THE BONANZA MYSTIQUE

Ahead of its time in 1947, it is still the airplane that many dream of owning.

BY EDWARD G. TRIPP

The Bonanza (and I mean the *Bonanza*—or Model 35, or V-tail, or butterfly) has represented the ultimate single-engine aircraft to most of three generations of pilots.

During its development, it generated so much excitement that 1,500 aircraft were on order when production began in 1947. Even back then, it was not a plain vanilla airplane. It certainly looked different, and it could cruise at 152 knots at 10,000 feet. Standard equipment included a two-way radio, automatic direction finder and marker beacon receiver, and it was all lit up for night flight. It was a *lot* of airplane for 1947. And—sigh—the list price was $7,975 initially and then $8,945.

The Bonanza is entering its thirty-fourth production year, and it is *still* a lot of airplane. It has developed and changed, from the original straight model 35 to the current V35B, right along with the development of general aviation. Horsepower is up by 125, empty weight is up 623 pounds and gross 850; yet it has kept its good characteristics where other developing aircraft have traded handling qualities, for instance, for useful load.

It is still an object of desire, and for some it is a cult object. The American Bonanza Society is more than 7,000 strong and has its own newsletter (with a lot of useful information for enthusiastic Bonanza owners) packed with advertisements for accessories and modifications.

There are so many modifications and update kits for older Bonanza models, in fact, that it is an almost infinitely renewable aircraft. Some early Bonanzas have been modified so highly that they are indistinguishable from late models to all but the annointed.

For those who can afford the price of admission, the Bonanza remains a very efficient airplane, even if it is not the most flexible and productive one in the market. And it still stands out on the ramp.

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With 16 basic models, plus six variations on the V35, there is a lot of history to write about the Bonanza. The Bonanza spawned the T-34, the Travelair and the Barons, the Debonair (dubbed Bonanza in 1968) and the stretched Debonair, the Model 36. And what about the fact that this luxury airplane has been produced in quantities approaching 10,400? The temptation is strong.

The Bonanza qualifies as a classic airplane; but it is also a current production airplane, having broken the Model 18's record for longest production last year.

Major development has not occurred since the V35B was introduced in 1970 at a base price of $39,250. Detail improvements have been made, and increasing utility has been added with such accessories as standby generators, electrically deicing propellers and radar.

How many objects conceived in 1944—or even 1964, for that matter—look modern or up-to-date today? Furniture, cigarette lighters, automobiles and buildings, to suggest a few, date themselves. Both as an object and as an airplane, the Bonanza is holding its own quite

PHOTOGRAPHY BY ART DAVIS

nicely. If you approached the Bonanza as though it were a new offering in the current market, you would find quite a few appealing characteristics that also made a good deal of sense operationally.

For instance, the airplane sits on the ramp with its nose up in the air, looking somewhat haughty. The nose gear is mounted well forward, which helps to distribute the load more evenly among the gear and makes ground maneuvering less of a trial on the pilot's legs. The nose-high attitude also provides an extra bit of propeller clearance: a good advantage on rough fields and gravel.

The gear and gear doors look rugged, and they are. They are the same as the gear on the Barons, which have to handle another ton at gross. The 154-knot-indicated gear-extension speed comes in handy for speed reduction, high rates of descent and stability in turbulence. The strong gear and fairly wide geometry make aceing takeoffs and landings easier and also make the aircraft capable of handling rougher fields than most insurance companies will permit you to use.

The Bonanza appears smooth and efficient sitting still. The skins are heavy, and while the wings are smooth, with flush riveting and good skin joints, there is a lot of structure to be seen. The strobes and navigation lights are inside of the wingtips. The only objects to mar the smooth impression are antennas, handles and steps.

Engine access is so simple that not making a thorough preflight is inexcusable. Both sides of the cowl open with the release of two levers, exposing all but the bowels of the engine compartment. The rest of the exterior makes preflight simple, also. There are few nooks, crannies and fasteners at which to look. The control surfaces are hinged internally.

Standard fuel-tank capacity now is 80 gallons (74 usable) with single filler points in each wing. The neck of the filler has a tab for more precise control of partial fueling: There are marks for quantities of 32 and 27 gallons usable in each tank. This is important, if you plan to use maximum payload. The Bonanza is very weight sensitive, particularly in terms of center of gravity, and requires a great deal more calculation and planning than other light aircraft.

There are three fuel drains, one for each fuel sump and one for the system low-point/fuel-selector valve.

Cabin access is standard for low-wing airplanes, although the door opens well into the overhead; so once you are on the wing, the rest of the operation is relatively graceful.

More and more Bonanzas are being fitted with the large baggage door (it is part of all the basic option packages) a desirable option both for loading cargo and for loading little children or small people in the aft area.

At various times the Bonanza has been offered as a six-seat airplane. The center of gravity envelope is quite narrow, however, and it should not be considered a six-, five- (there is now an optional fifth seat) or even a four- (with a heavy load of options) seat aircraft.

There have been a number of accidents that were the end result of loss of control because of overloading or improper loading. There is a heavier responsibility for the pilot to perform takeoff and landing weight-and-balance computations in the Bonanza than in many other

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aircraft, because of the rather narrow envelope and because the CG moves aft as fuel is burned. (The fuel tanks are located ahead of the main spar.)

The aft CG limit moves forward with weight, too. For instance, the aft limit is 85.7 inches at 3,000 pounds, but 84.4 at 3,400 pounds.

The aircraft used by the staff for this article, N6735V, is a 1980 model with 213 pounds of optional equipment. With full fuel, the payload is 638 pounds: three adults, a lightweight and some baggage. If these are not arranged in the cabin carefully, it is possible to be out of aft CG. Beyond the limit, it's every man for himself; and it is one realm of flight and control-response evaluation where I do not care to be the test pilot. Too many of them don't come back.

It is easy to be misled by the vision one gets from the cabin. It is pretty big, there is a lot of window area to make it seem even larger, and the baggage area, particularly without a seat back there, looks like a moving van. Be sure to study the section of the operating manual captioned "Weight and Balance/Equipment List," and be sure to do the math. The book is well organized, and there are lots of helpful hints.

The passengers are well accommodated. The seats are generous, there are quite a few touches to add to comfort

and the view is expansive. Each seat has an inertial reel shoulder harness. Do not buy a Bonanza without a couple of options, though: "Super Soundproofing" (because it is as noisy as any light airplane) and reclining-seat adjusters. There is a new ventilator blower for the 1981 models that might make a more practical addition than the air conditioning, which cost $5,730 in 1980 and takes away 70 pounds of useful load. It also means that one of the oxygen systems cannot be installed.

