Mike Montagne Speaks Out

An Interview with Mike Montagne
By Reed F. Curry

Mike Montagne is an innovator, a thinker, and a rodbuilder (retired) of the first water. I was fortunate to be in touch with him recently and he graciously shared some of his history and theories. He even shared some of his victories, like the near-world-record steelhead below, caught on the Dean.

For those unfamiliar with Mike's rods I quote from Ernest Schwiebert's "Trout":

"But Montagne is a craftsman of startling originality, and not all of his creativity is obvious. Edwards built symmetrical four-strip rods. Montagne builds his sticks at irregular angles to create their widest flats, and the primary power fibers, perpendicular to the planes of casting.

His four-strip design offers twice the density of cane power fibers found in six-strip construction of the same section thickness.

Such four-strip sections offer more than mere power fibers. Montagne rods resist bending across the corners, concentrating deflection in the casting plane. Such performance tends to correct casting faults that twist other rods. Better distance and accuracy are also improved. Wave- linear behavior is crisp and clean. The ratio of power fibers to inert cane along the neutral bending axis is multiplied, even slightly higher than power fibers in the earlier Edwards Quadrates."

The Interview

Reed: Please tell me more about your taper design software. What approach does it use --- the stress curves of Hexrod, or something entirely different. What inputs does it require and what output does it deliver?

Mike: Those stress curve calculations don't fly with me. I looked over Garrison's work. The technique is crude -- and I never found an explanation in any engineering resources (not that I'm astute there) which qualified moment of inertia theory, his stress calculations as necessarily applied to a member suffering such dramatic bending, or determined just where the neutral axis falls under any given conditions. Thus you have some pretty poor methods there -- because they don't even take into account THE bending -- and the leverage thus imposing the stresses upon the member.

What I found is that the "stress curves" -- or method of calculation used by Garrison -- originate as a crude method intended for instance to analyze the stresses in a bridge. I never found a qualification of the theory ("moment of inertia"), and it appears it makes no effort whatsoever to determine placement of the neutral axis -- which, particularly with disparate high modulus materials such as carbon fiber, is critical to the real stiffness of a section. First and foremost, the stiffness of a section is regulated by the leverage the opposing tension and compression sides have on each other. THEN there is the what I call "effective lever length" -- which is not the actual length of the rod, but the length of the lever through which the resistance is accelerated by each station of the rod. In each station of the rod, ELL is a perpendicular of the LOD, passing through the station. THIS is the leverage acting on that station of the rod -- and Garrison's "stress calculations" don't even venture to determine it.

Maybe I'm all wet there, but I developed my own methods -- which are far more complex, and account for the geometry of the leverage, positioning of the neutral axis, etc.

While useful of course to deliver generic tapers based on accepted designs of assumed merit, extrapolation or interpolation is a far different power than "designing" a rod by computer -- which of course may entail anything from true development comprehensive of physics, to relatively simple empirical extrapolation/interpolation of/from, and restricted to, the scope of known, accepted models. To go farther than that, or to determine the limits of how far we can go, requires truly comprehensive methods.

"Hexrod" appears to have simply computerized Garrison's ostensible stress calculations, which to my understanding do not even take into consideration effective leverage upon the stations of bending. In other words, what he is trying to calculate isn't what's happening. My approach is from the opposite end of the spectrum. It may be the only such try.

One thing I should mention critical to the further use of data is, unless "tapers" are determined by the original builder's specs for a rod design, data would be inherently very misleading. A few thousandths of an inch are critical to behavior -- and may or may not suggest flaws in design versus imperfections in manufacture. The database should indicate whether tapers are design specifications or empirical measurement. If the data is from measurement, it should detail every measurement -- expected finish, average or mean of how many rods, etc. I can tell you though they were very accurately made, it would be very difficult to interpret my tapers from measurement.

