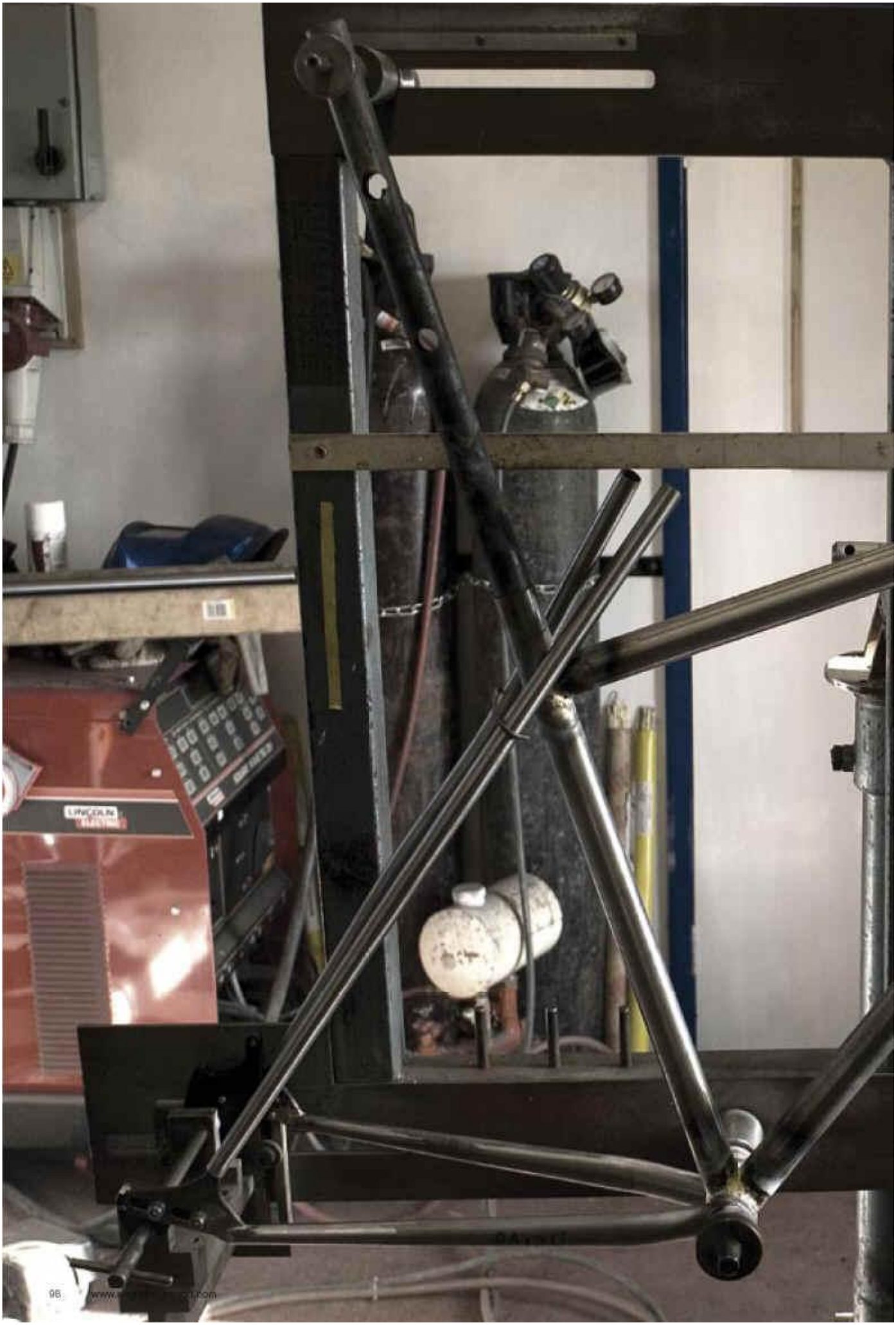
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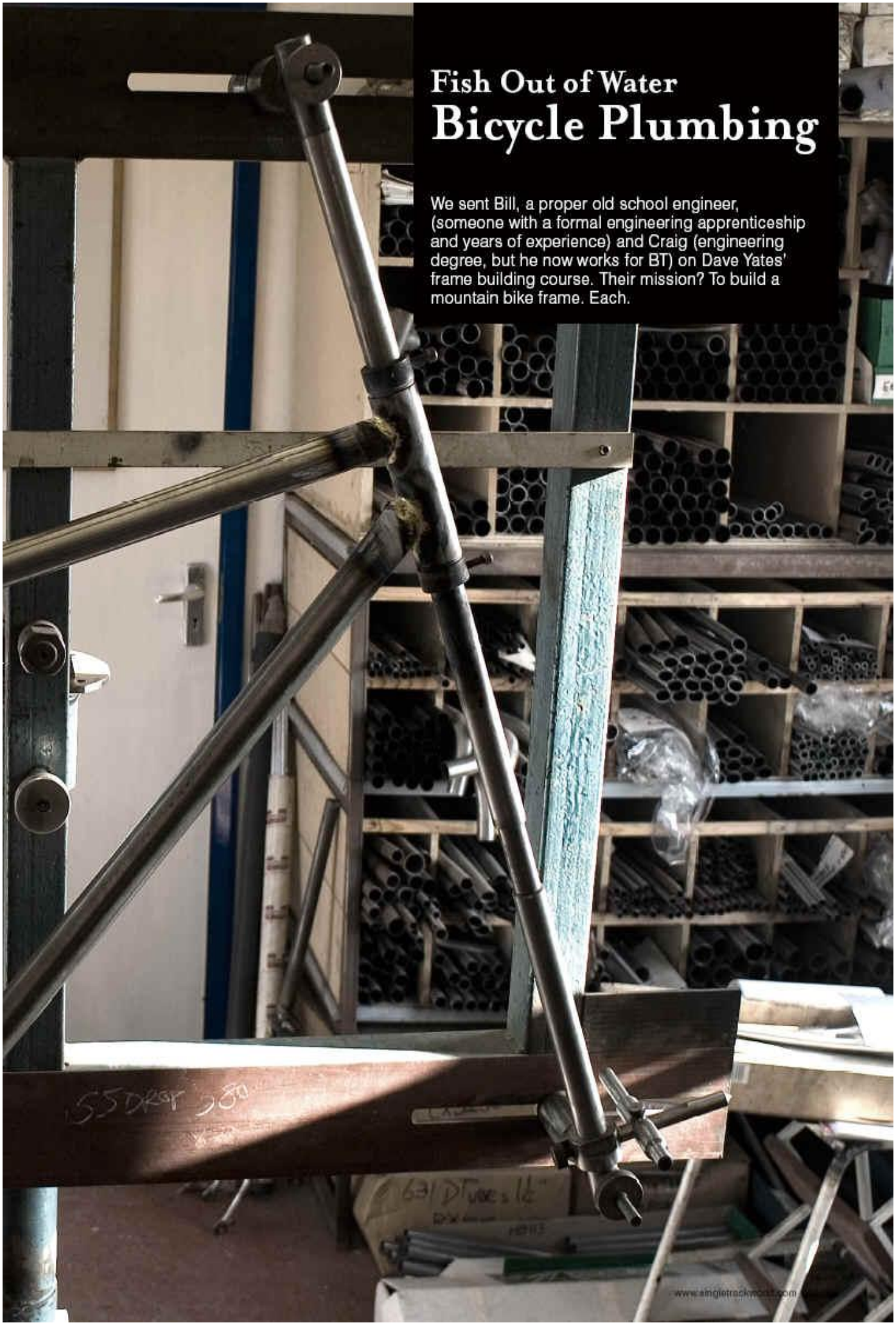
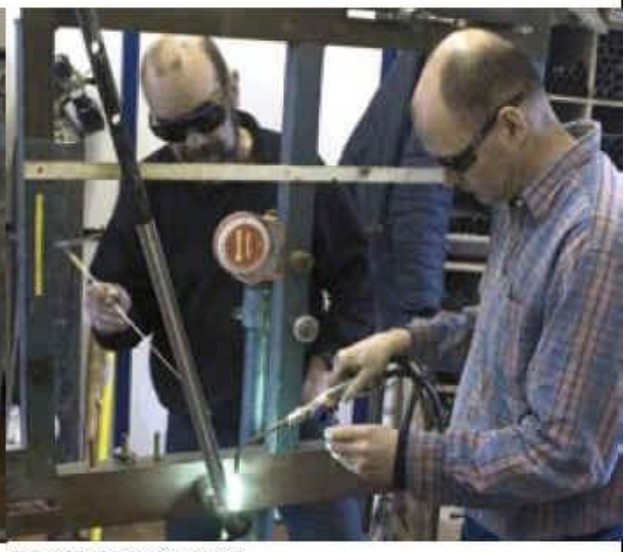