That should take care of the passengers. The best seat in the house is reserved for the pilot. That is, so long as he is not too tall. The sales pitch for 1981 includes raves about a new interior that increases headroom. The headroom already is fine, thank you. I would trade some of it for another two or three inches of seat travel.

It is not that a tall pilot really is jammed (and the rudder pedals are adjustable); but after two or three hours, it would be good to stretch a bit. The seats are chair height, which helps.

Visibility is excellent over the nose and to the sides. The windows are high, so even side visibility in turns requires little movement.

The panel arrangement is good, with a couple of exceptions. Flight instruments are shock mounted. Engine instruments are in the center stack, avionics in a canted stack to the left, and there is room for a few odds and ends to the extreme right, over the glove box. Subpanels contain autopilot and nav heads below the flight instruments with electrics below them. Engine controls are in the center, below their respective instruments, with all the circuit breakers to the right. All 1981 Bonanzas will have pull-type circuit breakers, instead of the reset-only kind. The switches and controls are all solid and positive in operation.

The hefty yoke is bolted to an even heftier control column that is mounted in the center of the panel—the famous throwover yoke. If I were buying a Bonanza, I would want the standard, single, control. However, the Federal Aviation Administration no longer will accept the single control for instruction or testing operations.

The dual-yoke arrangement intrudes too much into the right-seat space. Even worse, it blocks the pilot's view of a lot of switches and dials and knobs on the lower panels, most especially the gear switch and gear-indicator lights, which are mounted in a nonstandard position to the right of the control yoke.

We debated the merits and the demerits of the arrangement: The merits including that a pilot consciously had to look for the switch and lights and was more likely to avoid inadvertent gear retraction; the demerits being that distracted pilots would fumble around and do something wrong. The National Transportation Safety Board has been after Beech for the nonstandard placement of gear and flap controls, issuing a report (NTSB-SR-80-1) last June that concluded that the gear-up accidents in Bonanzas and Barons were all out of proportion to their population.

In the period between 1975 and 1978, Bonanzas, which comprise 30 percent of the single-engine retractable fleet, were involved in 67 percent (of a total of 63 accidents) of the inadvertent-gear-retraction accidents.

It is easier for a pilot to make a mistake in a Bonanza, it would seem. Thorough check-outs, adherence to the check list and conscious verification would help to reduce the number of accidents. But standardization is the way to go to reduce design-induced pilot accidents.

The jury is still out on this issue. . .the jury being Beech and the FAA. My personal opinion is the same as that on the issue of the engine controls in Barons. Beech should bite the bullet and accept the standard arrangement—gear switch on the left, flap switch on the right.

There is another caveat on the panel, although it really is in the fuel tanks: Because of unporting problems there are yellow arcs on the fuel gauges to remind the pilot that takeoff and maneuvers should not be attempted with less than 13 gallons of fuel in the selected tank.

Handling characteristics differ from one aircraft or one design family to another. Judgments about handling qualities are subjective, despite the several attempts to develop scientific standards for measurement. Most pilots find the Bonanza delightful to fly—light, responsive controls and quick response from the airplane. The high gear and flap speeds, the quick gear operation (four seconds, now) combine with responsiveness to build confidence rapidly that the pilot truly is in control.

There is a trap in that, however, and there are conditions in which the Bonanza can turn from Dr. Jekyll to Mr. Hyde. A pilot unaware of the nature of the Bonanza in flight, of the obverse of light, well-coordinated controls, can be transformed from one with a macho self-image to one in a bunch of trouble quickly.

The Bonanza is a hands-on airplane. Leave it untended, and a wing will drop and stay dropped. The infamous spiral dive will develop, then an inattentive, inexperienced or nervous pilot will over react.

Fly a Bonanza in relatively smooth air, and you will feel like Captain Midnight. Wander into turbulence, and the character of the machine changes. It is yaw unstable. There are many theories to cover this instability, from the V-tail to the hard chines on the bottom of the fuselage to the phases of the moon. There are many modifications that are purported to resolve it, too. However, this instability is not peculiar to the Model 35. It is a characteristic of all the short fuselage Beech aircraft: the 33, the 35, the 95 and the several Model 55 Barons. It might possibly be explained as the result of the relatively short distance between the mean chord of the wing and that of the (horizontal or V-) tail. Frankly, I do not know, and all the theories have only confused me; but the short-coupled fuselage seems the most cogent explanation for the characteristic.

For whatever reason, the Bonanza is a very work-intensive aircraft to fly in turbulence. In moderate turbulence, experienced Bonanza pilots can dampen much of the wiggle-waggle with well-timed rudder input. In high levels of turbulence, it requires a high degree of concentration. The best antidote to me is thorough competence in the airplane, an active instrument rating or a commitment to fly only in good conditions, and a good autopilot, complete with yaw damper.

The 1980 model we flew, 6735V, had an EdoAire Mitchell yaw damper ($2,715 and eight pounds in 1980). A King version is also available ($2,810 and nine pounds in 1980). One or the other is high on my must-have option list, right up there with a slaved gyro and a horizontal situation indicator. It is well worth the price for anyone who flies regularly, in terms of the reduced workload and increased passenger comfort.

This does not make the Bonanza a dangerous airplane, despite the inferences or outright claims of others. The spiral instability and the turbulent instability are characteristics that anyone who wants to fly one must be aware of, competent to deal with or decisive enough to leave the airplane in the barn if they are not.

The Bonanza has a high maneuvering speed—134 KIAS—and is certificated in the Utility Category with a maximum positive G loading of 4.4. It is most unforgiving of those who intentionally or unintentionally exceed its limits.

The basic characteristics of the Bonanza have not changed over the years. The environment in which it and other general aviation aircraft operate has and so has the cost of flying.