There was considerable further work I wanted to do and it's very unfortunate I wasn't able to. I would have completed my work if I could have taken my later taper designs into refined rod lengths featuring my later reelseat-grip combination, which comfortably placed the heel of the hand at the very butt of the reelseat, with your little finger against the reel. While my screw uplocking seat weighed a mere 17.5 grams, the later wood seat featured an absolutely rigid connection with the reel, and, owing to ambitious hollowing and sculpting, weighed a mere 8 grams. This provided an effective rod length some 3 inches longer from a given rod. But I also had refined my ideas of how long to build each rod to perform a given workload.

My most "mature" designs were rectangular sections featuring rather dramatic differences in the tapers -- particularly in the taper progress of the upper tip sections, which are the most critical rod segments of faster, compound tapers in any section design.

If data is from measurement, average or mean over numerous rods, it should also indicate it is derived from however many rods, the vintage of each specimen, who measured it, how, and with what, because those who are to interpret the data well must take this into account. Temperature and accuracy of tools of course is also vital to the validity of data. Knowing the builder's methods is also critical for interpreting empirical measurement. Did their equipment and methods render an assembly of straight taper segments, or were transformations progressive? All these respects weigh in what a taper specification or taper data means.

I can tell you I only measured a few rods, if any at all. I don't actually remember measuring any but a few graphite rods, but it's possible I measured a cane rod or two -- at least perhaps a tip or ferrule step.

No, my work was very different. Ultimately the application I developed designs a rod from data about the material: tensile and compressive strength; elongation/compression per stress; and mass. In abiding by maximum unit stress, and in making most efficient use of the material, it always delivers rectangular section designs -- of course, wider across the plane of bending than deep, in the plane of bending. Rectangular section design of course is very different from hexagonal or typical regular polygonal sections -- and, though a rod may look similar to the naked, simple eye, tapers and taper possibilities are very different.

Nonetheless, my application starts elsewhere. First the question is, "How is a rod to bend/behave during a casting cycle, to deliver work/performance most conducive to casting requisites?" This is the central question of all real design attempts. We can develop by understanding, or we can grope at delivering what we think we are improving, slowly, by empirical processes -- building rod after rod, hoping changes contribute to better performance, but not having a formula for optimum performance, and never knowing even if we have really "got there" yet -- or how much further to go to realize virtual optimums.

Oddly perhaps, my rod-building was initiated by an evening's evaluation. If you've seen my original catalog, that evening was born what Andre Puyans used to call Montagne's theory of linear acceleration. All the rationale presented there transpired from something like a half-hour's thought and a single drawing.

What the theory of linear acceleration was, is a geometry (many others -- Mel Krieger, etc... -- have borrowed from it since) for proper operation of a fly rod. The thoughts were inspired by an evening's casting from a platform I regularly practiced at -- but immediately they posed a refutation of Garrison's postulate that a fly rod delivered its energy during the recoil phase of casting. The theory of linear acceleration indicated acceleration occurs instead, during the increasing bending phase of what I call the casting cycle.

No one can truly design a rod from physics and material data, unless they know how a rod best behave, and unless they develop the technology to deliver designs which will deliver that behavior. The first issue thus was to determine how a fly rod best operate during the casting cycle. Much thought has been given this issue over the history of fly fishing, and it is perhaps the most important issue of fly casting. The intrinsics of a proper analysis are critical not only to fly rod design, but to understanding casting.

My linear acceleration postulate is simple physics and ballistics. Owing to the relatively low sectional density of fly lines (sinking or floating), it is critical how a fly line is accelerated, because it is critical how a fly line behaves as it is presented to the air it passes through. As air resistance affects a fly line dramatically, not only in terms of deceleration, but in terms of aerodynamic behavior as well, there are very definite requisites of acceleration to achieve optimum performance from the fly line.

Owing to the relatively low sectional density of fly lines as compared to the usual projectiles of ballistics, the ideal scenario for distance or distance with minimal energy, is to accelerate a fly line in a linear manner. This presents the least cross-sectional area to air resistance, and renders the greatest possible sectional density -- weight per cross- section presented to air resistance. Greater weight per cross-sectional area retains energy/inertia proportionately better.