Fish Out of Water

Bicycle Plumbing

We sent Bill, a proper old school engineer, (someone with a formal engineering apprenticeship and years of experience) and Craig (engineering degree, but he now works for BT) on Dave Yates' frame building course. Their mission? To build a mountain bike frame. Each.

This is the doofer…and this is the flange whiffler…



Dave poised with his sensei's chopstick

Day 1: Virgin Welders

The first day, and Bill takes up the story:

Whether you choose to make a road frame, mountain bike frame or some macabre hybrid, Dave reckons within five days you'll be able to go home from his course with a perfectly serviceable frame. And possibly a pair of forks. The secret to making Dave's course so accessible is his custom made jig. His current one is the 'Mark Three'. This is to be used in conjunction with your own 'Mark One Eyeball'.

Dave's safety brief, in a true gritty North Eastern style is straight to the point. "Assume everything's hot. You will cut yourself. Everyone does. One bloke the other week; oh I don't' know what he did, but there was blood everywhere, on the tools, on the walls, he made it to the kitchen, it was all over the floor. Debbie was mad. Still, at least there was none on the frame - it makes it rust"

We need to decide on tubes. 853 seems to be the order of the day for the main front triangle. I've chosen some shapely oval 853 tubes for the top and down tube. Craig appears to have taken a more conventional circular approach. The difference in the tube weights is noticeable even at a 'component' level. We've both opted for curved seatstays in a Merlin-style. Craig has a stiffer 853 option for his chainstays, while I've gone for a slightly more compliant Columbus make up. Dave likes 853, but he's not precious. He once made a frame out of four different manufacturers' tubing.

Half expecting a sit down talk about geometry, Dave is already showing us how to mitre the seat tube to the bottom bracket. Before we've even sorted out the details of the head angle and seat angle, I find I've fitted the mitre (Craig, far less experienced is still faffing with his pipes), and I'm brazing it to the bottom bracket shell. I've welded before, Dave's quietly impressed (so I like to think) and the ice is broken. Craig's caught up, he's allowed the respite of a tea break before he's also brazed his seat tube to the bottom bracket. It's not even lunchtime, but already we've leapt, nay bounded over the first hurdle and fabricated our first frame sub-assembly.

