

CUT SHELL AND DIE!

By His Royal Chatoyance, Charles W. Erikson Duke of Pearl
September, 2010

POISON: (poi'z'n), *n.* [ME. *poisoun, puison*; OFr. *poison, puison*; L. *potio*, potion; see POTION], **1.** a substance, usually a drug, causing illness or death when eaten, drunk, or absorbed in relatively small quantities.

TOXIN: (tok'sin), *n.* [*< toxic + -in*], **1.** any of various unstable poisonous compounds produced by some microorganisms and causing certain diseases. **2.** any of various similar poisons, related to proteins, secreted by plants and animals, as snake venom.

Craftsmen have been using mother of pearl, abalone and other pearly marine shells for many thousands of years. Along with other fine and exotic materials shell has come to be associated with the very best of the stringed instruments in which ornament plays a role. During the current and resurgent "Golden Age of Luthiery", guitar and banjo inlays and trim of lustrous shell have been especially prominent, and these materials and the techniques to work them have expanded beyond what anyone could have imagined only a decade or two ago! But shell's ubiquitous presence has also raised concerns, sometimes bordering on the hysterical, about possible health risks for those who spend much bench time handling or working with it.

My own intimate involvement with shell goes back to the mid 1960's, initially as a banjo builder and a few years later as a manufacturer of shell products to the industry (Erika Banjos, later Erika Shell), a profession which continues to this day (www.dukeofpearl.com).

During the first couple of years as a shell supplier almost no precautions were taken to avoid exposure to the dust (other than an industrial vacuum), but eventually, in a dim reptilian sort of way, it occurred to me that there might be health issues to beware of, especially in breathing the ever-present dust which permanently clouded the air and so finely coated my entire shop. So, not considering inlay work to be a cause quite worth dying for, I began to investigate the chemistry of shell, references about shell in the medical literature, and any scientific research involving shell as a material, as well as chasing down rumors and stories of craftspeople who had supposedly become sick or even died from working it.

Shell dust isn't listed as a hazardous substance with any governmental or industrial agency, including N.I.O.S.H., O.S.H.A., and the Center for Occupational Hazards, Inc., who sponsored an "Art Hazards Project" dealing with art and craft substances. In a 1978 letter on file from Director Catherine L. Jenkins of the Art Hazards Project she comments:

There are reports of allergic type pneumonia from the dust of shells, and that it really is a fairly unexplored form of occupational hazard.

Nevertheless there have been and continue to be unending references in craft and luthiery literature referring to the "toxins" and "poisons" of nacreous shell dust, but inevitably these are completely lacking either direct primary evidence or any support from published medical studies. Words convey meaning, and if not used correctly the originally intended precision of words will become blurred and

eventually lost, something perhaps especially true with technical or scientific terms (such as “*toxic*”, “*poisonous*”, “*immune system*”, “*antibody*”, “*allergy*”, etc.). Many of the statements about shell hazards that we’ll be taking a closer look at are notably and unfortunately careless in their use of technical language. Of course it’s always tempting to include scientific sounding words or phrases when trying to appear authoritative; but even though misuse of words may be naïve or unintentional, meanings may nevertheless have been applied which might be seriously inappropriate and misleading, even though the actual basis for such claims is anecdotal or second-hand (stories, gossip, and rumor). It might help to look at and comment on several typical examples.

One gentleman from Oregon, a customer of ours who was doing lapidary work, insisted a physician had told him that cutting shell released a deadly poisonous “apache gas”, but he couldn’t remember who or where the good doctor was and no reference to the term could be found in either French or English dictionaries or medical literature. John Emr, who was a partner in a large old New York shell products company, the former Cresthill Industries, says their shell workers reportedly believed the dust to be a powerful aphrodisiac – but that could have just been a rumor encouraged by the personnel department for their own purposes (and most aphrodisiacs are eaten, not inhaled).