In order to achieve linear acceleration, the back-casting stroke has to align the line in what ballistics calls, the "line of departure" (LOD). The LOD is the theoretical (real) line in which the projectile/fly line is ultimately accelerated in.

The theory of linear acceleration thus dictates the casting cycle. If a rod performs the requisites of linear acceleration, then as the fly line is accelerated by the rod, the tip of the rod must take the line of departure (unless the uppermost section is bent into the LOD -- in which case the relevant point is a determinative station of the rod within the LOD).

This means from an initial, relatively inert moment initiating the forward casting cycle, the rod must bend increasingly so as conducting the fly line in the intended LOD, to a moment of greatest bending (MOGB).

The moment of greatest bending then is defined by a point on the LOD where a perpendicular to the LOD, passes through the axis of rotation (AOR). At this point of the casting cycle, the tip is the closest it will be to the butt or AOR. The axis of rotation moves during typical casting practice, but for the most part we can consider it the wrist of the caster -- which moves up and down, forward and backward, in coordination with the bending and recoil of the rodsection.

So you have this semi-horizontal LOD rendering an angle of departure (AOD) necessary to provide a trajectory to reach the target with an intended behavior. We have a beginning of a casting cycle comprised of a relatively inert (hopefully, stabilized) rod, with the fly line aligned in the LOD. We have increasing bending during an increasing bending phase of the casting cycle, to a moment of greatest bending -- conducting the tip/fly line in the LOD.

Beyond the MOGB, we have a recoil phase of the casting cycle, and consequent rod behavior during the recoil phase -- generally comprised of recoil beyond the neutral position (owing to inertia during recovery, which carries the rod to and fro with successively less excessive energy, beyond neutral/straight), and a number of vibrations ultimately culminating in "recovery" to or nearly approaching a neutral condition most conducive to initiating the reverse casting cycle when the fly line is poised for reversal of the cycle.

The conclusion of the theory of linear acceleration is that very little if any acceleration is engendered by the recoil phase of such a casting cycle, because recoil can only occur if less acceleration force is applied by the rod; and because, as the tip leaves the LOD under such circumstances, and, as a result of its linkage with the fly line, the tip therefore has less effective forward speed than the fly line -- which already is accelerated in the LOD. In forward and backward casting developing linear acceleration, very little acceleration is engendered by recoil.

While this may define the process and objectives of the physics of the casting cycle, the question still remains, how should the rod bend then during the casting cycle?

When I began, as I understood the issue (largely as Schwiebert presented it), there were three basic schools of thought, which I summarize as the fast, progressive taper theories typified by Powel, Winston, Howells, Dickerson, and others; the school of relatively equal bending throughout the length of the rod as championed by Garrison and his ostensible stress curve calculations; and the parabolic school of design -- where a relatively supple buttsection has little authority over a relatively stiff midsection, usually coupled to a relatively fast tapered upper tip.

An evening I spent with Andre Puyans might typify how the virtues of each were typically weighed -- always by experience affected by little other than how well we can wield each type of instrument without a definition of ideals. Andy one evening had me cast an early E.C. Powell that decided the issue quite clearly on such terms. He sent me outside saying, "CAST IT!" The best six-strip I ever touched. A truly splendid rod. But why?

The parabolic school delivered an ill-behaved instrument -- and we can easily understand why, evaluating the rod over it's incumbent casting cycle (graphed as delivering linear acceleration). Owing to its deficient buttsection, it exercises no authority over the remainder of the rod, and suffers a hugely wide, repetitive, time-consuming (slow) recovery to a neutral condition. "It vibrates." It develops acceleration only by tremendous overloading of the lower butt, and after the MOGB, suffers the widest pattern of recoil, and greatest number of bounces in finishing the casting cycle -- which are communicated to the lower part of the loop.

