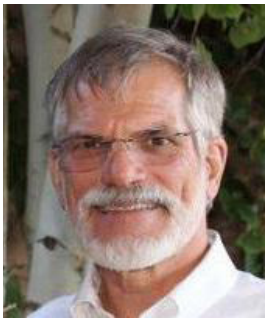
KEYNOTE PRESENTATION

Eddie Bell

To open the inaugural year of The Jewelry Symposium, it is germane to look back on the progress our industry has made in information sharing and advancing technology. Part reminiscence, part industry history, this presentation reviews the creation of The Jewelry Symposium's predecessor, the Santa Fe Symposium®, and strives to serve as a reminder that anyone can do research.

Eddie Bell grew up in the jewelry business. He learned the trade from his father, Saul Bell, a master jeweler and the founder of Rio Grande Jewelers Supply in Albuquerque, New Mexico, USA. During his 50 years in the family business, Rio's employment grew from 8 people to over 500. Being technically oriented, Eddie focused on the manufacturing and engineering. Believing education is the key to growth and that sharing information between practitioners would be the fastest way to advance our jewelry industry knowledge in a rapidly changing environment, he co-founded the annual Santa Fe Symposium® on Jewelry Manufacturing Technology in 1987 with his friend Dave Schneller. The proceedings from the 34 meetings of the Santa Fe Symposium are published in 30 books, the last 20 of which he was the content editor. He has served on the board of MJSA and was inducted as an honorary associate of The Goldsmiths Company in London in 2006. Eddie has presented technical papers on jewelry casting all over the world. His articles have been published in leading jewelry business magazines worldwide including Gold Technology.



KEYNOTE PRESENTATION

Eddie Bell
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on Jewelry Manufacturing Technology

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OPENING PRESENTATION OF THE INAUGURAL TJS

Last July 25th, Linus Drogs asked if I would consider being the keynote speaker here today. He knows I am retired. So, naturally, I wondered what Linus didn't understand about retirement. Linus cast a part for my 1936 Chrysler, though, so I figured that I needed to at least consider his request. Well, I did consider it. I realized I had no idea what I would say. So, I told him I have no idea what to talk about.

You would think he would take that as a "no", right? So why am I standing here? Well, it turns out that there is someone who has more influence than Linus. (Sorry, Linus.) My daughter, Jessa. Every father of a daughter knows the difference between Dad and Daddy. For those of you not lucky enough to have a daughter, I'll clue you in.

Usage of 'Dad': "Dad, Mom said it is time for dinner."
Usage of 'Daddy': "Daddy, you would make a great keynote speaker. I would be so proud if you were on the agenda, and they really want you to speak..."

So, I agreed to speak, still having no idea what I would say. I procrastinated for a while and then I read an article in the newspaper about Chatbots. It said Chatbots can write dissertation papers for PhD candidates. "Hold on", I thought. If a Chatbot can write a college thesis, surely it could write a simple keynote speech.

So, I went to my computer to learn how to work it. It seems you just have to tell it what you want, and it just spits it out. I told it that I have been retired for over seven years and I am a little out of touch. I wanted current information relevant to jewelry making in 2023. I was just asking it to sprinkle in a little humor when a pop-up window stopped me.

It said, “THIS IS YOUR FRIENDLY CHATBOT. WHAT DON’T YOU UNDERSTAND ABOUT RETIREMENT!”

Recycling is popular these days, so I thought that I could recycle something. Twenty-five years ago, I wrote a tongue-in-cheek dialog for AJM magazine on how to cast really good porosity. Surely, nobody would remember that except maybe Rich Youmans. But then I thought that this is the first meeting of The Jewelry Symposium and this is a serious effort and maybe that wouldn’t be appropriate. Then as fate would have it, I was in a retail jewelry store and saw a lot of cast jewelry with an abundance of porosity. It occurred to me that there must be a great demand for porosity-infected jewelry. Otherwise, why would it be present in such abundance? Especially considering that we have known for some time the cause and cure for porosity.

I could start with the master model. For really porous casting, stay away from uniform thickness. Concentrate on getting thick-thin-thick combinations. The thick areas will take longer to solidify, and the thin areas will choke off metal feeding the thick areas. Thus, producing beautiful shrinkage porosity.

Of course, since this is a serious forum, I won’t tell you that.

The feed sprue is another tool useful for making porosity. It has the advantage that it can contribute to both shrinkage and gas porosity. The idea is to flatten the feed sprue where it connects to the pattern. This retards metal flow and usually will freeze before the metal in the pattern does. This causes nice shrinkage porosity. In addition, increased casting temperature is required to completely fill the pattern, which results in gas porosity.

Again, I will not tell you that because I want you to take this symposium seriously.

