varying speeds, from hovering, up to about 110 miles an hour.

I was one of the people who took a pretty keen interest in helicopters straight away, and began to think of how we could use them in New Zealand. And I came to the conclusion that under certain conditions they could be invaluable. But the first thing we have to do is get rid of the idea that they are miracle-workers, and that we only have to buy a few and then go ahead doing all sorts of remarkable things with them—rescuing mountaineers and sailors, carrying supplies to deerstalkers, dusting crops, servicing lighthouses, and so on.

A U.S. COASTGUARD helicopter hovering, preparatory to landing on the deck of the icebreaker, North Wind, at Wellington recently

Maintenance is a Drawback

The helicopter is a very remarkable thing already, as I'll explain in a moment when I describe how it works. But you must remember that the last edition of the Oxford Dictionary calls it a "Flying-machine that should rise vertically by airscrews revolving horizontally." (Note the *should*). That definition was framed in the 'thirties. This is 1947, but the helicopter is still very expensive to operate. It needs about two hours of maintenance work for every five hours of flying (an ordinary plane needs one hour's maintenance for 25 hours' flying). And its payload is low; an ordinary plane is four times as efficient in terms of payload per unit of engine horsepower.

Its purchase and maintenance could not be justified for any single one of the uses I have named above. But if we could have a helicopter in each island on call for those various duties, in no time they would pay for themselves —perhaps in lives as well as in savings of time or money.

The Byrd Expedition had two helicopters here. The one fitted with rubber pontoons was the smaller. It has a 180 h.p. radial motor mounted ordinarily, driving the vertical rotor shaft through a right-angle gear. The rotor's total diameter is 38 feet. The pontoons carry air at a pound and a-half to the square inch—you could inflate them with your lungs. The rotor's tip speed remains constant at 250 miles per hour. The craft has a maximum speed of 60 m.p.h. and an average cruising speed of 40 m.p.h.

The larger machine, fitted with wheels, has a 450 h.p. radial motor mounted flat, driving the rotor through planetary reduction gears. The rotor's diameter is 46 feet. Its maximum speed is 110 m.p.h., and average cruising speed 80 m.p.h. Its payload (including the pilot) is 570lb., and the view from the cockpit extends through 180 degrees vertically, and a good deal more horizontally. Both machines have lateral airscrews at the tail to counteract the tendency of the fuselage to spin round, against the rotors. Their pitch (and hence the force they exert) is controlled by the pilot's rudder pedals.

An ordinary plane with the same payload (570lb.) would need only 200 h.p. instead of 450 h.p., and it would do about 130 m.p.h. instead of 80 m.p.h. That makes it about four times as efficient. In addition, maintenance on a helicopter, as I've said, is needed in the ratio of two hours' work for every five hours' flying. But this is no worse than the demands of the ordinary type of plane were when it was at the same stage of development. A great deal of the greasing and inspection work is needed now because the helicopter is in its early stages. We can reasonably expect developments in design that will improve the ratio.

Mechanical Stresses

But in the meantime the mechanism that supports and controls the rotor is highly complicated, and subject to so many stresses that it needs this constant attention. The blades alone have to be replaced completely after 500 hours' flying. And when you realise how many different movements go on at the hub, you realise why so much care is needed.

The blades are hinged so that they can actually fold right up above the hub. Only centrifugal force keeps them spread when the helicopter is in flight. So they are going round, and they are also free to fold upwards. In addition, their pitch has to be variable. When the machine is flying forwards, say at 100 m.p.h., the tip speed of the blades on one side will be 250 plus that forward speed of 100 m.p.h. But on the other side, where the blades are flying backwards, the tip speed through the air will be 250 *minus* 100 m.p.h. Therefore the lift would be much greater on the "fast" side than on the other, unless there was an automatic device to alter the pitch of every blade twice in every rotation. When you flick a card through the air so that it spins as it goes, you find that it turns over, because it strikes the air much faster on one side than it does on the other. So in order to prevent this happening to the helicopter, it's necessary to have a device that constantly feathers the blade, making the pitch less on the fast side and greater on the slow side.

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But that's not the end of the story: the same device has to be made subject to the pilot's control, so that he can increase the pitch of the blades on any chosen sector of the arc—that is how he tips the plane to change its direction. And finally, he has to be able to increase or diminish the pitch of all the blades together, to give more lift or less. All this is done by a mechanism (fixed above the hub) whose name is its best description—it's called a "spider."

It doesn't require much imagination to realise that there's going to be a high degree of fatigue in a mechanism that has all those stresses—plus one I haven't mentioned—the torsional vibration set up by the intermittent thrusts from each cylinder of the motor.

The spar of each blade is a steel tube tapering by steps—like a steel golf club. And its diameter at the boss is 2in. It has short projecting arms near the boss, to which the spider's "legs" are fixed.

Pilots Must be Fit

Neither is metal fatigue the only kind of fatigue involved in flying a helicopter. Pilot fatigue is so great that an exceptionally fit man, used to the job, is done in after five hours' flying in a day. A normal aeroplane is inherently stable. It rights itself, as long as there is room. But a helicopter is inherently unstable. The pilot must be in full control all the time—and by that I mean from second to second. If he wants to wave to a girl friend on the ground he can only spare one hand for a very short flap at the window. He has to have both feet on his rudder controls, one hand on the stick, and the other hand on the combined elevating lever and throttle. The throttle is made so that ordinary vibration shakes it shut—so he can't relax his control at all.

The helicopter's equivalent of a stall —and what the pilot has to avoid— occurs if its speed falls below a certain critical point, and at the same time there is not enough power in the engine

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