The parabolic (which is something of a misnomer, as more or less parabolic taper conformations give the performance of the Powell) may cast the farthest per its weight however, because by far the greatest concentration of the weight of a rod is in the buttsection -- and it has none. It may of course NOT cast as far -- it only generates more force per weight. It achieves this perhaps meaningless distinction at the expense of the worst possible behavior, the least control, and great stress on the lower part of the rod -- the latter of which would be a decided disadvantage in building rods for playing steelhead or salmon, but which also produces adverse, uncontrolled, bobbing inertia on light leaders in light fishing.

Some people believe the greatness of a rod is in the taste of the caster. But no caster overrules physics -- all of us have to contend with physics. Our casting is ruled by physics. The physics of the parabolic, on our superficial evaluation (here, so far), are the worst possible. Instant recovery alone is conducive to ideal line behavior, and the necessities of initiating a subsequent casting cycle. The parabolic has the slowest possible recovery -- so slow in fact it is ill prepared for subsequent casting cycle phases. In pictures, you will note the huge forward arcs of rods in the recovery phase of the casting cycle, typically huge loops, and tremendous waves generated in the lower part of the loop. All are the result of inherently terrible recovery characteristics.

Next we have the Garrison school -- rods which ostensibly bend equally throughout their length. The inherent attributes of this class of taper design fall between the parabolic and the faster tapers proven by Powell, Winston, and Howells.

On the optimum end of the spectrum we have the "fast" rod. Owing to larger buttsections, the faster rod more instantly communicates power to outer segments, recovers from less bending, and far more potently recovers from bending -- it has far more authority to do so.

Unfortunately, my first work was influenced by the champions of slower actions and tapers -- who seemed largely to influence general thought. I did not want to build rods which outperformed typical casting skills. But a year or two into this, and largely thanks to Andre Puyans' tremendous guidance, I got straightened out: I built the fastest creatures a caster could handle. Upper tipsections were as fast as .035-.040 thousandths of taper in ten inches. Why so fast? My application showed the way.

As I've explained in loose terms, no one really "knew" how a fly rod should bend during the casting cycle. Understanding physics, there is an ideal. But how do we achieve it? What is this ideal taper for fly casting and linear acceleration?

In order to resolve this question, I built my application.

It has no name really, but I suppose if we are going to refer to it, a handle is conducive to discussion. The last version was written to run on an early Apple II -- and owing to having to operate with 64K blocks of memory by "bank switching" three "chained" (exchanged) program segments -- each of which was named M1, M2, M3, respectively -- let's just call the application "M123."

It happens I'd calculated ballistics since I was 10, and the background was instrumental to solution. What does M123 do, and how does it do it?

Acceleration is the product of force. For instance, the acceleration of gravity, 32 fps/s, is the product of our weight acting on our weight. A force acting on an object of weight W, applied for 1 second, achieves 32 feet per second of velocity. Persistence of this force generates an additional 32 fps of velocity every subsequent second.

Understanding this, we can determine the relative acceleration of a scope of taper designs.

How?

Simple really. Given that a casting cycle is initiated with a neutral rodsection exerting zero force, and that a casting cycle culminates at a moment of greatest bending of maximum force, we can divide up the linear acceleration period (LAP) into segments defined by a rodsection intersecting the LAP from the axis of rotation. Each segment of the LAP will be subject to a force relative to the amount of bending in the section.

By adding up the force segments of the LAP, we can determine the relative acceleration attributable then to different bendforms.

Other respects desirable to rod design are determined by recovery. These are largely behavior related. We can also appreciate certain behavior characteristics during the acceleration phase. To render an evaluative expression of performance or behavior attributable to a bendform, an additional scale was developed which further expressed how "nicely" or ideally a rod delivered its incumbent performance attributable to its bending characteristics (essentially rendered by taper and material).