From www.ganoskin.com/orchid/archive come these totally unsubstantiated statements, which unfortunately have been widely copied and quoted on other craft and hobby blogs and forums:

The dust formed in cutting abalone contains a glucamite, a substance that is mistaken by the body for glucose. It can be breathed in and also absorbed through the skin. It can take weeks and months to purge it from the body. ...this compound can lead to...serious heart problems such as an irregular heart beat. To guard against absorption through the skin wear a long sleeved shirt and latex gloves. Some people say that a chemical guard crème...gives sufficient protection to your hands. In any case it would be a good idea to apply such a crème to all exposed skin surfaces. (August 6, 1999)

I was cautioned by my pearl grower/cutter [that]...He had developed an irregular heart beat from exposure to the dust and was educated by an expert on how to protect himself. The noxious substance can apparently be inhaled as well as absorbed through the skin. The dust contains a glucamite, a chemical which the body mistakes for sugar and thus transports readily within one’s tissues. (August 2, 2000)

If true, this would be major news in a number of industries and there would be a body of published research or reports easily accessible. But notice that actual names and documentary references are completely absent, with only “*some people*”, “*my pearl grower/cutter*”, and “*an expert*” vaguely offered as informational sources. Intense searches through the medical literature and on the internet produce absolutely nothing at all about anything called *glucamite*, other than references and links circling back to these two Ganoskin posts. It all sounds so technically detailed and convincing, but until solid evidence is produced must be considered to be merely a fabricated rumor (at least at the original source, wherever that might have been).

From Tiki Central, an internet crafts forum on www.tikiroom.com:

Do not work the shell wet to avoid Chlorine Poisoning through the Skin and Lungs and think about others if they are in a room with you - It is possible to poison them and not you. The same applies to Abalone Shells also"; and "Abalone shell is as bad if not worse than Asbestos. (September, 2004)

Again, note the total lack of references which would allow these claims to be cross-checked. Nacreous shells, including abalone, do not contain or release chlorine in any form. A massive amount of published research establishes asbestos to be highly dangerous, but since the same cannot be said for shell what possible basis is there for the above comparison and conclusion?

The March, 1993 (Vol. XX, No. 2) issue of **Blade** magazine featured a special 5-page full-color article, “*Abalone: Knife Handles Fingerpainted by God.*” It featured excellent examples of custom knives from some of the best makers in the world; but when it came to discussing abalone there were seven major pieces of misinformation, everything from misidentifying shell to the false statement that musical instrument inlay is where scrap shell is marketed. The story also contained the following notes on shell dust hazards (pp. 52-53):

By far the biggest drawback to working with abalone is the health risk to the maker. “When shell is ground, there’s fine dust that’s very much like particles of glass that comes off, and of course these particles don’t dissolve in your lungs. There was some research done on that by Colt Firearms because they were using it for pistol grips,” Jim [Sornberger] said. “There’s also a protein that is released when the shell gets hot. This protein attacks your antibody system. Cumulatively over a period of time it can kill you. I understand that it can be absorbed into the bloodstream if you have a cut, and open cuts are pretty common with knifemakers.”

Eldon Peterson of Whitefish, Montana, is familiar with the hazards of working with abalone. “The dust and fumes from abalone and pearl are extremely toxic,” he commented.

The general remarks about dust are correct. But the claims about heat releasing a protein, the protein being absorbed through open cuts, and extreme toxicity are highly suspect since nothing can be found elsewhere which documents this. Colt Firearms is invoked as a source on such research, but soon after the article appeared I made several calls to the Colt factory and could find no one who knew anything about it. Knowledge of such research was finally and positively denied by Jim Alaimo, who was then superintendant of Colt’s custom shop (where any non-standard work is performed). To be fair, we’ll later look at problems where shell’s scleroprotein is implicated, such as personal allergic reactions and hypersensitivity pneumonitis, but that doesn’t seem to be what was being talked about here.

Hopefully having reviewed a few of these mild to extremely bogus accounts will help in recognizing other similarly undocumented, unfootnoted, badly referenced stories about the “dangers” of shell. Once identified as the unsupported rumor it actually is, a person can: 1) ignore the piece; 2) contact the author and request hard evidences such as names, medical records, or published research; 3) submit a response to the publisher encouraging a printed correction or retraction (good luck on that one!); 4) forward a copy of this article; 5) resist the temptation to pass the rumor along or to quote it as an authoritative source.

Accounts of illness or death caused by exposure to shell dust have very occasionally been published in magazines or on the internet but when closely investigated each of these turns out to have been grossly misreported in some way, as is discovered when attending physicians can be questioned about actual details.