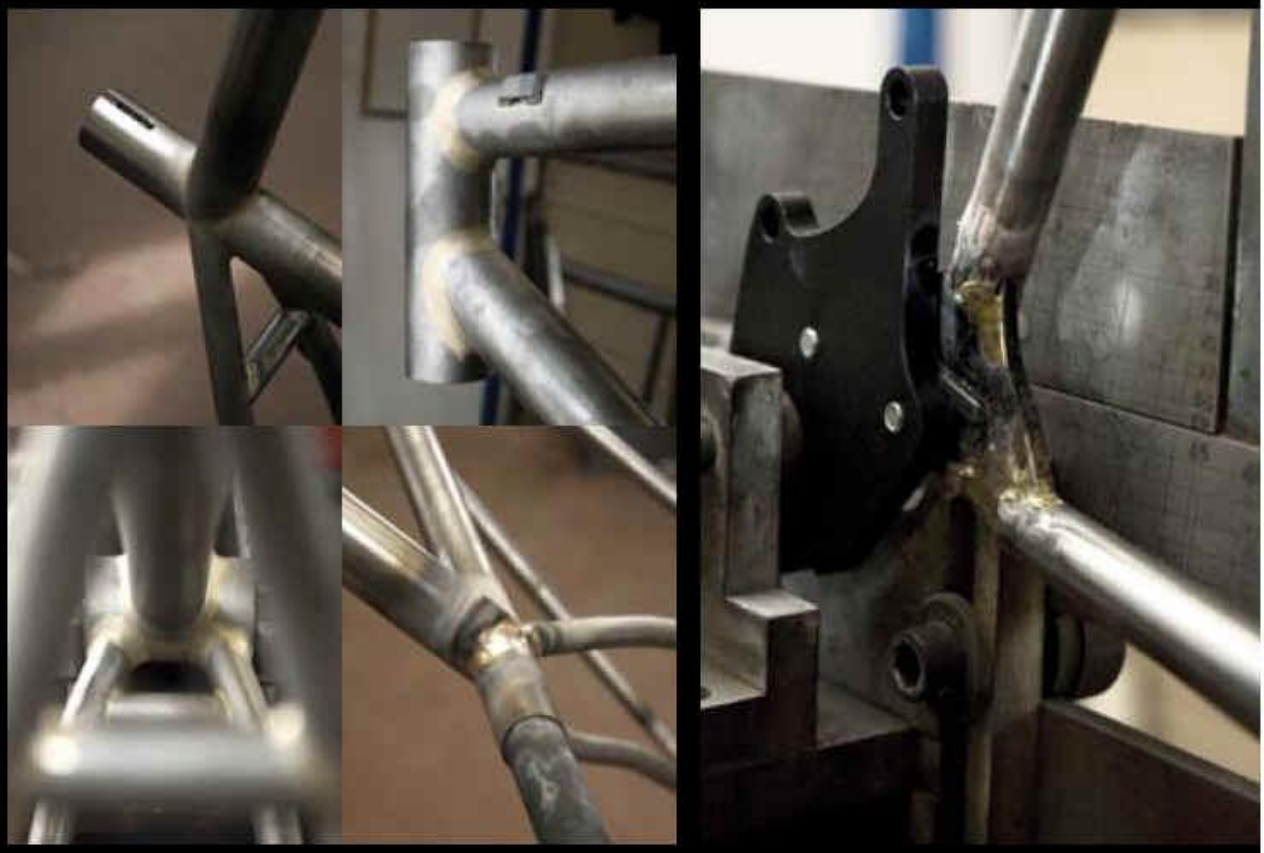
Craig:

I've never welded before. I've soldered, but that's it. I think I'm mechanically able. I'm not sure everyone else does… Nevertheless, with careful instruction from Dave and a clear guide on what to heat at what angle, and when to apply the brass, I manage to successfully braze my first ever joint without fanfare or fuss. Dave's pleased. It's definitely better than Bill's. And no zip ties involved.

Bill:

After lunch, Dave and I get to discuss head and seat angles. Making things easier, I've brought the frame around which I'm going to base my custom build, so measuring angles and drops is easy. If you want to turn up with your own angles on paper, that's fine too. Dave recommends bringing any componentry you might want to fit, and forks and disc brakes too. Here Dave's jig comes into its own. Everything centres around the bottom bracket, which is why it's the first sub-assembly. Setting the seat angle is then easy. Then, taking into account the forks you're going to use,

Just imagine the wrath you'd incur by moving this lot round…



the bottom bracket drop, and the desired head angle, the steerer is locked into place in the jig. This makes the job of fitting the top tube easy, dependant on the effective top tube length you require. The downtube is then just cut to length to fit. I say 'makes easy', but I've chosen these tricky oval tubes. Craig's 'standard' choice seems a better option now. Still, I'm sure mine will look better. By the end of the day, my tubes are all cut and mitred. I'm excited; tomorrow I'll be brazing them all together.

Craig:
As Bill's been hogging the jig (Honestly, the man's like, 46, and he still thinks it's acceptable to 'dibsy' the jig), I've been working on the back end. Dave's got some dropouts in for the Rohloff hub, which come with some horrible threaded eyes, presumably for panniers. So I busy myself sawing them off and filling down to make a smooth curve.

Day 2: Brazes and Blisters

Bill:
After what initially seemed like a good idea, the oval tubes have proved tricky, but I've finally got the front triangle tubes and joints in a condition Dave deemed worthy. Assembled in the jig, Dave instructed me to put on small brazed tacks on each joint. This held the tubes together in the correct position, enabling me to do the brazing without the tubes moving.
Drama number one; downtube tack failure. With reactions only found in Marvel comic books, Dave took the tube, flamed the offending tack and repositioned the errant joint with a new neat brass tack. Drama over and I continued with the rest of the frame. Front triangle successfully brazed and ready for stays.