The operation of this rather classic application (in terms of software development) thus centered around undefined "bendforms" which could be physically represented on a display.

The greatest initial innovation beyond realizing we could rate relative acceleration and performance behavior, was the method of acquiring the prospective bendforms. To generate the bendforms, I developed an equation that could deliver any bendform possibly useful to evaluation.

How did the program work then?

A range of arguments is operated on. That is, we input the greatest and least X and Z factors we want to operate upon (bendforms more radical on both ends of the scale of slow and fast, and complex compound, than we would ever want to use can be generated). Another input variable indicates for each of the two principal curve- regulating factors, the size of the increment by which we would step through the range of each -- minimum to maximum. The program then iterates for one X and every Z, and then through the next X and every Z, until combining every possible combination of X and Z throughout the scope/range directed.

Each X and Z combination will generate a specific bendform. At each X-Z combination, the application graphs this bendform as the moment of greatest bending of a casting cycle. It divides the casting cycle up then into so many individual segments defined by a proportion of bending of the same bendform -- with each respective proportion diminishing to zero bending, which defines the beginning and thus the total scope of the casting cycle.

The recoil phase is displayed likewise, demonstrating, from the angle of the axis of rotation, the respective scope and behavior of recoil attributable to the bendform.

The relative force generated over the increasing bending phase of the casting cycle then is appointed to the X-Z pair, as well as evaluative expressions of behavior.

The bendform is also evaluated for proportionately delicate casting cycles -- producing a numeric evaluation of its versatility. Effectively, this further evaluation depicts how similar its delicate casting cycle is to its long-distance cycle and behavior. The nominal expression rewards the design for similarity, because, to the caster, the rod casts the same, forcefully or sweetly, to deliver diverse distance or delicacy. Another factor depicts relative natural breadth of the loop.

As each X-Z combination is graphed, it is paused on the screen for visual evaluation, with its nominal acceleration and behavior evaluations expressed numerically, as well as degrees (total angle) of acceleration, recoil, etc.

So, fifty prospective bendforms, representing actually fine increments of a wholly adequate diversity of taper philosophies, can be evaluated in some 5 seconds each -- or some 4 minutes.

Upon concluding the exploration of taper philosophies, the respective evaluations of each are graphed for each Z and X. Here we see all the data of each hypothetical as compares to the others.

I can hardly convey how insightful the visual and numeric evaluation is. There IS an ideal taper philosophy. It is very fast. To my surprise, it has sort of a hinge in the upper section -- with the outermost tip a bit straighter. Hindsight explains this now, but after some 6 or 9 months spent fervently developing this application, I cannot tell you how instantly and terribly gratifying its results were. Thousands and thousands of hours of mathematic evaluation and development were reduced to seconds.

This much of the application resolves WHAT we are to develop. Now, how do we build it?

To make this part of the story "short," there are substantial breakthroughs required. The logic is not as straightforward as we might assume, because materials have limitations, require different considerations, etc. Garrison offers an engineering method called "moment of inertia." You will note it doesn't even account for angle of incidence or leverage on the bending subsections.

In lieu of non-existent methods, a comprehensive system had to be developed -- taking into account my hollow-building developments, and so forth. The design respects of the application thus deploy the laws of acceleration to deliver a design for any selected bendform, in any material, in any rod length, to cast a given fly line any distance with the attributable behavior.

M123 much as indicates ideal bendform. You simply confirm acceptance of a bendform, input the foregoing arguments of length, line weight and type, and casting distance, and the program designs the hollow-building, does the layout for all my equipment, specifies how to cut the culms, how many good circumferential inches are required, how to split the cane, and even renders essential guide-spacing as determined by segments of bending. All in something like a second.

M123 comes pretty close to divine revelation.

Andre Puyans is a heck of a caster. He knows cane rods and cane rodmakers and design like no one else I know -- aside perhaps from the greatest masters who lay their hands on the wood. He is one of perhaps a half a dozen people to have seen M123. One evening at his shop after a 15-minute demonstration, a bit teary-eyed, Andy said something like, "I learned more in 15 minutes about fly rods and fly casting from that program than I learned in the whole rest of my life."