As an excellent example of how these urban myths are propagated, an archived Banjo Hangout thread from August of 2009 (<http://www.banjohangout.org/archive/156329>) mentions the famous and now deceased luthier J.W. Gallagher as having suffered from facial skin cancers caused by M.O.P. and abalone shell dusts; but it’s important to note that this is a claim being passed along by another luthier,

who quotes a comment he ran across by Chet Atkins, who assumedly heard it from Gallagher while visiting his shop. That's a shaky foundation on which to build any conclusions!

I'm not familiar with specific medical details of Gallagher's case, but an almost identical story had circulated for years about the late inlayist Hascal Haile. An article on Haile in the September 1979 issue of **Pickin'** magazine served to further entrench the belief about shell's supposed risks:

Hascal's work has been noted for beautiful abalone inlay. Despite it's beauty, there is danger lurking within even the tiniest piece of this substance. Dust created when cutting or polishing abalone is extremely irritating to the skin. An even greater threat is posed by the highly caustic gas released by heat when abalone is cut with a power saw. All of these factors were unknown to Hascal Haile a few years ago, and he has suffered deep and disfiguring facial burns, necessitating plastic surgery.

In speaking with Mr. Haile, it was clear he was sincere about his claims and insisted that this information was based on "a whole week's worth of lab work done on [his] case at Vanderbilt University", but after numerous calls I was unable to locate anyone there who agreed with him, including Dr. J.B. Lynch who performed the facial surgeries. A letter sent to me by his personal physician (F. Tremaine Billings, M.D., in Nashville, TN) on Nov. 6, 1979, states:

None of us here believe that the dust from the work Mr. Hascal Haile does is causing his problem. We all feel that he picks his skin, pulls hairs, picks scabs off and generally is somewhat manipulative of his skin. Many people use the same material that Mr. Haile does without jeopardy. I would say that if you keep the dust down, have your room well ventilated and perhaps keep a little moisture, so that the dust is not too thick you will do well; particularly after your use of the grinding machinery be sure to wash yourself well and do not pick at your skin.

In a phone conversation with Dr. Billings, he went on to explain that Haile refused to deal with his habit and insisted on publicly excusing his appearance by blaming it on shell dust irritation, eventually coming to believe the story himself.

It's also commonly thought that guitar maker Stuart Mossman's health was affected by exposure to shell dust. The Mossman Guitars website has this comment:

In 1983 Mossman decided to sell the company after suffering from serious respiratory problems. Mossman began to feel that his breathing was being affected by years of inhaling sawdust, lacquer fumes and abalone shell fragments.

Mossman's medical history is unknown to me other than that he died on March 4, 1999 from cardiac arrest at age 56, but the proven dangers of chemically active lacquer fumes and resinous sawdusts are in a well established risk class of their own, a far cry from the inert and for the most part medically insignificant factors associated with actual shell material (at least in the context of small shop or hobby level shell working activities). Unfortunately, Mossman seems to have lumped all three together, causing shell dust to be perceived by other luthiers as a threat equivalent to sawdust and lacquer fumes even though not much evidence exists to support that opinion. Without hard scientific documentation, this was nothing more than an assumption and a guess, a self diagnosis ("he began to feel...") made by a medically untrained layman and based on unproven generalities.

I've been doing inlays and commercially processing shell for the musical instrument industry since 1967 and have spent countless hours tracking down stories such as this, but not a single one has ever produced hard evidence that shell was a causative or major contributing agent in any of the rumored sicknesses or deaths. I've probably inhaled, ingested, and been exposed to shell dust as much as anyone on the planet, and it's always been a major health concern that I not be doing long-term damage to any body parts (although short-term damage is just something that goes with the profession!).