Incomplete burnout is a really sneaky trick that is sure to perplex anyone not dedicated to porous casting. You see, carbon reduces the decomposition temperature of the investment binder below the casting temperature of most jewelry alloys. The decomposition liberates sulfur-dioxide gas. The gas gets trapped in the metal and porosity is produced.

Once more, since this is a serious meeting, I can’t tell that either.

If someone is trying to keep you from making nice porosity, just

shorten the cool down time at the end of the burnout cycle. That will ensure that the mold temperature is higher than the kiln control says. The added benefit is that each flask will be cast at a different temperature. This eliminates any chance of consistency in your casting. And it confuses anyone trying to stop you from making the best porosity known to the jewelry industry.

You guessed it, I shouldn't say that here.

Enough of that.

HOW IT ALL STARTED

I grew up in the jewelry industry. When I was a kid, Rio Grande Wholesale Jewelers was in downtown Albuquerque. In the summer months, I would go to the YMCA to swim and then to what we called "The Store," to spend the afternoon and walk home with my father after closing. In those days we wholesaled merchandise such as cigarette lighters, jewelry, and silverware to retail stores. We had a trade shop where we did jewelry repair and custom work for the local retailers. We also sold watch materials to watch makers. And for the stores who had in-house shops, we had things like sizing stock, findings, and tools.

I was an energetic and curious kid and to keep me occupied my father would put me to work. I remember making deliveries to some downtown bench jewelers. While they were always nice to me, it was clear that what they did was none of my business. We had a diamond setter in our shop who was very secretive too. My father was an exception. He started in a jewelry apprenticeship at the tender age of eight, when he was sent to his uncle's jewelry manufacturing shop in St Louis, Missouri. That was in 1908. My father would teach anyone interested anything he knew. But aside from my father, I grew up accepting secrecy as normal to business and the trade

Fast forward about twenty years and the marketplace had changed. Electric watches, fax machines, credit cards and toll-free calls were some of the changes making the wholesale business we were in obsolete. So, we transitioned to become Rio Grande Jewelers Supply.

It's a long story I will not go into now, but along the way we started manufacturing ultrasonic milling machines for machining hard and super-hard materials like gemstones. Most of the class ring manufacturers used our machines to encrust gold symbols

in ring stones. About this time, we started to market our Sonic Mill machines to electronics and technical ceramics industries by exhibiting in their trade shows.

Wanting to learn as much as I could, I started to attend the technical sessions attached to these shows. I was astonished to learn that many of the papers delivered were given by employees of the tech giants of the day like Phillips and Motorola. It seemed to me that these people were helping the competition. How was that allowed and how did they stay in business?

Slowly, I realized that in the years I had spent in the jewelry industry, we hadn't progressed an inch technically. And I realized that by sharing, other industries were moving up at a fast rate by working together. For the most part, we all have the same technical problems at the same time. I realized that these companies were working together to leverage their research dollars. Why couldn't the jewelry industry do the same thing?

To give an example, the burnout of printed resin patterns was a problem for every early implementer. I think all the jewelry manufacturers who bought 3D printers and started to direct cast the resin patterns had poor results, at least part of the time. They all wanted to find a solution to the problem. In a forum such as this one, the work that each has done is leveraged when the companies share their problems and solutions. Not only that, this is the place where the academic and research community, so very important to us, can learn what our problems are and help us understand the science. As Gary Dawson said in his recent podcast, "We all do better when we all do better."

Along came Dave Schneller. Dave had a company in Boulder, Colorado called Colorado Gold. He was a customer who also became my friend. Dave came from the banking industry, where sharing information with competitors was normal. I can only imagine how the secrecy in the jewelry industry impressed him. He became active in the International Precious Metals Institute (IMPI) where they presented good technical papers but not much useful to jewelry making. However, that is where he met many of the first Santa Fe Symposium® speakers.

In 1986, MJSA had three shows a year: New York, Providence and Los Angeles. Dave and I were at the Los Angeles show and had just attended the so-called technical sessions, which were mostly thinly disguised sales pitches for goods and services. However, there was one talk about SO2 causing gas porosity in castings.

Excited by that SO2 talk, Dave and I talked over dinner about how we could get more technical presentations going. I thought that if the electronics and ceramics industries could work together without going out of business, why not jewelers? We ordered our third beer and somehow we talked ourselves into organizing a truly educational, non-commercial symposium such as this.

ANYONE CAN DO RESEARCH

Dave and I had many phone conversations leading up to our first symposium. We often talked about how to get it started and where to find speakers. One thing Dave said that never occurred to me and really stuck was, "anyone can do research." He said that one did not need formal education to do research, one only needs curiosity and focus. Up until that moment I had never considered that I would ever write and present a paper.

At that time, a lot of our customers were experiencing temperature measurement and control problems. I would try to help them, but I realized that I only knew enough about temperature control to be dangerous. I had a need for better knowledge, and it was obvious that I wasn't the only one. I decided I could do a research project into temperature measurement and control and write a paper for the 1987 symposium.

