

The Glue Explanation Just Won't Stick

by Robert A. Galganski

Why the struts found with the Roswell debris were not balsa wood.

Rectangular and I-shaped cross-section thin-strut fragments recovered from the Foster ranch debris field in early July 1947 allegedly displayed extraordinary physical properties. Persons who handled them said they were extremely lightweight, slightly flexible but unbreakable, and could not be cut or burned. Roswell skeptics dismiss these reports, attributing them to the vagaries of long-term memory and embellished accounts of similar wreckage - specifically, balsa wood sticks-from rawin radar targets comprising Project Mogul Flight 4.

Former Mogul project engineer Charles B. Moore hinted that specially treated balsa wood used in those targets may have contributed to the wood misidentification problem. In an October 31, 1994, People magazine article titled "A SaucerScorned," he indicated that "the balsa wood was soaked in glue, like Elmer's Glue. It s a casein product [a protein derived from milk] that just won't burn at all." Moore added that the glue made the wood "a little bit stiffer and less easy to dent than ordinary balsa."

Moore also referred to altered balsa-wood characteristics in the 1995 Crystal Sky Production video, Roswell Remembered, stating that ". . . some of them [the sticks] appeared to have been stiffened by having something like Elmer's Glueon them." Curiously, he did not discuss the subject in his most recent and complete recollection of Project Mogul (Benson Saler, Charles A. Ziegler, and Charles B. Moore, UFO Crash at Roswell: The Genesis of a Modern Myth, Herndon, Va.: Smithsonian Institution Press, 1997).

The glue-treated balsa-wood sticks were also discussed by Kent Jeffrey as part of his recent 180-degree reversal on the Roswell Incident (Kent Jeffrey, "Roswell Anatomy of a Myth," MUFON UFO Journal, June 1997, pp.3-17). He speculated that the glue "would probably have given them a different color than that of raw wood, as well as a different feel or texture probably to the degree that someone who didn't know them for what they were, might not recognize them as wood."

In summary, Moore and Jeffrey suggest that balsa wood sticks coated with an Elmer's Glue like substance were unrecognizable from and stiffer than raw balsa wood, and noncombustible. The stiffness has been cited by Roswell skeptics to explain why the thin-strut fragments found on the Foster ranch could not be broken by human hands. I conducted three series of simple experiments to test the "glue hypothesis." This article presents my findings.

TEST SPECIMEN SELECTION

Because it's been more than 50 years since the original Project Mogul Flight 4 rawin radar targets were fabricated, my experiments utilized currently available materials. Published descriptions and additional information graciously provided by Charles Moore formed the basis for their selection.

Balsa wood. Ordinary 5/16-inch (8 mm) square balsa-wood sticks available from any hobby shop were used. Because wood is a natural product, the physical properties of these sticks were probably similar to the original struts used in rawin target construction. The first series of experiments was conducted with unmodified (raw) balsa wood.

Glue. Consistent with Moore's recollection, the second series of experiments utilized balsa-wood sticks coated with Elmer's Glue-All. Afterward, I learned from the manufacturer Elmer's Products Inc. (a division of Borden, Inc.) that their glue was introduced in 1947 under the brand name Coscorez. In 1951 its packaging was changed and the product was renamed for its then-new marketing symbol, Elmer the bull. The glue's current composition is virtually identical to that of the original 1947 product. Upon drying, a coating of this white-colored liquid changes into a clear (transparent) film.

But I also found out that Elmer's Glue is and always was a water-based polyvinyl-acetate-type adhesive which *contains no casein*. So Moore's description, strictly speaking, is contradictory. Consequently, it is not certain whether a casein or a polyvinyl-acetate glue was used with the 1947 rawin target struts.

To account for both possibilities I ran a third series of experiments which replicated the others - this time with a casein glue made by the National Casein Company. National Casein, which has been making casein and resin products since 1919, sent me a sample of aircraft-grade 8580 Casein Glue, their best product. According to Ken Blake of the company's New Jersey branch, its strength is comparable to the highest-quality casein glue available in the mid 1940s. National Casein 8580 Glue is a water-based, ivory-colored liquid (after mixing - see next section). A surface coated with it has a translucent appearance when dry.