In 1977 I was able to get extensive testing done by one private and one government lab on all types of shells, including different parts of each shell such as the parasitic encrustations on the shell's exterior, the outer "bark" layer or conchiolin (a hardened protein), the inner nacreous layer, and the soft black non-pearly "flow lines" in abalone. The results showed NO evidence of poisonous or toxic substances in other than trace amounts, if that, including: cyanide, bismuth, arsenic, radioactive isotopes, silicon (in its free SiO₂ state, a form associated with silicosis or "miner's disease"), lead, mercury or any other heavy metals, in spite of the fact that each of the above have been claimed as being released during the working of shell. Among other things, the lab results showed that shell contains: 82-86% calcium carbonate (CaCO₃); 10-14% conchiolin (C₃₂H₄₈N₂O₁₁), an insoluble scleroprotein of the keratin type that forms the outer layer of shells and which also binds the crystalline nacre (which is calcium carbonate in the form of aragonite); and 2-4% water. In order of decreasing presence, shell is composed of mostly calcium, with strontium (not the radioactive SR⁹⁰), aluminum, magnesium, iron, manganese, sodium, and silicon.

Raw shells do contain two potential sources of organic contaminants: the often heavy encrustation of tube worms, boring clams, boring sponges, coralline algae, and other things which die and decay on the shell once it's removed from the sea; and remnants of the harvested animal's flesh left clinging to the interior of a shell. Buying "fresh" raw shell at the waterfront is a disgustingly odiferous and maggoty task! This decomposed and septic bacteria-laden material most certainly creates both infection and protein allergy risks for anyone handling uncleaned whole shell, and poses far greater dangers than would the cutting of inlay from relatively clean processed materials. Dr. Waller Lewis, in an 1855 report titled "*Parliamentary Report, The Laws and Ordonnances in Force in France for the Regulation of Noxious Trades and Occupations*" (p. 59), states:

As soon as one enters a workshop where five or six cutters are working, you are suffocated by this dust, and feel a slight smell of animal matter. This odor is due to the composition of the shells, which inclose an organic animal matter, more or less abundant, according to the age of the mollusk, etc. The fibrous and nacreous structure is that part which generally contains the most animal matter, and consequently gives off most of the dust. This explains how it is that the water in which the grindstone bathes becomes so quickly putrid, and renders the work of the mill still more insalubrious.

Well, he almost got it right! We now understand that shell's organic component, a tough scleroprotein (Lewis' "fibrous" "animal matter") which is closely related to horn, fingernail, hair, and tortoiseshell isn't readily soluble in water and so would not be the main agent in the lubricating water's rapidly developing bacterial activity. As anyone who processes raw shell knows, he's correct about the quick putrefaction but what is being decomposed are all the soft tissue remnants still clinging to both surfaces of the shell.

In a small shop, working with commercially prepared materials generates only a minimum amount of waste or dust, not enough to bother most people, even those who specialize in doing inlays professionally. While exposure to dust (of any kind) is never healthy, it's certainly to be avoided by anyone suffering from asthma or emphysema, or even by habitual smokers whose respiratory system is

already seriously compromised – a smoker's main concern isn't going to be the breathing of a small quantity of shell dust! Severe reactions to a tiny amount of shell dust is atypical and almost always due to a specific personal allergy or other medical problem.

For example, one so-called shell dust fatality I was able to track down in 1976 was of a woman, Evelyn Tomasik, who cut shell professionally for ornamental uses in the Kon-Tiki chain of restaurants in California and Florida. As reported, her death was attributed to massive shell dust inhalation. But according to her physicians (Dr. Neil at Navapache Clinic and Hospital in Showlow, AZ, another doctor at St. Joseph's Hospital in Phoenix, AZ., and Dr. George Bondi at St. Luke's in Phoenix, AZ), shell dust was not at all a factor except possibly as an aggravant to one of her many chronic conditions such as diabetes, heart problems, collagen/vascular disease, Iatrogenic Cushing's Syndrome, and other illnesses.

Another example: in 1970 or 1971 a Mr. Johnson in Paramount, CA, reportedly died from breathing dust generated by the abalone shell mosaic table tops he had been making. However, his personal doctor discounted the story, instead insisting that Mr. Johnson had been allergic to a large variety of substances, was especially bothered by fumes from the casting resin he constantly used, and died from acute emphysema and "other problems".

I could go on and on with similar cases, but most accounts of serious shell dust related health problems wind up not being traceable to anyone with medical authority, only to uneducated guesses, unfounded assumptions, personal anecdotes, second or third hand stories, and bad journalism.

