Letters

"Electric" Airliners

I would like to correct a number of points in reaction to M. Mitchell Waldrop's article "Flying the electric skies" (News & Comment, 30 June, p. 1532).

- Pilots are at all times firmly in control of the Airbus A320. The many computers in the aircraft, including those in the "fly-by-wire" system, are there to relay pilot commands and to make their task easier, not to replace the flight crew.
- Airbus Industrie has equipped the Airbus A320 with flight controls driven by computers primarily to enhance safety. Savings in weight and maintenance are but a useful bonus. Our competitor's claim that we use "technology for technology's sake" is nothing less than "sour grapes," since its own aircraft, designed in the 1960s, is too old to enjoy the benefits of today's technology.
- The Airbus A320 is the most advanced airliner in the world—bar none. In addition to being the first civil aircraft with full digital fly-by-wire controls, the Airbus A320 is also the first to permit centralized maintenance. The concept of automatic diagnosis and corrective action of relatively minor equipment faults has been a part of the Airbus A310 and the A300-A600s since the early 1980s. Its introduction on McDonnell Douglas' MD-11 thus comes as no surprise. Many of our competitors' tomorrows are our yesterdays.
- All large, modern airliners—including the Airbus A320—have hydraulically powered flying controls. The hydraulics provide the "muscle" and, in conventional aircraft such as the Boeing 747, are signalled by mechanical cables. In the Airbus A320, they are replaced by electrical wires and a bank of computers. The A320's fly-by-wire computers provide a valuable safeguard against stalling, overspeeding, and overstressing the aircraft—all maneuvers that airline pilots are trained to avoid. These safeguards are based on experience gained with civil aircraft such as the *fully* fly-by-wire, 20-year-old Concorde and a partial use of fly-by-wire in the Airbus A310 and the A300-A600—rather than on military types of aircraft.
- All Airbus aircraft, since the very first entered service in 1974, feature protection against windshear. Again, Airbus Industrie led the way, and today the A320 offers greater protection against windshear than *any* other civil aircraft.
- All aircraft make extensive use of computers—in their navigation aids, systems and even their conventional flying controls. An aircraft's ability to fly a given route depends on the number and importance of serviceable computers—a minimum equipment list spells out exactly how many failures are tolerable, and only if this is exceeded is the aircraft unable to fly.
- All large airliners, including the A320, are designed to withstand a maneuver load of plus 2.5 G maximum. Pilots who, in emergency situations, have had to maneuver their aircraft suddenly, have often *assumed* that they had flown it close to its structural limits, when in fact they were still well within them. In the A320, the built-in flight envelope protection made possible by fly-by-wire enables the pilot to fly the aircraft right up to the design limits swiftly and confidently, *knowing* that he will not exceed them.
- There is no equivocation about the outcome of the independent investigation by the French authorities into the crash of an A320 in France in 1988: the aircraft, its engines, and its systems performed correctly. Indeed, an expert commissioned by the authorities notes that the sophistication of the fly-by-wire system, which prevented the aircraft from stalling and therefore crashing out of control, probably helped save the lives of 133 of the 136 passengers on board. Incidentally, the aircraft was being flown as low as 30 feet (9 meters) and not the 50 feet (15 meters) that is quoted.
- In short, the Airbus A320 represents a carefully thought out and extensively tested step forward in airliner technology and safety enhancement. The hundreds of pilots who have flown the Airbus A320, the 2 million or so passengers who have now experienced its comfort, the world's certification authorities, and the 25 customers that have bought more than 500 of the aircraft seem to agree.

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It is right to question the potential safety of highly computerized airliners coming on the scene. When it comes to blithe spirits, the aeronautical engineering fraternity is light years ahead of any character out of a Noel Coward play. Their comfortable insouciance, especially when contemplating potential catastrophic failures, is the most bemusing.

Cockpit computers have eliminated the flight engineer and with him a critical set of

eyes, considered essential when a plane is in congested terminal areas. This loss is made all the more acute because these same computers need reprogramming whenever the preset flight plan is changed for any reason, which in turn calls for the pilot who is not flying to have his head "in the cockpit" punching numbers into the black box. The pilot in control will already have his head in the cockpit flying his instruments, so that more often than not no one is looking out of the cockpit window searching for conflicting traffic.

More insidious, however, is the prospect of a fallible piece of software controlling a critical flight path of the aircraft and which the pilot is barred from correcting. And I would rather not think about the demented introduction of a virus into all of this.

In my own continuing experience of more than four decades of professional flying, I have yet to flick on a light switch at home or an autopilot in airliner in which sooner or later those pesky electrons did not misbehave. So the manufacturer's insistence that the fly-by-wire controls on the Airbus A320 "makes it impossible" to create an error will bring nothing but cynical chuckles from even the neophyte pilot.

Their statisticians invariably get into the argument at this point and insist that these potential glitches only happen once in a trillion times, but they fail to add that there is no mathematical guarantee it will happen on the trillionth rather than the first time. But I can assure them it will probably happen on my flight, when I least need or expect it.

This sort of sophistication should be left to the single-seat fighter, where it appropriately belongs and where the pilot can bail out in a hurry when the inevitable occurs—a privilege neither I nor my passengers enjoy.

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Animal Experimentation

For more than a century, as so deftly illustrated by the recent attack on my work by Charles S. Nicoll and Sharon M. Russell of the University of California, Berkeley Department of Physiology (Letters, 26 May, p. 903), physiologists have been using the antivivisection movement as a "straw man." Historian Gerald Geison has shown that many physicians expressed skepticism about the value of animal experimentation as a therapeutically effective method of discovery during the 19th and early 20th centuries (as many do today) (*1*). In that inhospitable environment, laboratory physiologists were able to survive as a profession by mounting the most successful propaganda campaign in medical annals: They convinced much of the medical community, the public, and the media that the dramatic advances in 20th century therapeutics were a result of animal research.

It is therefore particularly ironic that the physiologists accuse me of concocting "written distortions of medical history." My work demonstrates that the real threat to animal researchers was never the antivivisection movement, but physician-scientists who do not agree with the provivisection propaganda. The list of elite physicians who have decried the exaggerated claims of bench scientists reads like a Who's Who of outstanding physician-scientists of the 20th century. In 1919, no less a clinical investigator than Archibald Garrod, who himself discovered the one gene–one enzyme hypothesis by brilliant clinical deduction, warned against "a tendency to ascribe almost all advances of medicine to the workers in pathological laboratories [animal experimenters and microscopists] and to represent the members of the clinical branch as merely applying in practice knowledge which has been gained in the laboratories" (*2*). In 1952, the epidemiologist who finally overturned the dogma that cancer is a purely genetic disease, wrote, "The overestimation of animal experiments is so rampant that the issue is of general interest" (*3*). In 1967, the physician who ushered in the New Immunology by interpretation of incisive natural experiments on the human body, disputed physiologist Julius Comroe's contention that heart transplantation was pioneered by laboratory physiologists (*4*). In 1979, Paul Beeson, the doyen of American internal medicine, wrote that "progress by the study of man is by no means unusual, in fact, it is more nearly the rule" (*5*).

The statements of such eminent authorities constitute a prima facie case that the historical importance of animal experimentation has been grossly exaggerated by physiologists.

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