Material preparation. Moore wasn't sure if the glue was merely brushed on the sticks or if they were soaked - full-strength or diluted (presumably with water)- in the glue. For the second (Elmer's Glue) test series I selected an all-glue, full-immersion pan soak in order to maximize the assumed beneficial effects of the treatment. The specimens were submerged-individually-in the glue for 20 minutes, removed, and allowed to dry. Because of some distractions during this time, some sticks stayed in the bath a few minutes longer than the others.

During my conversation with Ken Blake I learned that a wood's strength isn't influenced very much by whether or how glue has been applied to it-a full soak or merely brushed on its surface. Both techniques provide mostly a mechanical attachment of the glue to the surface of the wood-as with paint; very little glue impregnation occurs. Without pressure treatment per se-e.g., where a material such as a preservative is literally forced into the cells of an outdoors-use-type wood-the glue penetrates only several fibers deep below the surface. (I subsequently evaluated Blake's statement by experiment. See the Beam Strength and Other Tests section below.) Since I had soaked the Elmer's Glue treated specimens, I had no choice but to prepare the casein-glue-treated sticks in the same manner.

All of National Casein's glues come in a dry powder form and require mixing with water according to a specified procedure. These instructions were followed explicitly during glue preparation. To eliminate the above-noted soak time variability, I

immersed all sticks en masse for 20 minutes in the resulting full-strength liquid product.

After all glue-treated sticks were removed from their bath, their surfaces were brushed with additional adhesive during the initial drying stage in an attempt to give them a uniform and drip-free coating. As a result, a relatively thick film covered the wood.

Balsa wood revisited. All raw wood test specimens and those soaked in Elmer's Glue were purchased in July 1997; they were subsequently employed in the first two series of experiments performed in early October 1997. The third and final series of tests-those using casein glue-were conducted in early December and used wood purchased a couple of weeks earlier. Given the high volume of business the hobby store does, it is possible that the latter batch of sticks came from a different shipment. Consequently, some of the wood physical properties such as bending and shear strength could have been different from those characterizing the earlier group. The extent of such possible disparities-which may have been well within the envelope of variability normally displayed by all woods-is uncertain.

COLOR, SURFACE LUSTER, AND TEXTURE

Obviously, raw wood will look and feel different compared to wood that has a coating of dried glue on it. How much so depends on a number of factors such as the type of wood and its exposed grain pattern, type of glue used, and the number of coatings applied. When wet, both adhesive coatings obscured the balsa wood's natural tan color and grain pattern. But when completely dry its distinguishing characteristics were once again visible. The Elmer's Glue-treated pieces were shinier and felt smoother than raw wood; their casein-glue-treated counterparts felt rougher and had a slightly yellow cast and "frosty" appearance. But in both cases the treated specimens *still looked like wood*.

BEAM STRENGTH AND OTHER TESTS

Since wood has a cellular structure whose outer fibers can absorb liquid, some of its physical properties can undoubtedly be altered by immersing it in or coating it with glue. But could a dry, thin shell of glue *significantly* increase the bending and shear resistance of balsa wood-an inherently weak material-especially since, as noted earlier, most of the applied substance merely resides on the surface? The following tests were performed to provide a quantitative answer to that question.

As shown in Figure 1, struts were secured to the top surface of a workbench by means of a carpenter's wooden clamp. This setup constitutes a cantilever beam configuration; the beam is fully restrained at its single support location. Three series of replicate tests with raw and glue-treated sticks were run. Known masses were systematically and gently placed in a metal pan suspended at the free end of each strut 10 inches (254 mm) from the fixed support. They generated a static (i.e., slowly applied) load perpendicular to the beam longitudinal axis. The cumulative applied force acting on the beam was recorded until the beam began with an audible "crack" to break.

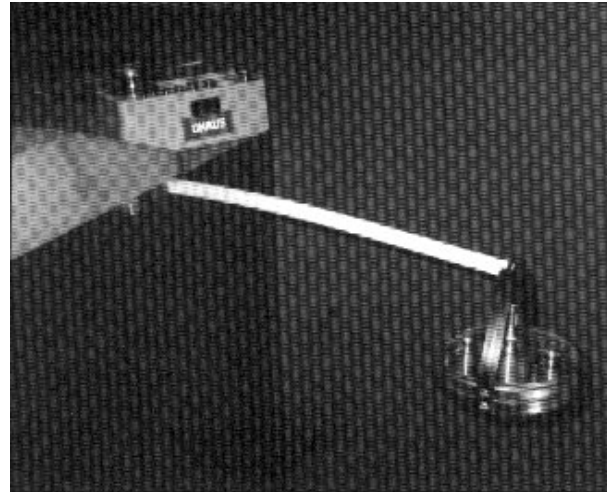


Figure 1. Bending- and shear-strength test setup.