It is possible that a besmirched reputation could affect its popularity (although the retention of value in the used aircraft market has not indicated that yet). Far more likely is that its cost in conjunction with the ability to

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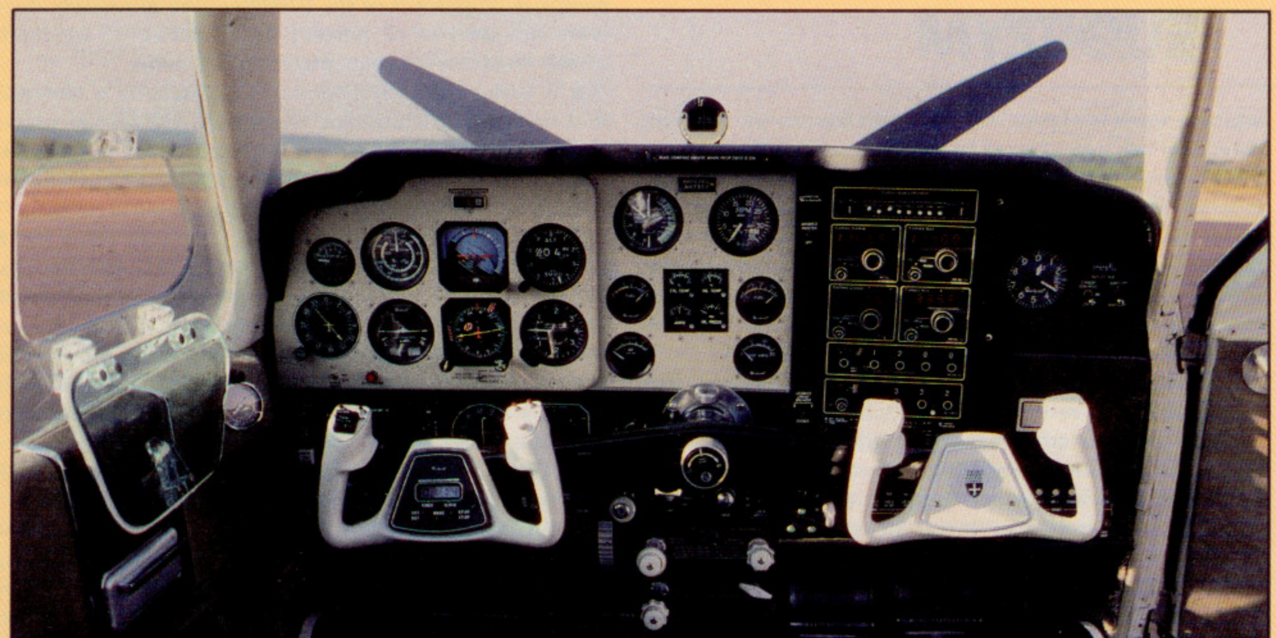

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buy or the reasons for buying and its limited loading flexibility will end its long life or relegate it to a special production airplane for the enthusiast.

The factory states that the average equipped price for a V35B in 1981 will be $151,100, which means that an aircraft equipped for ultimate utilization easily will top $165,000. The larger and more flexible A36 will average only $8,000 more.

Simply stated, by every measurement save the unique charisma of the Bonanza, the 36 offers more airplane and more transportation for the dollar.

The market seems to be agreeing. In 1977, 1978 and 1979, A36 production was almost exactly twice that of the 35. In the latest available figures for 1980, the V35B rate was 32, the 33 was 37, the 36 was 145 and the newcomer 36TC was 113. In the affections of hundreds of thousands of pilots, however, there never will be an equal to the dear butterfly. □

BEECHCRAFT BONANZA V35B

Basic price $91,950 (1980) $105,000 (1981)

Price as tested $152,333

Specifications	
Engine	Continental IO-520-BA or -BB
	285 hp, max continuous 2,700 rpm
	Recommended TBO 1,500 hr
Propeller	McCauley 3-blade
	80-in constant speed
Wingspan	33 ft 6 in
Length	26 ft 5 in
Height (to top of fins)	7 ft 7 in
Wing area	181 sq ft
Wing loading	18.8 lb/sq ft
Power loading	11.9 lb/hp
Seats	4/5 optional
Cabin length	10 ft 1 in
Cabin width	3 ft 6 in
Cabin height	4 ft 2 in
Empty weight	2,117 lb
Empty weight (as tested)	2,330 lb
Useful load (basic aircraft)	1,313 lb
Useful load (as tested)	1,078 lb
Payload with full fuel (basic aircraft)	960 lb
Payload with full fuel (as tested)	638 lb
Ramp weight	3,412 lb
Gross weight (takeoff)	3,400 lb
Fuel capacity	80 gal (74 usable)
Oil capacity	12 qt
Baggage capacity	270 lb (35 cu ft)

Performance		
Takeoff distance (ground roll)		1,002 ft
Takeoff over 50 ft		1,769 ft
Rate of climb (gross weight)		1,167 fpm
Maximum level speed (sea level)		182 kt
Cruise speed (75% power,	8,000 ft)	170 kt
	10,000 ft	168 kt
	12,000 ft	165 kt
Cruise speed (65% power,	8,000 ft)	163 kt
	10,000 ft	160 kt
	12,000 ft	157 kt
Cruise speed (55% power,	8,000 ft)	150 kt
	10,000 ft	148 kt
	12,000 ft	145 kt
Range at 75% cruise (with 45-min reserve)		
	8,000 ft	740 nm
	10,000 ft	775 nm
	12,000 ft	810 nm
Range at 65% cruise (with 45-min reserve)		
	8,000 ft	775 nm
	10,000 ft	810 nm
	12,000 ft	840 nm
Range at 55% cruise (with 45-min reserve)		
	8,000 ft	825 nm
	10,000 ft	845 nm
	12,000 ft	860 nm
Service ceiling		17,858 ft
Landing distance (ground roll)		763 ft
Landing over 50 ft		1,324 ft

Limiting and Recommended Airspeeds

(Indicated, not calibrated)

Vsi (Stall speed with no flaps)	64 kt
Vso (Stall speed with full flaps)	51 kt
Vne (Never exceed)	196 kt
Vno (Maximum structural cruise)	167 kt
Va (Design maneuvering)	134 kt
Vfe (Maximum flap extended)	123 kt
Vfe (Approach speed with 15° flaps)	154 kt
Vle (Maximum gear extended)	154 kt
Vx (Best angle of climb)	83 kt
Vy (Best rate of climb)	96 kt

Based on manufacturer's figures.

ROOTS AND OFFSHOOTS

Tracing the growth of a legend.

BY ANNE W. STUDABAKER AND MARY F. TURNER

"Bonanza Means Business" was Beech's slogan for the Model 35, and business started back in 1947 when the airplane received its type certificate. From the beginning, it was a remarkable airplane, not only because of its innovative design—the butterfly tail—but also because of its remarkable performance. In its first 20 years, the series 35 continually was being awarded medals for endurance and speed records.