Craig:
Meanwhile, I've already brazed my chainstays to the dropouts, and I'm hopping around waiting for Bill to get the heck off the jig so I can put my front triangle together. He's already had a couple of digs about 'These youths that do nowt but design and talk in management'. As he sips his tea nattering with Dave I remind him of this and ask if it might be possible for him to take his still-warm frame out of the jig so I can have a go.

...after successfully brazing three of the four joints on my front triangle, Dave casually asks if I remembered to check the orientation of the bottom bracket. I didn't.

Bill:
Typically, avoiding the simple option (I'm all curves this week) I've chosen some really cute little dropouts, but like too many things in my life, they're an inch shorter than I'd like. Dave offers to lengthen them so they are suitable for the rest of my frame, welding on a bit of spare steel. It's then not too hard to fit and braze them into my stays; I'm finished brazing not long after a superb round of bacon butties.

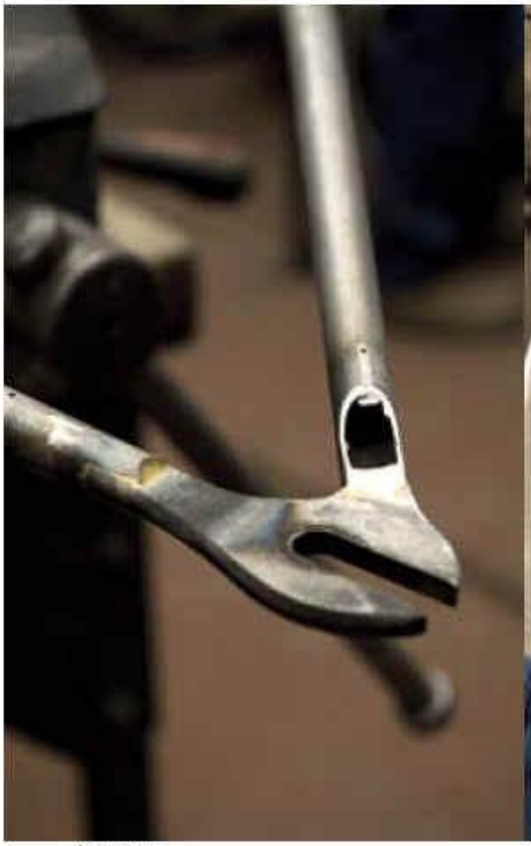
Craig:
Drama No.2: after successfully brazing three of the four joints on my front triangle, Dave casually asks if I remembered to check the orientation of the bottom bracket. I didn't.

It's back to front.

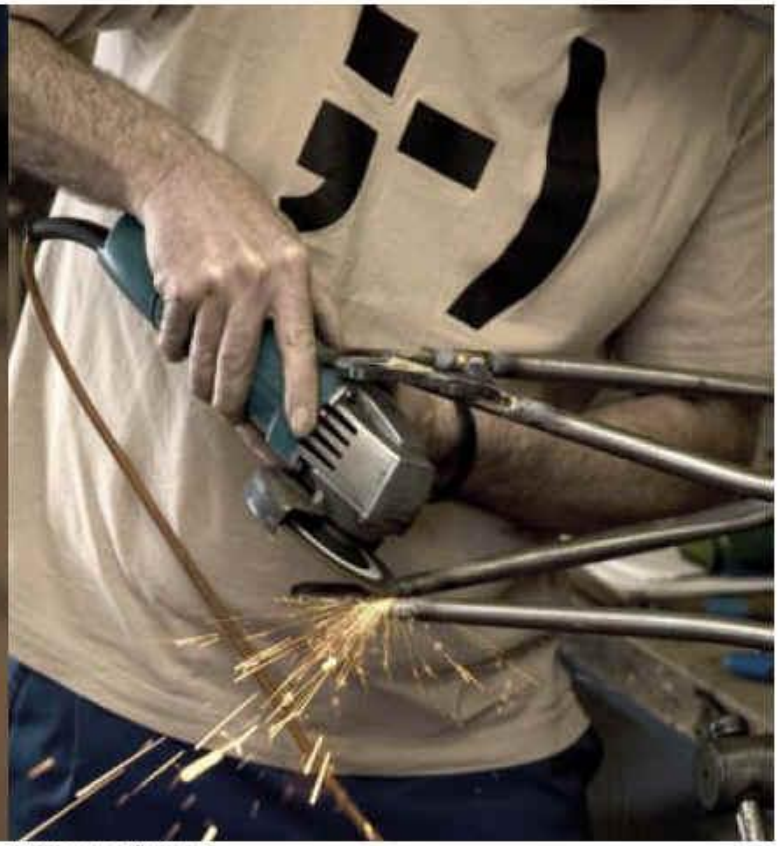
Bill says I went a little pale. Thankfully I recovered my posture before he turned the camera on. Dave came to the rescue, this time under my careful supervision(!) he managed to pop off the bottom bracket shell and replace it in an impressive five minutes.

Bill:
Craig is still hogging the jig. I have a go at some fillet welding on a test joint I made. At this point I realise how easy Craig has it with round tubes; my ovals are definitely harder to mitre. Dave's impressed at my fillets. In fact he offers me a job. Craig thinks he was joking, but I hope he was serious. It's only Tuesday, I've had so much fun. I've already written my letter of resignation for work.