As far as the much repeated speculation regarding the supposed arsenic content of shells, our lab tests confirmed that absolutely no arsenic was present in ocean pearl oyster (*Pinctada* sp.) and abalone (*Haliotis* sp.) shell. It's interesting to note that the eating of shellfish such as lobster, shrimp, abalone, etc. temporarily increases the urinary excretion of arsenic in humans. As arsenic is used to impart color in glass work, it seemed possible that it might also be used by a shellfish to give color to the shell, but the lab analyses show this to not be true. The human body secretes arsenic rapidly as long as the levels absorbed aren't too great, but higher levels are eventually accumulated in hair, nails, and sometimes skin (most noticeably in the neck, eyelids, and nipples), causing these tissues to become bronzed in color. Although breathing shell dust may produce in some people a few *apparent* symptoms of heavy metal poisoning, poisoning by arsenic would also include (besides the tissue discoloration) such additional signs as frequent nose bleeds, bleeding gums, weight loss, brittle nails, garlicky breath, a tingling sensation in the toes or fingertips, and loss of hair. As far as we know, this syndrome does not occur with shell workers and inlayists (as scruffy as they may appear!).

This is not to say that shell dust can't be dangerous, because it definitely is. But it's important to correctly identify the real risks. The dust acts as a strong desiccant (absorbing moisture from skin and mucous membranes), and is hard to wash off completely. When viewed under magnification, the dust particles formed during cutting and grinding of shell show glassy razor-sharp points and edges which can easily cause lesions of the little air sacs (alveoli) in the lungs, and result in a scar tissue condition known as fibrosis, with the scars also being susceptible to infections; the dust isn't dissolved by water or body fluids, so can eventually accumulate to dangerous levels. It can also contribute to nose bleeds, corneal scratching, damage to nasal cilia (the tiny hairs which help filter and propel mucous and particles outward and away from the lungs), initiate (rare) protein allergies, and transport infective materials which are always present on raw shells (remnants of rotted organic matter).

A century ago, long-term inhalation of dusts in poorly ventilated shell button factories was thought to be linked to a predisposition for tuberculosis (TB), seemingly a very common disease among shell workers. But included in one published NIOSH study, "*Historical Exposures to Mother of Pearl, the Industrial*

Experience in North America and Europe: A Cautionary Public Health Tale” by Gregory J. Harvey, is this observation drawn from three other research papers published between 1995 and 2005:

Within the last twenty years pearl workers in Spain and Japan employed cutting and grinding pearl have been diagnosed with hypersensitivity pneumonitis (HP). Hypersensitivity pneumonitis (extrinsic allergic alveolitis) is an immunological mediated reaction to a variety of antigens. It appears that the protein found in nacre is just one more different antigen capable of causing HP. The clinical features of (HP) can include fevers, chills, cough, difficulty breathing, fatigue, and weight loss. HP can lead to chronic end stage lung disease. Is it possible that earlier medical observers mistook (HP) for TB?

This seems to be a valid observation, but we must be mindful of the historical context: as with the 1800’s references, this is dealing with the large-scale industrial production of shell products, where many tons of material are being processed, workers are in contact with massive quantities of dusts over long periods of time, and safeguards against exposure and inhalation are probably minimal at best. This is a completely different work and risk scenario than with someone doing small scale or occasional inlay work while using modern vacuums and masks. Note: generally, an *antigen* is a molecule recognized by the immune system, one which can thus bind specifically to an antibody (a special protein produced by plasma cells, a type of white blood cell) in order to then be presented to a T-cell receptor for (hopefully) dismantling and elimination from the body. This not the same thing as a toxin or poison.

Both I and others in the modern U.S. shell industry have been active for many years with no health complaints, using nothing more than efficient vacuums and well-fitting masks, and sometimes a water lubricant/cooler. Our overseas facilities in South Korea and Indonesia are efficiently and safely set up with a generous flow of fresh water to all the saws and grinders (through an open concrete canal delivery system inside the building), a huge and powerful central vacuum ducted to all work stations, and thorough cleaning of the factory at the end of each day. Even with over 100 workers running equipment, there’s hardly any smell of shell and almost no dust in the air, something we’re very proud of!