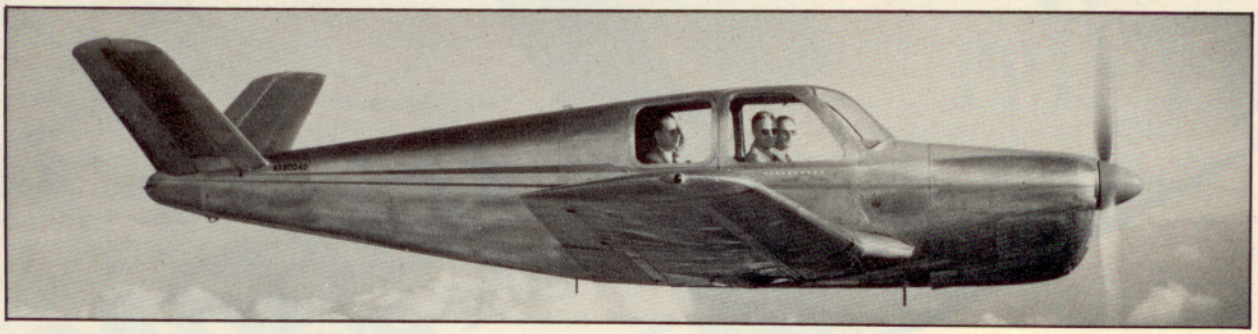
The most notable changes to the Bonanza occurred in the first generation (1947 to 1956). The V-tail's chord was increased, and the angle of incidence changed from 30 degrees to 33 degrees. A third window was added and the wings, tail and landing gear were strengthened in preparation for future changes.

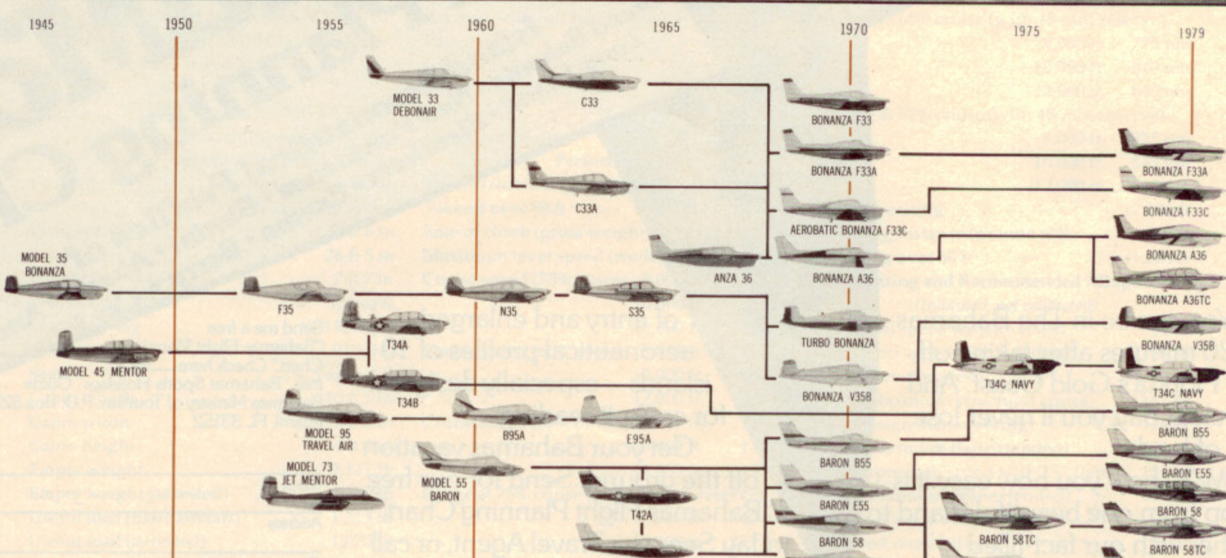
The second generation, marked by a new type certificate in December 1956, began with a new 240-horsepowered engine. Only Continental engines have been used in the Bonanzas; they began with the E-series rated at 165 hp and they now use the IO-520-BA or BB rated at 285 hp.

Almost everything increased along with the horsepower—fuel capacity, stall speeds, gear- and flap-extension speeds, gross weight—about the only thing that did not increase was service ceiling. It wavered around 18,000 feet (except for the turbocharged models, which went to 29,500 feet), and appears to have leveled off now at 17,858 feet.

Though the Bonanza is one-of-a-kind, it was the genesis for many other Beech models. In the genealogy below, we have traced the roots of some of Beech's aircraft back to the Bonanza. There are many sources of information on the specifications for the Model 35 series, and they are not all consistent. Data in earlier years were not as detailed as they are now, and operating manuals often were incomplete. However, on page 44, we have listed the basic performance figures and major changes it has undergone in its 34-year production life.