Reed: Is it currently available, if so on what platforms (Windows 98, 2000, Mac, etc.)? Cost?

Mike: The last version of it ran on an Apple II. My Apple was a very advanced machine for that day, and unfortunately, corrosion or something set in. I can no longer run the machine. I tried about 2 years ago. It's seemingly dead. However my brother Ray, who was an engineer on the Apple II GS, and who is still an engineer at Apple, was able to resurrect the code, and get the application running under an Apple II emulator on a Mac.

He no longer has that setup, but did save the code from the source files, and I still have it. There is substantial difficulty getting it to run, as the ultimate stages of M123 took advantage of exotic hardware (a Mb of RAM) -- which situation no emulator reproduces. I write software for a living now, but we're talking a quarter-million-dollar application here to resurrect M123 to modern OSs from code. If a major financier was interested, I could re-write it for Windows 32-bit. The only justification of such an effort would be production of high-modulus rectangular section design -- which, believe it or not, was my only original intention. I only built cane as a prototype to prove the design.

Reed: Mike, what do you see as the advantages of the rectangular section?

Mike: I'll just present them roughly, here. The advantages are phenomenal.

MOST of a rod matters little, if a builder is rendering well-distributed, faster tapers. What is critical, is the upper tip-section, and exactly where your compound tapers break off. Missing this juncture by 2 inches, and falling short of ideal proportions there has dramatic consequences.

Why does most of the rod otherwise matter little? Because when you get proper bending, the butt largely just drives the tip -- and the vital bending, necessary to delivering either great power or wonderful delicacy with no vibration and 1-inch loops, largely transpires in a limited segment of the upper tip. The bendform is critical. The challenge is perhaps intimated by the dramatic transformation at a shoulder in the upper rod, below which behavior is largely similar despite the magnitude of work asked from the instrument.

But how do we get this critically defined, dramatic bending in this limited upper section? And where is this area of the rod we should understand so deeply, under which, though "minimal" material is dedicated to the objective, little bending is suffered from what must be delivered to the highly flexible top?

Each part of the upper tip is critical. So let's evaluate the rectangular section against the hexagonal -- or any other regular polygonal section.

A bending member incurs tension on the outside of the bend curve, and compression on the inside. Somewhere between the two opposing extremes of the section in the plane of bending, is a "neutral axis" -- where theoretically no tension or compression is realized. The neutral axis is governed by the tension and compression response intrinsic to the material. That is, if tensile strength is far greater than compression strength (as it is in carbon fiber), the neutral axis moves way over toward the tension side in bending -- tending tremendously to over-stress the weaker compressive side. This is very adverse to deploying the material to the degree commercially promoted by the nominal evaluation, (tensile) "modulus."

We cannot achieve in such a member, suffering reversing cycles of bending, performance proportional to the commercial nomenclature, (tensile) "modulus." Why?

Any material can only withstand so much tension and compression under bending. Dissimilar tensile and compressive properties are deflected so as stresses the weaker property, and so, the ultimate performance of the member is limited by its weakest property multiplied by the disparity between the weaker property and stronger property. Increase tensile modulus, and you cause compressive failure all the sooner.

How does this apply to rectangular versus regular polygonal section design (round, hexagonal, pentagonal, etc.)?

Given we require this focused bending in a limited area of the tip, and given that we want to deploy a maximum section depth to utilize the material most efficiently, we must build the high-performance rod in this area of high necessary bending, with the greatest section depth possible. The material has greater leverage on the neutral axis -- and thus more efficient stiffness -- the greater the section depth.

But given the bending required, we can only build the section so deep, or we exceed unit stress. Regular polygonal sections therefore can only be built "so" deep, or stiff. The greatest section depth possible is a depth, in the plane of bending, which delivers maximum tension or maximum compression under the required bending.