As expected, all struts broke at the fixed support. Maximum free-end beam deflection just prior to failure, measured relative to the original horizontal orientation, ranged from about two to three inches (51 to 76 mm). That's a lot of deformation in a short (10-inch) span. Of the three wood specimen conditions examined, the casein-glue-treated beams bent the most. The persons who handled the debris-field struts reported that they were only *slightly*

TABLE I
Transverse Force Required to Break Balsa-Wood Struts

Balsa-Wood Test Specimen Condition	Breaking Force for Specimen (in newtons)					Average Breaking Force (newtons)
	A	B	C	D	E	
Raw	10.0	6.0	6.9	6.7	–	7.4
Soaked in Elmer's Glue-All	4.7	4.0	4.2	–	–	4.3
Soaked in National Casein 8580 Glue	21.2	19.2	15.4	15.3	16.0	17.4

Note: 1 newton = 0.2248 pound

flexible.

Table 1 documents the magnitude of the force at which each strut failed. None could support more than 21.2 newtons (less than five pounds). *Anybody* can apply such a force with a finger.

The data scatter present for each wood condition reflects the effects of such factors as nonhomogeneous wood composition, the probable small variation in beam cantilever length and force location relative to the fixed support, as well as slight differences in glue soak time and/or glue film thickness.

All beams soaked in Elmer's Glue-All failed at a *lower* force level (average force equal to 4.3 newtons) than their untreated counterparts (7.4 newtons) a strength reduction of

more than 40%.

The beams soaked in National Casein 8580 Glue exhibited the opposite effect. Their average breaking force was 17.4 newtons, about two and one-half and four times higher than the levels reached with the raw wood and Elmer's Glue soaked wood, respectively. However, as noted earlier, they could *still* be easily broken by hand.

Blake's contention that soaking or coating the wood with glue would not significantly affect its strength was evaluated during the final test series. I applied a single coat of casein glue to one strut and allowed it to dry. When loaded, it broke at 16.9 newtons, very representative of the 17.4-newton average failure force level exhibited by the five casein-glue-soaked beam samples. He was right.

Two different beam failure modes were observed. All glue-soaked struts exhibited a classic pure-bending stress-type failure shown in Figure 2: a somewhat jagged but primarily vertical break confined to the support. The raw wood struts failed due to a combination of bending and horizontal shear stress, producing a long, diagonal break that extended away from the support along the length of the beam. The internal wood fibers projecting from the broken end surfaces of all struts were obvious; they could be seen and felt. If the struts found on the debris field were indeed made of wood, eyewitnesses should have been able to identify them as such simply by looking at them. Nobody ever mentioned seeing this definitive broken-wood signature on the debris-field strut fragments.

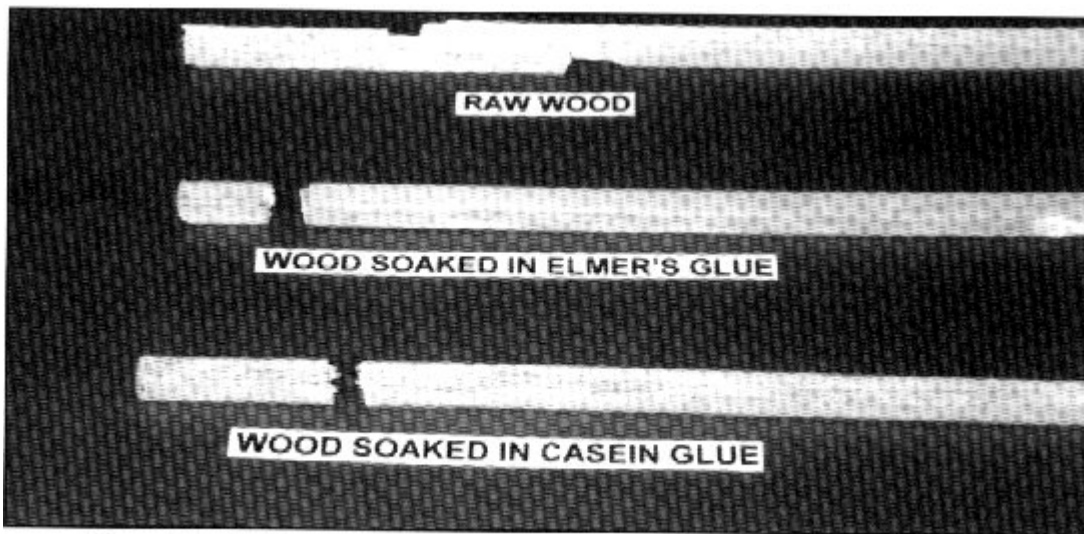


Figure 2. Typical condition of balsa-wood struts following beam- strength testing.