specifications continued p. 44





Bonanza

Model	Top speed	Max cruise	Rate of climb	Service ceiling	Stall speed w/flaps	Empty weight	Gross weight	Useful load	Engine hp	Fuel
1947 35	160 kt	152 kt	950 fpm	18,000 ft	48 kt	1,558 lb	2,550 lb	992 lb	E185-1 165 hp	40 gal
1949 A35	160 kt	150 kt	890 fpm	17,100 ft	49 kt	1,580 lb	2,650 lb	1,070 lb	E185-1 165 hp	40 gal
Wing center section strengthened, which increases gross weight and pushes A35 into utility category; stearable nosewheel; new starter; max gear- and flap-extended speeds increased.										
1950 B35	160 kt	150 kt	890 fpm	17,100 ft	49 kt	1,575 lb	2,650 lb	1,075 lb	E185-8 165 hp	40 gal
New engine gives 196 hp for takeoff; improved propeller; faster-retracting landing gear; increased flap area.										
1951-1952 C35	165 kt	155 kt	1,100 fpm	18,000 ft	48 kt	1,647 lb	2,700 lb	1,053 lb	E185-11 185 hp	40 gal
New engine changes almost everything; 206 hp on takeoff and max continuous of 185 hp; all metal propeller; wing-root fillets for lower stall speed added; incidence of tail changed from 30° to 33°; tail chord increased on new corrugated stabilizers.										
1953 D35	165 kt	156 kt	1,100 fpm	18,000 ft	48 kt	1,650 lb	2,725 lb	1,075 lb	E185-11 185 hp	40 gal
1954 E35	165 kt	156 kt	1,100 fpm	18,000 ft	48 kt	1,675 lb	2,725 lb	1,050 lb	E185-11 185 hp	40 gal
Optional engine E225-8 with 185 hp increases performance; new aileron trim control.										
1955 F35	165 kt	156 kt	1,100 fpm	18,000 ft	48 kt	1,697 lb	2,750 lb	1,053 lb	E185-11 185 hp	40 gal
1956 G35	168 kt	165 kt	1,300 fpm	19,000 ft	48 kt	1,722 lb	2,775 lb	1,053 lb	E225-8 225 hp	40 gal
E225-8 engine became standard; redesigned nosewheel strut; longer tail pipes.										
1957 H35	179 kt	170 kt	1,250 fpm	19,800 ft	49 kt	1,833 lb	2,900 lb	1,067 lb	O-470-G 240 hp	40 gal
Heavier engine; discontinued oil tank behind engine; hydraulic constant-speed propeller; heavier wing center section and fittings.										
1958 J35	182 kt	173 kt	1,250 fpm	21,300 ft	49 kt	1,820 lb	2,900 lb	1,080 lb	IO-470-C 250 hp	40 gal
Fuel-injected engine; electric auxiliary fuel pump; optional autopilot; louvers on engine-access doors.										
1959 K35	182 kt	173 kt	1,170 fpm	20,000 ft	51 kt	1,832 lb	2,950 lb	1,118 lb	IO-470-C 250 hp	50 gal
Standard fuel capacity increased with 70-gal option.										
1960 M35	182 kt	173 kt	1,170 fpm	20,000 ft	51 kt	1,832 lb	2,950 lb	1,118 lb	IO-470-C 250 hp	50 gal
Square-corner wingtips increase total wing area from 177.6 to 181 sq. ft.										
1961 N35	178 kt	169 kt	1,150 fpm	19,200 ft	52 kt	1,855 lb	3,125 lb	1,270 lb	IO-470-N 260 hp	50 gal
New engine; gross weight increased with useful load; top speed reduced; larger rear window; improved fuel system.										
1962-1963 P35	178 kt	169 kt	1,150 fpm	19,200 ft	52 kt	1,855 lb	3,125 lb	1,270 lb	IO-470-N 260 hp	50 gal
Redesigned instrument panel; gear-lowering speed increased.										
1964-1965 S35	184 kt	178 kt	1,200 fpm	18,300 ft	54 kt	1,885 lb	3,300 lb	1,415 lb	IO-520-B 285 hp	50 gal
New engine; longer cabin.										
1966-1967 V35	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	1,941 lb	3,400 lb	1,459 lb	IO-520-B 285 hp	50 gal
Increase in gross weight reduces performance figures.										
1966-1967 V35TC	217 kt	200 kt	1,225 fpm	29,500 ft	55 kt	2,000 lbs	3,400 lb	1,400 lb	TSIO-520-D 285 hp	50 gal
First turbocharged Bonanza; only offered through 1970.										
1968-1969 V35A	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	1,985 lb	3,400 lb	1,442 lb	IO-520-B 285 hp	50 gal
New speed-sweep windshield.										
1968-1969 V35ATC	217 kt	200 kt	1,225 fpm	29,500 ft	55 kt	2,021 lb	3,400 lb	1,379 lb	TSIO-520-D 285 hp	50 gal
1970-1971 V35B	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	1,972 lb	3,400 lb	1,428 lb	IO-520-B 285 hp	50 gal
In mid-production an engine damper pin was changed and the engine was renamed IO-520-BA.										
1970 V35BTC	217 kt	200 kt	1,225 fpm	29,500 ft	55 kt	2,035 lb	3,400 lb	1,365 lb	TSIO-520-D 285 hp	50 gal
1972-1973 V35B	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	1,985 lb	3,400 lb	1,415 lb	IO-520-BA 285 hp	50 gal
1974 V35B	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	2,031 lb	3,400 lb	1,381 lb	IO-520-BA 285 hp	50 gal
1975-1976 V35B	182 kt	176 kt	1,136 fpm	17,500 ft	55 kt	2,051 lb	3,400 lb	1,361 lb	IO-520-BA 285 hp	50 gal
1977 V35B	181 kt	172 kt	1,167 fpm	17,858 ft	55 kt	2,087 lb	3,400 lb	1,325 lb	IO-520-BA 285 hp	50 gal
1978 V35B	181 kt	172 kt	1,167 fpm	17,858 ft	55 kt	2,093 lb	3,400 lb	1,319 lb	IO-520-BA 285 hp	50 gal
1979 V35B	181 kt	172 kt	1,167 fpm	17,858 ft	55 kt	2,117 lb	3,400 lb	1,295 lb	IO-520-BB 285 hp	50 gal
1980 V35B	181 kt	172 kt	1,167 fpm	17,858 ft	55 kt	2,117 lb	3,400 lb	1,295 lb	IO-520-BB 285 hp	80 gal
Optional 80-gal tanks became standard.										

AOPA received a great deal of mail from members in the past year regarding the structural integrity of the Beech 35 series (the V-tail or butterfly) Bonanza.

Many were irate; many were concerned that there might be a serious flaw in their aircraft. Since the issue had been raised, we had to look into the matter.

Barry Schiff wanted to take on the task of evaluating the record and putting the controversy into perspective. It became a personal issue for him. We discussed the direction of the article several times, trying to avoid refutations of specific programs and publications. However, the impact of CBS's *60 Minutes* and an article in *Aviation Consumer* was such that Schiff felt compelled to deal with them directly.

In effect, his article is a personal statement in response to his concern about misplaced emphasis and sensationalism.

All aircraft have imperfections or operational characteristics that can put a pilot in hazard, if he is unaware of them, careless, not proficient or presses beyond the limits. The V-tail Bonanza has a higher-than-average rate of inflight airframe failure. This does not mean that the airplanes just come apart in the air; but when pushed beyond their normal operating envelope, they are more likely to fail. Most of the accidents have been the result of pilot actions.

Awareness of the potential can help pilots avoid the condition. In this respect—getting pilots' attention—*Aviation Consumer* has performed a service. Unfortunately, the way the magazine presented the information seems to have misled as many as it informed. *—EGT*

BONANZA BESIEGED

An attempt to put the controversy into perspective.