“*Report on Manufactures, Part III, Twelfth Census of the United States*”, 1900 (p.323) implicates shell dust in causing such problems as pulmonary consumption (what we now term chronic bronchitis), and a further complication known as *hemoptysis*, the coughing up of blood. Mentioned in Gregory J. Harvey’s paper is an 1876 industrial study by Dr. B.W. Richardson announcing that:

The dust is also a causative factor in producing a serious disease of the bones, to which the name of “osteitis” has been given to clearly differentiate it from other and perhaps similar afflictions.

Interesting but not very informative, since there are now 8 or 10 recognized forms of bone inflammation associated with this term and it’s impossible to know what exactly Richardson was talking about (or even if the cause/effect relationship is valid). Exact causes still remain unknown: it may involve a genetic predisposition since four out of ten people with the complaint also have a family history of the disease; and there is some evidence that it may also be viral in nature, but this remains unproven.

To some, it may seem like splitting hairs to argue about chemical toxicity versus mechanical dangers, but the issue is exactly whether or not shell dust *per se* is toxic as commonly believed, in order to distinguish real medical information from fable, to discuss actual and not imagined risks, to determine if it’s the shell itself or other things associated with shell that are causing problems. It does absolutely no good at all to initiate precautions against "dangers" that don't actually exist, while continuing to work

unprotected against the real medical insults. Proper safeguards can't be initiated until the risks have been accurately identified.

In Santa Cruz, CA, smack in the middle of Red abalone territory, O.L. Frye (Frye's Gem Stones) processed raw shell into jewelry and in 1971 authored a 15-page booklet on his methods of working shell, "*The Queen of the Red Abalone, New World Gems.*" Although not fully detailed in the book, Frye went to extreme and unnecessary lengths to avoid any contact with the dust, based on an exaggerated understanding of the risks: when working shell he completely coated all the skin on his head, neck, hands and arms with Vaseline® Jelly, wore thick layers of clothing, long sleeved shirts, a head covering, rubber gloves, pants, and apron, and a full face mask with filters; after work, he completely stripped to a new change of clothing, bathed and de-greased himself, and laundered all his work garments twice with the strongest detergents he could find. This is panic-driven overkill based on rumor and ignorance.

But none of these issues involve actual **toxins** or **poisons** originating in the shell itself, as so often believed, and most are virtually identical to problems associated with many other more or less chemically inert dusts having sizes in the nanoscale range. Larger airborne particles of 15 to 25 microns in diameter are usually trapped in the nose and throat; dust particles smaller than this are the ones to worry about, since the tinier they are the deeper into the respiratory passages they go, with sizes of 0.2 to 5.0 microns being especially dangerous and being retained the longest (sometimes permanently and cumulatively). The bottom line is that breathing *any* sort of fine dust is unhealthy.

There's a remote possibility that shell slightly scorched from excess heat during grinding might introduce a few products of mild oxidation but certainly nothing that needs to be a concern, especially since this material would be discolored and/or too brittle and flakey to sell into the market or to work with. We've always done a lot of our raw shell processing dry (which helps avoid putrefied water lubricant problems) but the secret to not scorching shell is to use coarser grit stones or diamond wheels, plus a lot of pressure so that material is removed quickly before heat can build up.

On the other hand, extremely burnt or ultra-violet (UV) degraded shell definitely can produce harmful substances, but that's something not encountered in the normal course of shell work or doing inlays. In the previously mentioned booklet by O.L. Frye he states that shell decomposes into carbon dioxide (CO₂) and calcium oxide or quicklime (CaO). Quicklime (also known as unslaked or caustic lime) is produced commercially by a process known as "calcining" which involves burning the shell (shell burns at a low temperature, around 300° F.); and the addition of water to quicklime produces hydrated or slaked lime, a powdery carbonate. These materials are all very caustic and can occur in shell which has been openly exposed to the UV in direct sunlight for more than a few months. But shell in this condition loses both its pearliness and its strength, becoming flakey and chalky white – degraded shells such as this are referred to in the industry as having gone "blind". If a shell is only slightly sun-burnt and has enough thickness, it's still possible to grind away the damaged portion and salvage what's left of the solid nacreous layer. But since UV affected shell is unsuitable for making inlay products, unless processing raw shell from scratch it's extremely unlikely that craftsmen would encounter these caustic substances in commercially finished products such as blanks, dots, strips, veneers, or pre-cut inlays.