Craig:
With my frame cooling in the jig, I set to work measuring the chainstays to length. It takes to the end of the day to get them just right, slowly eking the curvature from the raw 853 stays to mate with the bottom bracket shell. It's a slow process. More than once the file screeches and slips and I fear for my wrists on the raw stay ends ('Always file down and away, not up and into' says Dave). But it's very rewarding when the fit is nigh-on perfect and even Bill admits the fit is 'tight as a gnat's chuff'. Tomorrow, first braze will be mine!



Steel poetry



Does this count as a 'hand tool'?

Day 3: First bike shaped object

Bill:

Today's the day I start to fillet braze my front triangle. It's not the best thing to try and do first thing in the morning. By the time I'd done my first fillet I realise it would have been much better if I'd done some practice fillets earlier. I soon learn what it means to have too much brass to remove. But eventually I have a neat fillet. And a nice pair of brass dust covered boots.

Craig:

So far, the seatstays are proving to be the hardest. I've spent an hour fettling to get them right. Individually, the seatstays then seem to fit perfectly. But fitting them together I realise that in fact I've twisted them both to the drive side. Bugger! Another hour's fettling them before brazing. I'm so engrossed that my tea's gone cold, and there's a bun still uneaten.

Because the sliding dropouts are aluminium, we have to use a heat shield to protect them. Dave helps out deflecting the heat with a big piece of steel he has hanging about. After some awkward welds, most of the joints are brazed, and the dropouts are tacked. A cold brew to allow the frame to cool and I finish the brazing. First bike shaped object complete. Looks like all those years Bill spent as an apprentice haven't given him as much advantage as he'd like to think.

Bill:

I'm so engrossed in finishing the two head tube fillets that I hardly notice where Craig's up to with his frame, other than having to hand over the torch occasionally. Next thing I know he's parading around the workshop with it, finished and beaming with pride as his frame is now in one piece and perfectly aligned. At least I can have the jig back now.

Chainstays next; fortunately my filing skills haven't deserted me overnight, unlike my brazing technique. In the meantime Craig is doing the business with the torch and creating some very tidy practice fillets. He's realised very quickly from both my example and his fear of mundane tasks how to apply the most efficient amount of brass fillet.

Craig:

The rest of the afternoon is spent learning to fillet weld. Dave provides some excellent instruction and I am quickly comfortable with what is a tricky process. I always imagine fillet welds to look like the fish scale ripples you see on big aluminium frames. It takes a lot of time to rub these down, but Dave shows me how you can use the torch to smooth them, which saves plenty of time and effort, leaving my boots free of brass.

Bill:

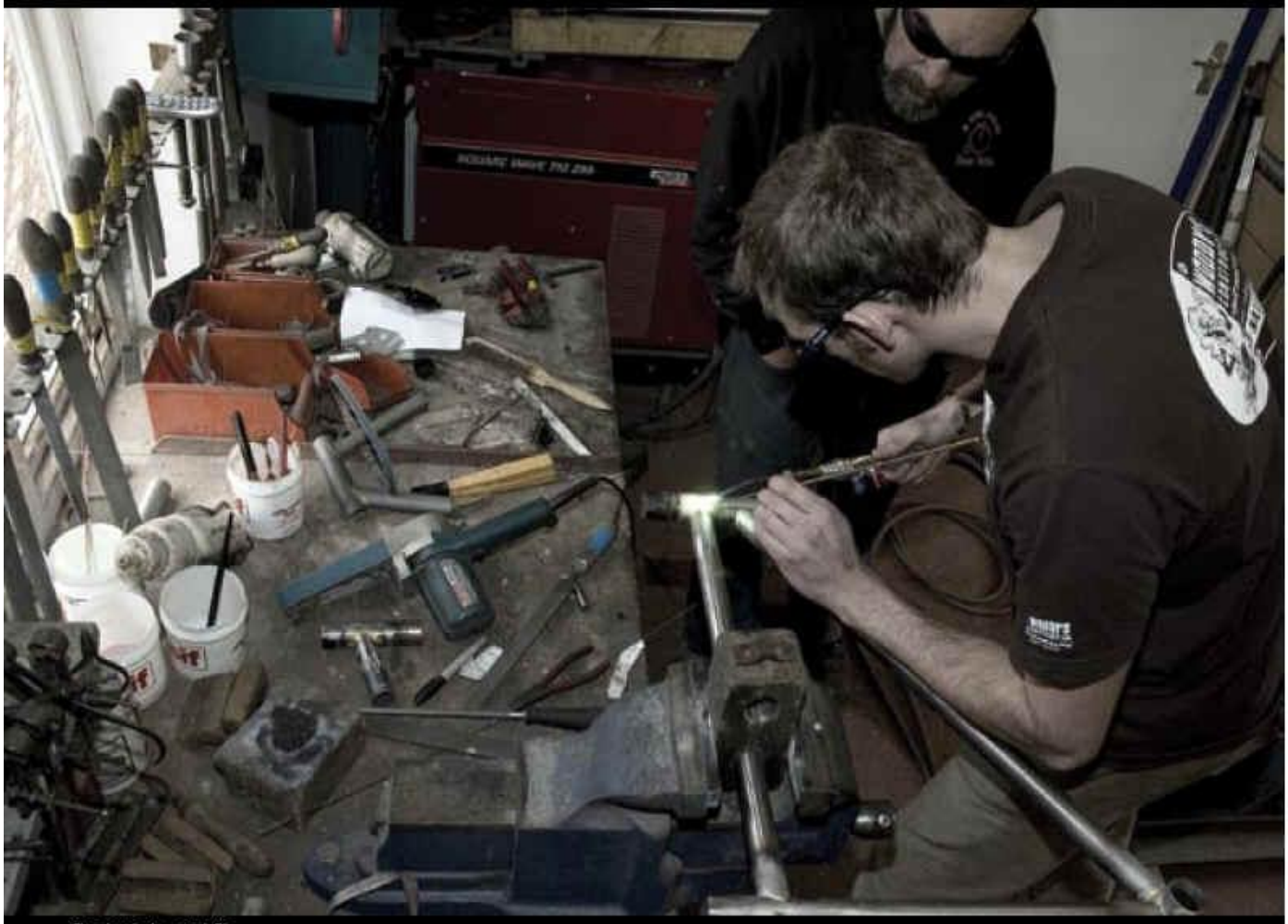
Yet again I'm paying the price for wanting a curvy, swervy frame. I'm