Thus a hexagonal section can only be so stiff as delivered by a section of such depth. Only a rectangular section, built wider, across the plane of bending, can deliver more stiffness. ONLY the rectangular section in fact can be built INFINITELY more stiff, without raising unit stress above tolerable or desirable levels.

How much stiffer is it?

Well, if you have a hexagonal tipsection 50 thousandths deep, and a rectangular section 50 thousandths deep and only 25 thousandths of an inch wider than it is deep, there is a tremendous difference not only in stiffness, but in efficiency.

The hexagonal section has what I call "work-performing flats" which are (from memory) something like .028 inches wide. These opposing flats, separated by the greatest section depth in the plane of bending, incur the greatest stress, and perform by far the greatest amount of work. The rectangular section, able to deliver this same amount of bending, is .075 inches wide. It is 2.67 times as stiff under mere static conditions!

But under dynamic conditions, it enjoys a substantially greater margin of superiority. How?

The neutral, midsection of the cross-section is largely dead weight, along for the ride, and taxing the relative stiffness of the work-performing flats.

The midsection of the hexagonal rod is something like .056 wide; and the relative dynamic efficiency of the stiffness expressed by the proportion of work-performing material to non-contributing mass then is something like .028/.056 = 0.5. The proportion of neutral area on the solid rectangular section then is .075/.075 = 1. The rectangular section, while 2.67 times as stiff, is ALSO twice as efficient. Given this efficiency for 2.67 the degree of stiffness, the solid rectangular section is something like 5 times as stiff under dynamic conditions of casting -- the critical stations of this of course, being the upper section above our vital "shoulder."

Other factors contribute further, such as weight of glue lines. But given that I built tipsections hollow to within less than 10 inches of the very tip -- and removed more weight from tips than previous makers did from buttsections -- and something like 4-5x the weight from buttsections that had been removed previously -- you can understand the performance disparity in faster rods.

[Note: This image is the hollowbuilder]

My construction was hollow like an airplane fuselage -- with some 250 circumferential ribs reinforcing progressively thinner walls along the rodsection.

Reed: Would you give us more on your later rods in terms of their unique tapers?

Mike: Most of the rod served as a very stiff lever to propel the upper section -- with just enough bending down below to move the upper axis of bending through the casting cycle, in a relatively linear, controllable manner. Buttsections were usually simply some .025 to .050 over square, to this upper shoulder.

Above and comprising the upper shoulder, the rod was comprised of dual compound tapers -- differing in the plane of bending and across the plane of bending. Final (uppermost) tapers were incredibly fast.

Reed: How were you able to work at less than 40 thou for tips (the Payne 96 and the Leonard Baby Catskill mike out at .042" and .040" respectively, these were both done on saw bevelers)?

Mike: Yes, but I built steelhead rods with .050 and under tips that would rip a #9 or #10 hi-density shooting head out of the water in one stroke and throw 140 feet of line with one false cast and a huge - 6-inch wet fly. Also consider that at the rate of taper approaching .040 per ten inches, and as I built my rodsections 5 inches longer on both ends before cutting to tip and ferruling length, I actually built many tips that converged to less than .020 in section depth -- comprised of a hugely irregular rectangle of opposing trapezoidal and right-triangular strips.

(Try THAT in a Garrison rod binder, and see what kind of action you get! Any quad builder can tell you binding and glue-up are a nightmare.)

How did I do it?

Buttsections could usually be built of one, straight taper. Tip sections, as processed by the beveller, were another straight taper, to the shoulder. Double-compound tapers, differing in the plane of bending and across the plane of bending, were then produced by HAND SCRAPING, in forms quite different than Garrison's screw-jack contraptions. My forms were precision machined by yours truly in 15-inch segments from precision stock. A divider keeps the strip on each side of the form. The sides are rigidly and fastly bolted together. Shim stock was sometimes used for further taper progress, but double straight compounds proved not only to be adequate, but a more desirable process. With this process I produced perfectly configured and dimensioned right-triangular strips to under ten thousandths of an inch.