In spite of the criticisms leveled at the V-35, Beech Aircraft Corporation is proud of the V-tail's construction. So proud that a couple of years ago they built a cutaway version of the Bonanza showing, among other things, the ruddervator mixer assembly and the internal components of the Bonanza's Continental IO-520 engine. The cutaway formerly played the trade-show circuit, but now it is on permanent display at the Smithsonian Institution's National Air and Space Museum in Washington, D.C.

PHOTOGRAPHY BY ART DAVIS

BY BARRY SCHIFF

In a speech to the House of Commons in 1860, the great British statesman, Benjamin Disraeli, said, "[It is] much easier. . .to be critical than to be correct." This philosophy is as valid now as it was then. And, if Disraeli were alive today, he might cite as a classic example the controversy stirred up by *Aviation Consumer*. In an article published last year, that magazine impugns the reputation of the Beechcraft Model 35 (V-tail) Bonanza with critical ease, at the sacrifice of correctness.

The V-tail Bonanza long has been considered a preeminent model of general aviation design excellence. Nevertheless, *Aviation Consumer* chose to level a series of charges against the airplane that created a flurry of widespread reaction ranging from confusion to rage.

The author of the article is Brent Silver, an aviation consultant and aeronautical engineer, who testifies as a paid witness on behalf of plaintiffs, in litigation against airframe manufacturers that include the Beech Aircraft Corporation. He also is one of those who appeared on a segment of the recent CBS television production *60 Minutes* to help portray a disturbing and distorted view of general aviation safety.

In the magazine article, Silver used selected statistics on the Model 35 in an effort to demonstrate that the airplane inherently is not as safe as either of its sister ships, the Model 33 (straight-tail Bonanza) and the Model 36 (stretched Bonanza). He accused the Model 35 of suffering from ruddervator flutter, less-than-ideal handling qualities and structural weak points. But, by his own admission, these were offered only as "possible answers" to his own questions regarding the integrity of the Bonanza's V-tail configuration, the only significant difference between the Model 35 and the straight-tail models.

Careful analysis of the lengthy article leads only to one conclusion: No factual proof was offered to substantiate the allegations. To demonstrate the point, each major accusation must be considered individually.

Flutter is an aerodynamic phenomenon that can be compared loosely to the fluttering of a flag at high mast on a windy day. Quite obviously, a fluttering control surface is something to avoid in any airplane. The consequences can range from airframe vibration to a catastrophically divergent (worsening) condition capable of shaking an airplane to destruction. The flutter is caused by a complex interaction between several variables, one of which can be an improperly balanced control surface.

Prior to installing any control surface, it first must be balanced according to design specifications. This prevents flutter from occurring within the operational limitations of the airplane. Whenever the surface is painted, it similarly must be removed and rebalanced to within prescribed limits. This is true of all airplanes, especially those of a high performance nature.

With respect to a V-tail Bonanza, the ruddervators of later models (S35 and after) must be balanced between 14.4 and 17.4 inch-pounds tail heavy, a procedure performed easily by any competent airframe mechanic.

The *Aviation Consumer* article claims, however, that if a ruddervator becomes excessively tail heavy by as little as 2.2 inch-pounds (roughly equivalent to taping two silver dollars to a ruddervator's trailing edge), this could cause the control surface to flutter, but only at or above 18,000 feet. This is incorrect. The airspeed at that altitude (the service ceiling of several Bonanza models) is so slow as to preclude the possibility of flutter. But more important is that the figures cited in the article were obtained by extrapolating results obtained in 1974 when a C35 Bonanza was placed in Lockheed-Georgia's wind tunnel. According to W.G. Pierpont, Beechcraft's chief scientist, extrapolation of this type of data to such a high altitude can introduce substantial error.

As but one example of how extrapolation can lead to erroneous conclusions, consider the following: If the noon temperature in Las Vegas is 80°F and becomes 110°F by 3 p.m., extrapolation projects the temperature to be an incredible 170°F by 9 p.m.

Based on extrapolation and *not actual data*, the magazine warned that 2.2 inch-pounds of ruddervator imbalance (at 18,000 feet) could excite flutter and that such imbalance could be caused by "a couple of ounces of ice, water, oil, dirt or bird [excrement] near the" ruddervator's trailing edge. If icing is so severe as to collect on the *trailing* edge of a control surface at such an altitude, the pilot will be maneuvering a block of ice and probably have other difficulties to worry about. Also, it has been shown that water cannot collect on or within the trailing edge of a slanted ruddervator (especially in flight).

Assuming its own conclusions to be fact, *Aviation Con-*

continued

sumer then seems to have overstepped its bounds. It offered to Bonanza owners the option of rebalancing their ruddervators by adding as much lead in the counterweights as room allows. This would be courting disaster. Arbitrarily increasing the balance weight actually could cause predictable, high-speed flutter (especially for the S35 Bonanza and all subsequent models).

Precise data obtained from the wind-tunnel flutter tests demonstrated that the ruddervators had to be more than an extraordinary 30 percent out of balance before flutter could be induced. Even when the control cables were disconnected from the ruddervators completely (to eliminate control-system damping), flutter could not be made to occur until the surfaces were out of balance by more than 10 percent.

The article went on to frighten Bonanza pilots by asserting that catastrophically divergent flutter could be induced at only 92 knots, if both trim-tab cables were to break. This may be true; but since such an absurd improbability never has been reported in a Bonanza, the discussion has no practical value. It is useful, however, as a scare tactic. Also, the same consequences can be expected of any high-performance airplane with broken trim-tab cables.

More to the point is the Bonanza's actual history of flutter encounters. The first case occurred in 1948, after the airplane was repainted by a house painter using lead-base paint. The ruddervators were not rebalanced as required by the maintenance manual. Another flutter report concerned an airplane that had been structurally weakened when the pilot executed more than 60 barrel rolls at entry speeds in excess of 160 knots indicated airspeed. There have been nine other cases of Bonanza flutter. Fact: All occurred to Bonanzas built only during 1947 and 1948. Fact: All eleven aircraft were flown safely to a landing; no one was injured. Fact: The last known case of flutter occurred in 1966 (to an original Model 35).

Investigation did reveal that, in some cases, flutter was triggered by insufficient fuselage torsion strength immediately forward of the tail. Believing this to have been caused by aerobatic maneuvering, Beech strengthened the bulkhead at station 256.9, beginning with the Model A35 Bonanza (1949). Consequently, there never has been reported a case of flutter involving an A35 Bonanza or any subsequent model.