Intuitively, the contention that a wimpy stick of balsa wood can be rendered unbreakable by coating it with glue is patently absurd. This gut feeling is supported by basic beam theory. It clearly indicates that a beam having the material and geometric properties of a rawin target strut will easily break under extremely low-magnitude transverse loading.

The wood s paltry bending and shear resistance can be increased *somewhat* by turning it into a composite beam for example, by bonding a thin layer of modern high-strength (and in this case, lightweight) material such as 7075-T6 aluminum alloy to its surfaces. A

coating of glue simply won't work. And the skeptics haven't as yet, anyway claimed that the sticks were actually some U.S. top-secret, super-high-strength material laminate unistrut.

I avoided all the nerdy engineering theory for my readers and cut directly to the chase by doing the tests described above. The results showed conclusively that the struts recovered from the debris field had to be fashioned from some extremely lightweight material substantially stronger than raw or glue-treated balsa wood.

Skeptics might suggest that stiffness should be tested. Stiffness, defined in terms of a force per unit length or moment (a force times the perpendicular distance between its line of application and the axis of rotation) per unit rotation, typically describes a material's resistance to elastic deformation, i.e., deformation fully recoverable upon removal of the loading. It has nothing to do with its breaking or ultimate strength.

Two other types of experiments were conducted to assess the purported enhanced burn and cut resistance of glue-treated balsa wood. Although the protocols employed were not as rigorous as those involved in the beam-response evaluations, they provided vital information needed to make at least a qualitative evaluation of those claims.

Combustibility. The ends of all three wood specimen types were exposed to a 20-second continuous burn from a lighter flame. The significant result: Both glue-treated struts caught fire and burned not as quickly or as extensively as the raw wood (see Figure 3), but they did succumb to the flame. Since the treated specimens actually burned, the noncombustible struts found at the debris field had to be something other than balsa wood treated with a polyvinyl-acetate-type or casein-type glue.

Cut resistance. This was the least rigorous experiment performed. I used a new knife blade each time in an attempt to remove a two-inch long, roughly triangular cross-sectioned piece from the edge of all three specimen types (see Figure 4). As best as I could determine (feel), the raw wood provided just as much resistance very little to the blade as did the Elmer's Glue treated wood. The specimen treated with the casein product was a bit more difficult to slice, as evidenced by the smaller piece displayed in Figure 4. But I was still able to whittle it. Because they couldn't be cut (period), the thin-strut fragments found on the debris field were not made from balsa wood.

SUMMARY AND CONCLUSION

Roswell skeptics suggest that the unusual thin-strut fragments found on the Foster ranch debris field were merely casein-glue-treated balsa-wood wreckage from Project Mogul Flight 4. This claim typical of the broad and often vague pontification that pervades ufology is unsupported by any substantive evidence. In this case, skeptics could have easily tested the "glue hypothesis" as I call it but didn't. Perhaps their usual knee-jerk response denial to a potentially unsettling alternate explanation prevented them from even considering a scientific approach. I did.

I performed a series of straightforward and simple tests that provided unambiguous empirical data. The results led to an inescapable conclusion: The struts, which reportedly exhibited extraordinary physical properties atypical of late 1940s technology, could not have been made from balsa wood. This means that they could not have been components from a Mogul balloon train, which leaves no other conventional explanations that have not

already been eliminated. As such, an extraterrestrial origin for the struts and other debris-field material must still be considered a viable *possibility*.

Editor's Note: Robert A. Galganski has a master's degree in civil engineering and is employed as a ground vehicle crash safety systems research and development specialist. He recently received the Ufologist of the Year award at the 1997 National UFO Conference in Springfield, Ohio, for his contributions to Roswell Incident research.

* Only two of the seven photos in this article are reproduced. See the *International UFO Reporter*, Winter 1997-98, Volume 22, Number 4 for the remaining photos.