Some Definitions

Brazing is filling the gaps between joints using molten brass, using flux to stop oxidization. Before 'full' brazing, joints may be tacked into place to hold the rough structure. Brazed joints are allowed to cool before a 'fillet' is created by going over the same brazed joint with a 'fillet' of brass (simply more brass) creating a smooth fillet welded joint. This makes the joint a stronger, and it looks better.

Dave can also do TIG welding, but really, it's just for experienced users. There's no tangible advantage for Bill and I building mountain bikes, so we didn't bother.

'Mitring' is simply filing the ends of the tubes to be the same shape as the tube they are meeting. For example, you would mitre the top tube end to marry to the head tube.



Clean bench-clean mind. Oh…

…it doesn't half hurt if you touch the frame while you're filing it - the smell of burning flesh.

drawn to the idea of having the stay 'wrap' around the seat tube and blend into the top tube. It sounds ace and the picture I have in my mind is great, it just means extra work with the file and torch. Oh well, nothing good comes easy as they say.

I muck up the notches in the stay ends and have to cut them off and start again. Memories of binned mistakes from my past come flooding back. Thankfully I've not yet cut them to size, so there's no need for whole new tubes.

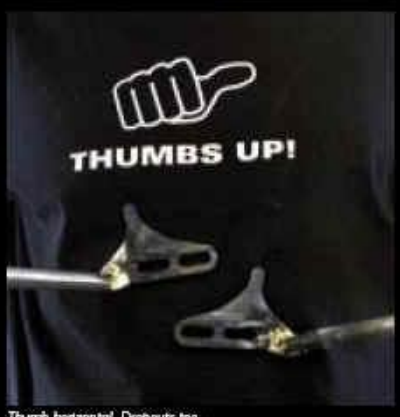
Craig:
It's the end of the day and I feel I'm a little bit further ahead. I hope it's not going to turn out to be a case of quantity over quality. Still, what Bill doesn't yet know is my Grandad was a metal worker… maybe steel runs in my blood.

Day 4: Only the sounds of squealing 853

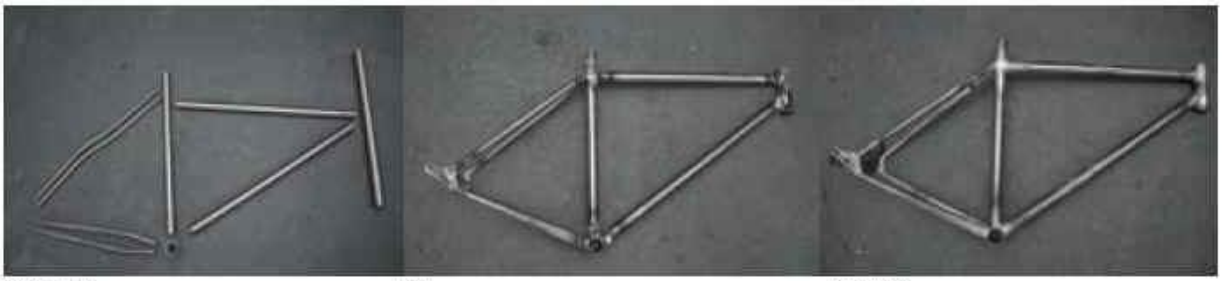
Bill:
Now it's time to make the second seat stay. I was really chuffed with the fit of the first ("Looked like it grew there" said Dave). I paid the price of impatience with bigger gaps and a poorer fit than I wanted, I would have binned it such was my annoyance with myself but Dave had a solution. I adjusted the other stay to balance them as a pair for height, level and position on the seat tube. Once the frame has cooled it's time to take it off the jig and do all the fillet welds. This turns out to be quite a marathon as there is a minimum of 32 fillets to do. I'm manipulating the frame each time to get the easiest angle to get the best results, always conscious of how much filing there is to do later with poor filleting. Filing the brass immediately after welding is the best way to remove and smooth the fillet, trouble is it doesn't half hurt if you touch the frame while you're filing it - the smell of burning flesh.

Craig:
Yesterday I hardly spoke to Bill I was so engrossed. Today turns out to be the same. We perhaps exchanged a dozen words, we're both so focused on the frames. I'm not having a good day. I manage to take most of the morning to fillet the joints around the top of the seat tube. Considering the amount of fillets left to do I'm not sure it's not an efficient use of my time. Maybe, steel doesn't flow in my blood after all. Though with all the filling there's a fair chunk in my nasal cavity.