The article discussed three aspects of the Model 35 Bonanza's handling qualities: Dutch roll, spiral stability and longitudinal stability.

Bonanza pilots have little to criticize with respect to handling qualities. The airplane has a beautifully harmonized control system, exceptionally low system friction and outstanding effectiveness and response throughout the speed spectrum.

It does, however, Dutch roll in turbulence more than most other general aviation airplanes (a yaw/roll oscillation consisting mostly of yaw). This trait may influence ride quality and pilot workload in turbulence, but has no bearing on safety.

The article suggested that, "if the yawing becomes violent" when penetrating heavy turbulence at high speed, the tail may undergo structural damage from excessive aerodynamic side loading. But nothing was offered to substantiate this, except for the speculation of Irv Culver, a design consultant who acknowledged to this writer that he never has made a study of the effects of Dutch roll on the structural integrity of a Model 35 empennage.

Bonanza

The V-tail, like all propeller-driven singles, has traits of spiral instability. The remedy? Fly the airplane, do not allow it to fly you.

By suggesting that the V-tail Bonanza is less safe than either of the straight-tail models because of Dutch roll, author Silver clearly is stalking the wrong game. Independent flight-test data and Beech's stability calculations confirm that the Model 35 (V-tail) has 93 percent as much directional stability as the Model 33 (straight tail). Also, the dihedral of the V-tail configuration actually increases the lateral (roll) stability of the Model 35. The result is that, although the Model 33 has slightly less Dutch-roll tendency than the Model 35, the difference between the two is so subtle as to be virtually undetectable.

A common misconception is that the Model 36 stretched Bonanza has less Dutch-roll tendency than the straight-tail Model 33 because of its increased length. Not so. The additional 10 inches of fuselage was added *forward* of the wing's quarter-chord point. Consequently, the Dutch-roll tendency of an A36 is slightly less than that of a V35B, but *more* than that of an F33A.

Since both straight-tail Bonanzas have essentially the same Dutch-roll tendencies of the V-tail model and greater vertical fin area exposed to aerodynamic side loading in a yaw, it is logical to conclude that the vertical tail surfaces of the straight-tail Bonanzas absorb greater forces than those to which the V-tail is exposed. *Aviation Consumer* ignored this fact.

In 1966, the National Aeronautics and Space Administration published a report (TN D-3726) entitled *An Evaluation of the Handling Qualities of Seven General Aviation Aircraft.* One conclusion is, "The [NASA] pilots [who conducted the evaluation] commented that all [seven] aircraft (which included the Model 33 and 35 Bonanzas) have acceptable lateral-directional dynamic characteristics."

Aviation Consumer commented on the Model 35's spiral stability by referring to the report of one pilot. While he was reading an approach plate located to his right, the N35 Bonanza he was flying entered a 40-degree right bank and pitched down 30 degrees. This leads one only to the conclusion that either the airplane was mistrimmed or the pilot was inattentive to the demands of instrument flight.

The V-tail Bonanza can be spirally unstable to the right, but it does not have an exclusive on graveyard spirals. Virtually all single-engine, propeller-driven airplanes (especially those without aileron trim) also have traits of spiral instability. The preventive measure when operating any of them is simple: Fly the airplane; it should not be allowed to fly you.

It is erroneous to imply that this characteristic makes the Model 35 less safe than either of the straight-tail models because all three are virtually identical in the spiral mode. (When trimmed properly, they have neutral-to-positive spiral stability to the left.)

The Bonanza has an exceptionally low drag profile, a credit to the design. But does such an aerodynamic asset cause unusually rapid acceleration when the nose is pitched downward? Not at all.

The National Transportation Safety

Board published an engineering study (TR-1099-1) detailing the spiral and diving overspeed tendencies of five different lightplanes. According to the report, each airplane was displaced from cruise flight into a 15-degree, nose-down attitude with 75-percent power and held that way for eight seconds. The differences in acceleration among the aircraft were surprisingly small. The airspeed of a V35B Bonanza increased only 31.4 knots, while a Cessna 210 and a Cessna 177 with fixed landing gear gained 30.2 and 28.0 knots, respectively. (Once recovery was initiated, additional speed in each case was less than one knot.) The report states also that airplanes with low drag profiles will continue to accelerate to much faster airspeeds, but the acceleration does not increase.

This demonstrates convincingly that a proficient Bonanza pilot has almost as much time to correct a flightpath disturbance as does the pilot of any other airplane.

One limitation of the Model 35 Bonanza is its center-of-gravity envelope. The airplane does not have as liberal an aft CG limit as the Model 33. (The Model 36 has a more spacious envelope, due to the effect of stretching the forward fuselage.)

When the CG of any airplane is behind the approved aft limit, static longitudinal stability is sacrificed. When this occurs, trimming becomes more difficult, airspeed excursions are more frequent, stall/spin characteristics may not meet certification criteria, and unconventional control movements may be necessitated. In other words, a pilot flying such an airplane assumes the role of an experimental test pilot because he treads where others fear to go.

Perhaps most significant is that control forces become lighter as the CG moves aft; it takes fewer pounds of pull to create a given amount of additional G load.

One of the joys of flying a Model 35 Bonanza is the light control forces normally required for maneuvering. In the cruise range and when the CG is within approved limits, only 17 to 20 pounds of control force are required to increase the load factor from one to two Gs. Straight-tail Bonanzas require 20 to 30 pounds per G.

Since the Model 35 normally is light on the controls, moving the CG aft makes it all the easier to increase load factor by pulling on the control wheel. It is possible, therefore, for a pilot who has lost control of an *excessively* aft-loaded Model 35 Bonanza in IFR con-

Bonanza

INSIDE THE V-TAIL

The tail surfaces of an airplane appropriately are called tailfeathers. Without them, an airplane—like an arrow—would wallow uncontrollably through the air. An empennage serves the dual purpose of providing stability and controllability (about pitch and yaw axes).

There have been a large variety of tail designs, and almost all are characterized by a combination of horizontal and vertical stabilizers and control surfaces. One obvious exception is is the V-tail. This configuration consists of two slanted stabilizers and ruddervators, so called because each combines the functions of rudder and elevator.

Although Beech may have been the first to put the V-tail into continuous production, the stylish design has roots that originate in 1910. History notes that two German designers, Hofinger and Hopfenweiser, attempted to build an airplane with a V-tail. They apparently failed for lack of an adequate control mixer. This is a mechanical system that converts conventional movements of the control stick (wheel) and rudder bar (pedals) into a combination of ruddervator deflections that control pitch and yaw (independently or in combination).