I did a deep dive into the subject, read as much as I could find and talked to anyone who would give me their time. The result was a twenty-page paper published in 1987. Doing that paper changed my life. First, I learned that I could gain deep knowledge on a needed, narrow subject. More importantly, I learned that that knowledge benefited me over and over in the years to come. Another benefit, one I didn't expect, was that in the eyes of the other symposium speakers, I was not just the organizer of the symposium, I was one of them. More on that later.

Anyone can do research. I am reminded about a little research project I did twenty years ago that never got published. I would like to present it now.

SOLDER CORROSION TEST

Some years ago, I was visiting a famous jewelry company where I was asked to help them solve a porosity problem. They said they tried all kinds of casting parameters, but the porosity persisted. Upon looking at the castings, I knew right away that the problem was not a casting problem. The castings were near perfect and

all had the same defect perfectly reproduced. Since the supposed porosity appeared in a place where I would expect there could have been a solder joint, I asked to see the master model.

The master model was brought to me by the head of the model shop and sure enough, I found a solder joint with the same defect in the same place as seen on the castings. The defect was being reproduced in the rubber mold, then on the wax pattern and then on the cast part.

When I pointed out the poor solder joint to him, he had a curious response. He said something to the effect that the solder joint could not have been that way when the model left the model shop, it had to be the result of corrosion. I asked what he thought caused the corrosion and he responded that it must be caused during the vulcanizing of rubber molds. I had noticed that solder joints came out more tarnished on silver models after vulcanizing natural rubber, but I was not aware of a corrosion pit being developed. However, I couldn't say for sure if the problem was poor workmanship or corrosion because to my knowledge it had never been investigated.

Well, I thought, there is only one way to find out. Do a research project.

QUESTION

Can solder joint corrosion be caused by a reaction during vulcanization?

For this research, seven silver and three gold solder composition were chosen as seen in Tables 1 and 2. I didn't know the solder composition used on the master model in question, but it is reasonable to expect less-noble alloys should be more susceptible to corrosion. Therefore, only easy gold solders were chosen and the silver alloys chosen ranged down to only 20% silver.

Table 1: Gold solder used with flow temperature

	Gold solders from United	Flow temperature °C / °F
1	14K Y X Easy	702 / 1295
2	10K Y Easy	727 / 1340
3	8K Y X Easy	727 / 1350

Table 2: Compositions and temperatures of silver solder used

	Au	Ag	Cu	Zn	Cd	Sn	Liquidus °C / °F	Solidus °C / °F
4		75	22	3			790 / 1454	740 / 1364
5		70	20	10			740 / 1364	690 / 1274
6		65	20	15			720 / 1328	670 / 1238
7		56	22	17		5	650 / 1202	620 / 1148
8		45	15	16	24		620 / 1148	605 / 1121
9		30	27	23	20		710 / 1310	605 / 1121
10		20	45	35			815 / 1499	710 / 1310

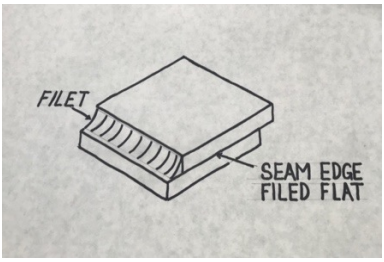

Figure 1: Ten different solder types were tested. The solder was exposed at a seam and a fillet.

Twenty sterling silver squares, 12.5 mm x 1 mm, were prepared by filing one side to assure a clean, flat mating surface and a gap-free solder joint.

Batterns® self-pickling flux and an oxy-acetylene torch was used. Sheet solder clips about 1mm square were cut for each solder type. Seam joints are most common to jewelry master models, but a fillet allowed more exposure to the solder. Therefore, a solder fillet was formed in one of the offsets. After soldering, the pieces were immersed in a hot sodium bisulfate pickling solution. Next, one seam edge was filed flat while the other three were left as soldered.

Figure 2: All 10 specimens were vulcanized in each of the 10 molds

Castaldo Gold® natural rubber was used to make the molds, and they were vulcanized in accordance with the manufacturer's instructions. All ten specimens were placed in a 3.5" x 3.5" x ¾" mold and volcanized ten times in succession without any cleanup of the specimens.
Although, it may be common practice to refinish master models before making successive molds on it, we wanted the test to be as punishing as possible and for any cumulative corrosion to become evident.

DISCUSSION

Inspecting the samples along the seam edge, it is no surprise that the most noble solders had the least corrosion. The 14K gold and the three highest silver content solders had only slight discoloration where the solder was exposed to the rubber. The 10K seam was a little darker than the 14K seam. The 8K solder appears to have defused into the silver causing wider discoloration along the seam than the 10K.