There is one other factor, for anyone using rotary discs, saws and grinders when cutting up whole raw shells. Especially when using hard rubber friction-cutting blades containing abrasive particles (such as carborundum or diamond) there can be, in addition to the grits themselves, metals (aluminum is found in many abrasives), petroleum products, bonding agents, and other substances being released into the air as the tools wear down. These elements can create their own unique problems when inhaled (such as "metal fume fever") which have nothing at all to do directly with the shell material being processed.

Cutting dry with tungsten carbide blades or blades containing various solders, brazes, and protective coatings may create a caustic gas capable of producing hand or facial burns. In fact, fabricators of tungsten carbide jewelry state that the use of a cobalt binder may encourage unwanted reactions between the cobalt and the natural oils on human skin, because these oils can make the cobalt leach from the material, irritate the skin, and permanently stain the jewelry itself. Thus, many of these manufacturers now advertise that their jewelry is "cobalt free", replacing the cobalt with a binder of nickel. Secondary dangers from materials used in tooling have long been recognized as a significant hazard in their own right – again, referring to the 1855 report by Dr. Waller Lewis mentioned earlier, he points out that the huge quantities of dust generated from processing shell includes not only shell material itself but also dust from the grindstones used in the shaping and polishing stages.

Once, many years ago when our double charcoal filter masks weren't available for several days (because they had been sent out for cleaning and reconditioning) and all we had to control dust was a large industrial central vacuum, I experienced shortness of breath, a constricted throat, a metallic taste in the mouth lasting several days, and (possibly) paroxysmal tachycardia (sudden bursts of rapid heart rate), with an increasing sensitivity to even small amounts of airborne dust. At the same time, two of my shell workers who had previously not had problems became sick for 3 or 4 days with severe coughing, headache, nausea, chills, fever, and a slight case of "the shakes." A doctor diagnosed all these symptoms as typical of metal fume fever, a temporary condition that isn't serious as long as the person is removed from the "insult" (the conditions which caused it). Even though we were cutting large amounts of raw shell none of the above problems could be positively blamed on shell dust since the physician believed it was much more likely we were reacting to other contaminants in the air being put off by all the saw blades, grindstones, an air compressor, a huge industrial vacuum, hot electric motors, and other equipment. We were already aware of the potential chemical risks generated by our machinery, which is why we were using both chemical filter masks and an oil-less air compressor/positive flow mask system, rather than just simple dust masks (which would have been adequate if only cutting inlays with a hand-held saw).

Finally, it must be considered that a person who smokes (anything) is a lot more susceptible to all problems involving the throat and lungs. For a regular smoker, worries about shell dust would be but a secondary concern! Cigarettes not only produce airborne particles (the smoke itself) much smaller than any shell dusts but also agents and compounds including arsenic, cadmium, hydrogen cyanide, radioactive lead and polonium, and about 4,000 other chemicals; an additional hazard for smokers is that anything they touch with their fingertips (such as shell dust or bacteria-laden water) will be transferred to their cigarette or even directly to their lips – all of which could possibly expose them a multiple number of times to at least a few of the same harmful substances. Those working with shell need to first honestly evaluate their own pre-existing medical conditions (and bad habits) for anything that might be aggravated by dusts.

Given a clean bill of health, adequate safeguards for shell dust would then be nothing more than to employ one or more of the following: a close-fitting dust mask (which does interfere with being able to blow dust away from the cut while sawing), an open-air work space, a nearby fan, a vacuum fitted with a fine mesh screen next to the cutting board, and a change of heavily soiled clothing and a good scrubbing of any dust covered skin. Since fumes and chemically active agents aren't a significant factor except when processing large quantities of raw shell there's no need for the average craftsperson to use elaborate masks and air compressor feed systems. Keep it simple and comfortable, and enjoy many healthy years working with shell!

Some of this information was contained in a prior *Association of Stringed Instrument Artisans* (A.S.I.A.) article, "*Is Shell Dust Hazardous*", in **Guitarmaker #16** (June, 1992).



The Duke as he appears today, after many robust years of safely and intelligently working with shell.