I think in this image I may be finishing a hand-planed strip, but this is the essential process. I clamped a strip in place and pulled to the tip with a razor-sharp hand-scraping plate (hand turned after meticulous sharpening). Machine beveled rods only required operation on the top 15 or 20 inches of the rod. The form to the right was a prototype trapezoiding tool which I soon discarded. Come to think of it, from the placement of my tools here, it looks like this picture absolutely must precede my machinery -- but probably by very little.

I still have quite a few of my surplus ends. They're rather remarkable under magnification. A fellow did a study of classic woodwork at University of California, at Berkeley. He came over to see me one day, and took quite a few samples. We probably spent half a day or more together, discussing glues, methods, etc. His project was electron microscope photography of glue joints.

He was going to compare my work not only to other rodmakers. He had samples or pieces or something even of Stradivarius' glue lines. He sent me some pictures which were quite incredible, and it turned out his study found my glue lines 3 times tighter than Stradivarius -- who had the second tightest glue lines of the examined history.

By the way, I don't recall the exact figures any longer, but in a whole rod I had less than just a few tenths of a gram of glue. Yet there are perfect microscopic filets in the corners, on the interior of the rod. Gluing was fast and furious -- but a very exacting and painstaking process.

Reed: Of course I would be thrilled to get more pictures of your rods and machinery, especially the "secret beveller".

Mike: I'm afraid if I don't do an awful lot of work I may lose a huge number of pictures. They need to be digitized.

The beveller was more impressive than you might guess. I still have it, though it has been disassembled and vandalized.

I built from hand-split strips, and, converse to Garrison, would never straighten a strip. I did destruct testing on straightened strips -- produced also by far more gentler processes. They always break like crackers. I can straighten a node without any charring whatsoever, but I would NEVER do that to bamboo. When you consider the flat width in a rectangular buttsection is twice as great as that of a hex section, then you can understand the distance and amount of straightening required to build rectangular out of straightened strips is preclusive. Imagine the sheer placed on the "interlocking" fiber ends -- held together by mere overlapping of bulbous ends. In my opinion, "straighten" a node, and you don't know at all if you've started to slide it apart. But gluing broad, crooked rectangular strips then is almost impossible.

If you look at one of my rods, you'll see the grain follows the strip perfectly, even in the node. So, what my beveller does is allow you to steer down the crooked strip -- even traversing the hump of a node while maintaining tolerances of approximately 3 ten-thousandths.

I have not been to anyone else's shop except Jim Shaaf's once, to pick up some bamboo. He had the Dickerson machine, which he had gotten from Tim Bedford, but I never looked at it, and had long before built my beveller, and was convinced nothing better could be built with conventional cutters of any variety. I'd seen a picture from Dickerson's time, and I think there was stuff stacked all over it anyway.

In any case, I was talking to Schwiebert briefly and Tom Dorsey of Thomas and Thomas at an International Sportsman's Exposition. Tom had heard about my secret beveller from who knows who, and Ernie just happened to stop in on us.

Tom asked a whole lot of questions, and eventually asked me then if my beveller was like the Leonard beveller. I didn't know, as I'd done no research at all beyond reading Schwiebert on cane rodmakers. Tom then explained how the Leonard beveller was laid out -- and I answered "no." You can steer a strip through the Leonard beveller -- but not while maintaining accuracy.

My machine was almost silent, nearly dust free. It could handle amazingly convoluted cane with perfect accuracy -- though the job and the setup was certainly fussy. It was fast. It was single pass. There was almost no waste material. And the faces it produced were so perfect, they shined like mirrors. Under magnification, you could see a perfect band of light through the edge of a strip; and you could cut your finger to the bone with the edge of a strip, so little did the cutting process impact the unsupported edges of the material.