The butterfly-tail concept was revitalized in the late 1920s by Jerry Rudlicki, a Polish engineer who sought to improve an aerial gunner's aft-facing field of fire. Subsequently and prior to World War II, the V-tail was adapted to a host of airplanes, such as the Blériot-Spad 922, the Fouga CM-170 Magister jet trainer and, of course, the Beech Model 35 Bonanza.

The V-tail configuration does offer some practical advantages that a conventional empennage does not. It is affected less by wing downwash, requires less trimming during power changes and is not as susceptible to ground damage—features also characteristic of a T-tail. Additionally, the V-tail weighs less (18 pounds in the case of a Model 35) and creates measurably less drag (because of less frontal area, less surface area and fewer surface-to-fuselage intersections). These drag and weight advantages prompted the National Aeronautics and Space Administration to recommend in a recent report that manufacturers consider V-tail technology in the design of future-generation airliners.

V-tail disadvantages include the need for a relatively complex control mixer and a slight tendency of the airplane to pitch down when the empennage is assaulted by a gust from either side. When a relative wind from the side strikes the bottom of a slanted tail surface, the air is deflected downward, resulting in a slight tendency for the tail to rise. For similar reasons, a side gust striking the vertical stabilizer of a conventional tail results in a tendency for the airplane to roll away from the gust. In each case the effect is very difficult to observe.

Another disadvantage is that the V-tail is not as suitable for aerobatics. When the pilot commands maximum elevator power (either nose-up or nose-down), the ruddervators cannot deflect to as large a *differential* while simultaneously applying maximum rudder-pedal pressure. In other words, when full forward or aft pressure is applied to the control wheel, less than maximum rudder power is available, making it more difficult to perform a snap roll. For nonaerobatic maneuvering, this is of no consequence.

Just as a quartering crosswind can be broken down into crosswind and headwind (or tailwind) components, the surface areas of a V-tail similarly can be divided into horizontal and vertical components. The tail surfaces of a Model 35 are inclined 33 degrees to the horizontal and have a total area of 41.96 square feet (beginning with the Model C35 in 1951). This results in a vertical component of 22.86 square feet and a horizontal component of 35.19 square feet. By way of comparison, the straight-tail Model 33 Bonanza has vertical and horizontal surface areas of 15.96 and 37.19 square feet, respectively. In other words, the V-tail has 95 percent as much horizontal tail area and 143 percent as much vertical tail area as the Model 33.

It would be incorrect, however, to use these figures to compare directly the aerodynamic effectiveness of these tail configurations. This is a complex problem and requires consideration of such factors as tail arm lengths, aspect ratios, surface geometry, sidewash effects and empennage interference. From a practical standpoint, the differences between V- and straight-tail effectiveness are best determined by elaborate flight testing. ☐

ditions to panic and exert back pressure sufficient to violate structural limits.

Since the control forces of a straight-tail Bonanza are heavier, a pilot who has entered a graveyard spiral simply may not have the strength to create the Gs necessary to induce structural failure. Unless he executes a timely recovery, he may strike the ground with the airplane intact.

In either event, the pilot is just as dead. The best preventive measure—in any airplane—is to respect and abide by published limitations.

All of this figures very prominently in the accident statistics quoted by *Aviation Consumer,* because many of the accidents enumerated by Silver occurred with an excessively aft CG.

Does any of this justify condemning the V-tail Bonanza? Of course not, but it does say something about those who either ignore operating limitations or are unqualified to fly this high-performance airplane.

Considerable space was devoted to the discussion of the Model 35's structural integrity. But most of this assault was directed against Bonanzas built more than a quarter-century ago. Although those early editions (they are regarded as antiques) either require a periodic inspection of the wing carry-through truss or have been modified, this bears no relevance to subsequent Model 35s. The later models were certificated in the stringent Utility Category and are exceptionally rugged and durable. It is uncertain why the author chose to review such ancient history. Perhaps he intended for later-model V-tail Bonanzas to be found guilty by association or lineage.

The article did contain a frightening, sequential diagram emblazoned across two full pages. This was said to represent a trajectory reconstruction of a Model V35TC that came apart over Pas, Manitoba, in 1972. What the caption failed to mention, however, were the conditions necessary to cause this structural breakup. A computer analysis of these diagrams estimates that the airplane was exposed to a peak of between 8½ and 9½ Gs at an airspeed of 300 knots. Could *any* lightplane survive such maltreatment?

Despite an elaborate effort, *Aviation Consumer* failed to find serious fault with the design and structural integrity of the V-tail Bonanza because there probably is none to find.

At first glance, the statistics cited in the article do seem to condemn the Model 35 Bonanza because more of them (per 100,000 hours of flight) have been torn apart in flight than straight-tail models. But there are a variety of ways to apply and interpret this kind of raw data. Numbers alone can be very deceptive. As but one example, consider the following:

In 1978, author Silver alleged to the Federal Aviation Administration that the Model 35 suffers from a serious flutter problem. The response to him from Robert Stephens, chief, Engineering and Manufacturing District Office, Central Region, places in perspective the statistics employed by Silver to indict the airplane (emphasis has been added):

"In all reliable reports. . .where weather conditions at the accident site were established, *at least 90 percent* of the Model 35 disintegrations occurred in IFR conditions (*with more than half the pilots non-instrument rated*). When we consider that the ratio of hours of flight in visual conditions compared to hours spent in instrument conditions is approximately 15 to one, it would appear that over 90 percent of the structural failures should occur during visual conditions, if flutter were the cause. Since just the opposite is true, we have no reason to question the probable cause the NTSB has assigned to the various accidents. Accordingly, unless a definite link between adverse weather and flutter can be established, we cannot justify the expenditure of. . .public funds to investigate an abstract theory."

Not only were the majority of accidents caused by unqualified pilots, but 40 percent of them involved flight into thunderstorm activity. There obviously are many causes for airplane accidents. But when pilots operate within their limitations and those of the airplanes they fly, structural failure rarely is one of them.

In conclusion, it is intriguing to reflect upon how such a storm of controversy can be created about a design that has been regarded as a standard of excellence for more than a third of a century. And yet, upon close examination, the storm is little more than a tempest in a teapot or, as Shakespeare said, "much ado about nothing." Fortunately, all that is required to resolve the controversy is some legitimate scientific analysis to show what is true and what is not. □