The discoloration on the three highest silver content solder joints were no worse than the 10K gold and less than the 8K gold. The most discolored seam is the 30% Ag solder, which is much darker than the 20% Ag seam. The 45% and 56% solders are marginally darker than the 65% sample.

The fillets were harder to judge for several reasons, but the main one is the as-soldered condition was not uniform. The 56% solder contains 5% tin, and this solder is well known for rapid diffusion and if only slightly overheated will eat the parent material. Some of the other solders tended to clump and not make a smooth fillet. Therefore, I only looked for corrosion pit.

CONCLUSION

While this study is not exhaustive, in that every possible solder composition was not tested, I think the solders used should represent a broad enough range to trust the results.
The gold solders fared very well but not any better than the most common silver solders used with sterling silver, which are the 65%, 70% and 75% Ag-Cd free compositions.
Therefore, the extra cost of using gold solder is not justified.
There was no pitting in the solder joint that might be mistaken for porosity on any of the samples.

There was a buildup of discolored material that I suspect are sulfides on the less noble samples, but it was an addition to the original surface that could be removed without damage. I believe the problem with the master model that started all this was workmanship, not corrosion.
In my opinion, the best choices for solder joints on master models are the three color-matched to sterling compositions with 65%, 70% and 75% silver content.

Well, I'm glad to finally get this published.

Anyway, if this train of thought is to lead anywhere, it is to say that this is not earth-shattering research but it answers a question. The point is, anyone in this room could have done that research.

So why bother?

Well, I'll let you in on my experience. At the first Santa Fe Symposium we had four professors and a bunch of other learned speakers. I was pretty much in awe of them and to put it mildly, I was pretty scared. I had never written a paper before and I had never made a presentation. But I realized I had a lot to gain by being surrounded by them because they were people I could learn from.

"Commit yourself to lifelong learning. The most valuable asset you'll ever have is your mind and what you put into it." Albert Einstein

After being involved in forums such as this for over three decades, I have learned a lot about them and more importantly, from them. You see, I know who you all are. I know a lot of you well and have known some of you for years, but even if I have never met you before, I know who you are.

I know who you are because you're here. You are all continuous learners. Even the speakers were motivated to come here because they anticipate learning something. It took me a long time to realize that.

Over the years, I was asked to help start jewelry technology symposiums in many different countries and I did, but most of them couldn't sustain. That was curious to me until I realized that there was no local speaker content at those defunct symposiums. The problem was they imported the speakers who went a time or two but got bored because there were no local speakers there for them to learn from. Everyone in this room knows something of value that would be interesting to others. You never know where or when you will use some little piece of knowledge you picked up along the way.

It takes all of us to make an event like this a success. We need the speakers for content but without an audience there is no event, and most of us couldn't afford to be here if not for the generosity of sponsors. And only those who have done it know how much time and energy goes into organizing an event like this. My hat is off to the organizing committee who I am sure donated hundreds of hours to bring this event to life.

Anyone can do research. One of the things I saw was that new speakers were nurtured by the other speakers and they got better as they learned. You have no idea how much you will learn when you commit to writing a paper. In my case it exceeded my wildest dreams. When you write a paper, you must figure out what you know and don't know. The reward goes beyond what you learn from your own efforts; suddenly you will find an expanded and valuable network of people. That community is made up of the speakers here.

So, what do you gain when you join the community of speakers at The Jewelry Symposium? I already said that I know you are continuous learners, but there are degrees, and the top of the learning chain is reserved for the people who step up to teach. This is a friendly community. Don't be intimidated. Step out of your comfort zone and you will be glad you did. Some of the very best papers ever presented were given by jewelry makers telling other jewelry makers how they solved a problem or where their creative inspiration came from. Some of the best conversations I can remember were over a beer where a jewelry maker and a professor were equally enthralled about what they were learning.

We all know something of value, and we all have gaps in our knowledge that can be filled. There is a lot of know-how in this room. And how much better would we all be if we shared our knowledge and got knowledge in exchange? It is give-and-take at the highest level. Please step up and let us see you on this podium next year.

Now that I have relentlessly pitched you all on becoming a speaker at some future symposium, I want to make a plea that when you do make the commitment to write a paper, deliver it on time. The organizers here are volunteers. I can tell you how discouraging it is for organizers to have to beg for promised papers.

One more thought for those of you who are new to this group. Have fun. Only the work is serious, the people are not. Have fun. Get to know each other. Only you can make this a success.

IN CONCLUSION

I want to thank the organizers for bringing us all together and giving me the great privilege of opening the first meeting of this new symposium. I expect this is the first of many to come. There are a host of people present today who I want to thank for your mentorship. I have learned so much from you. You have no idea how much you all have enriched my life. Not only with the knowledge I gained from you but for your precious friendship. This is truly a community I am proud to be part of.