Bill:
I spend an age smoothing the seat tube, chainstay and top tube joints, I reckon it's curvy, swervy perfection. My fingers and hands are aching from filing and sanding the fillets. I begin my weary way on to the bottom bracket fillets, I look at them with dismay. How the hell do I



Thumb horizontal. Dropouts too…



Simple as; one... two... Dave! Help!

smooth these deep concave fillets? Dave at this point introduces me to power tools. An electric band sander and an air powered pencil grinder. And a round nosed scraper for removing and hollowing out the fillets on the bottom bracket. I was so happy. Apparently Dave wanted us to prove ourselves capable with 'proper' tools first. Oh how the job accelerated. Once the fillets were done the next thing was the disc mount fitting.

Bill:
Drama No.3: The freewheel binds on the chainstay; we decide to scallop it and fit a plate; you can't do that with aluminium... First job for tomorrow.

Craig:
After lunch I tidy up my stays. I seriously bugger up the fitting of the seatstay bridge. It's perfectly serviceable, but will need more brass than I'd like. The chainstay bridge is better but still not perfect. It gets to 5pm and I'm still floundering badly with the fillets around the bottom bracket. Some more close guidance from Dave is a great help (as are the power tools), and by 6:30pm the fillets are all in place and functionally smooth. I'll tidy it up tomorrow, hopefully it'll be a better day. Then, that should be it.

Day 5: Almost There

Bill:
As the plate is fitted to allow the chain to run free, I've learned another lesson about how complicated it is to design and build a frame from scratch. There are so many things already sorted in every frame you buy, it's given me a new respect for anyone who designs and builds frames.

Craig:
Ever picky, I decide to do some cosmetic work on the bottom bracket. I'm having a better day today and quickly it looks a lot better. The bridge goes in easily enough and it's time to add the cable guides. This is done using silver solder. Silver solder runs very differently to brass; going straight from solid to running right around the joint without the brief 'tackiness' of brass which allows you to build a fillet weld.

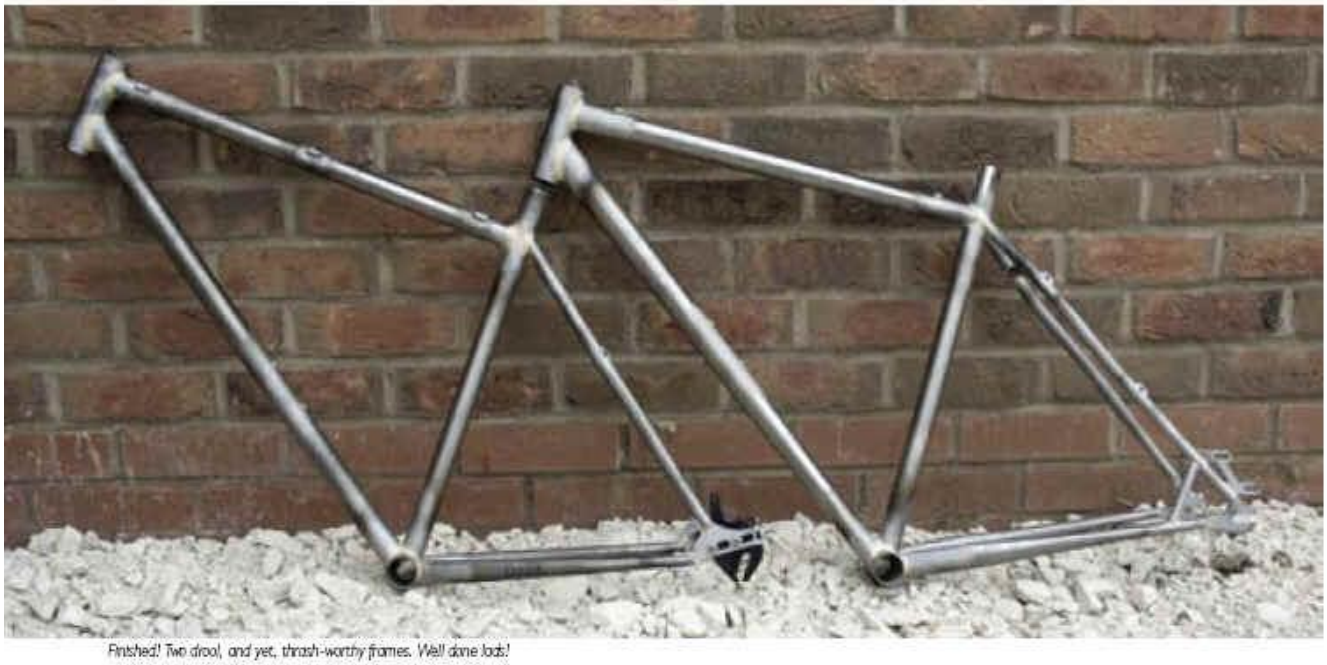
The deadline is approaching and there's still plenty to do, but the finished frame is now firmly in sight.

Reaming a seat tube is hard. The tube is naturally 27.0 but I want it to be 27.2. By the time I've finished I've a throbbing head... but a sudden realisation that, bar a final shot blasting, I've actually finished my frame!

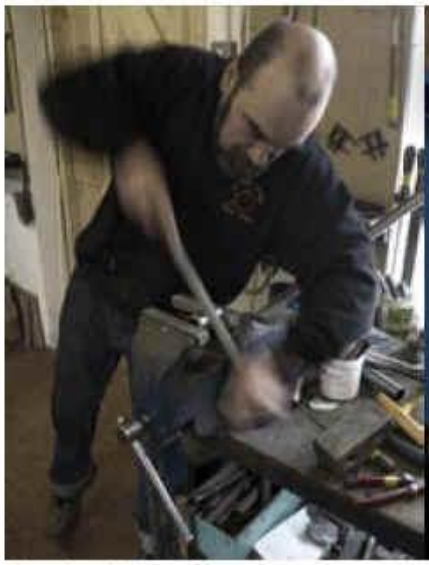
Bill:
I carry on finishing off my frame with stay bridges and tube sealing. The finished frame is shot blasted by Dave and hey presto! I have my frame. Apparently to date every frame built on his courses has been radically different. Road frame with gears, singlespeed road frame, fixed road frame, Audax, some others I can't remember and now ours. A Rohloff-friendly 26er and a singlespeed 29er. The first mountain bikes to be made on Dave's course.

Next Steps

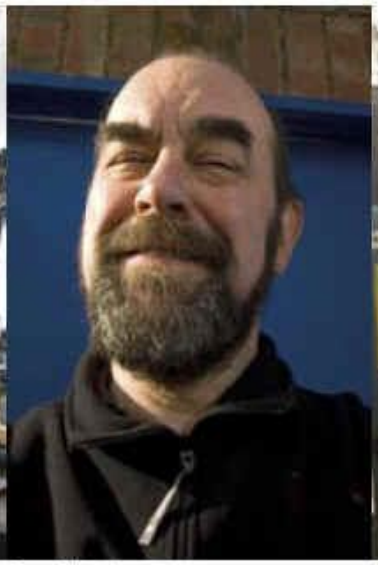
Bill:
A couple of weeks have gone by since we finished the course. It's a testament to how much I've enjoyed the course, how proud I am of my frame that I'm still not bored (though my wife may be) of telling people what I did on the course and showing off the intricate work on the frame. Next steps are to choose a colour and find a spray shop. Craig's already decided on a colour and left his frame with Bob Jackson's. I still haven't decided on a colour... I'm thinking gold, but it's a big decision to make. Like Craig, I'm hopping with excitement at the prospect of finishing this project. I can't imagine how cool it's going to be to ride a high class custom frame, purpose built for me, by me. By the time you read this, the frames should both be out on the trails. Stop me and say hi... I doubt I'll be bored of talking about it.



Finished! Two drool, and yet, thrash-worthy frames. Well done lads!



A few strokes with the bastard file...



Enjoy the happy face

Feeling cocky, punk?

Howdotheydo?

So what did Dave, the Master Framebuilder, think of his two students?

Chipps said "We've got two guys who would like to come on your framebuilding course. One has tool skills, the other has none at all. The contrast would make an interesting article."

Bill had served a traditional apprenticeship 'on the tools.' Craig on the other hand had not.

My approach to the courses is 'more action, less talk and chalk.' I have people brazing on the first day. As soon as Bill picked a file up, it was clear that he had done it before. With Craig, it was clear he had not. Bill understood real engineering terms like "just a midge's off there" and "looks as though it grew there." Craig needed to have them explained. However, by the end of the week both had produced frames of very acceptable quality (better than some 'pro' frames I have seen.) That said however, Craig was rather slow to grasp one of THE most important tasks in the workshop - it was almost the end of the week before he put the kettle on!

Once given instruction, I was able to let Bill get on with a job. Initially, Craig needed rather more direction, but he listened to what he was told and quickly picked up the basic techniques. With any physical skill there is no substitute for practice. Working with hand tools is a perfect example. Most people can be shown and pick up the basics fairly quickly, then it takes a long time to become good.

Both Bill and Craig had chosen to build MTBs. Bill's a 29er one speed and Craig's to take a Rolhoff hub, both with disc brakes. All things considered I don't think they could have picked a more difficult initiation into the mysteries of framebuilding. All fillet brazed including the bottom bracket area, with 'odd' dropouts and a disc mount. That sort of frame even makes me think hard about how to go about it. In addition, Bill had chosen funny shaped top and down tubes; 853 opposed oval tubes are the very devil to hold securely. Both did a superb job of mitreing the tubes, working on the slow, steady, 'measure twice, cut once' principle.

One of the techniques I use to instill a healthy fear of burning holes in the tubes is to do just that. I simply hold the torch on a scrap piece of tube and start counting. Usually I have a neatly burned hole inside a count of five. With that image lurking in the back of their minds Bill and Craig set to work with the torch. It must have been a powerful image, because they both produced excellent work. Fillet brazing is like a balancing act. You have to balance a pool of molten brass against gravity. Too much heat in the wrong place and you have a pool of molten brass on the floor. The torch is only the first stage of a fillet. The joint then has to be filed to a good profile and then finished with abrasive cloth. There is no easy way. Both our intrepid framebuilders produced a set of joints that anybody would be proud of, and I can only say "Well done" to both of them.

st

Daveisms

"You couldn't do that with aluminium"
"Don't worry if it's not quite right, we'll make it right"
"It's not about knowing how to do it well, it's knowing how to fix it when you don't"
"That's not a kick up the back side short o' finished"
"Harry, he had proper working man's hands, once caught a rod of red hot steel in his bare hands. Said it didn't hurt, but oh, the smell of burning [calloused] flesh."
"You've got enough brass in there to float several battleships"
"Oh, looks like it grew there"
"Well, it shouldn't fall apart - I'd prefer won't - [silence]"
"Want anything? - Ii they're selling bags o' fivers for fourpence, get me some o' them."
"If it looks right, it probably is"
"It's all right - I'd prefer good! - it's all right by my standards"

Dave Says:

Dave asked us to point out; the course does not provide any formal qualification... The object of the course is to make a beautiful custom frame, not to become a master framebuilder. (No, that takes far more tea drinking...Ed)

For more details see: www.daveyatescycles.co.uk