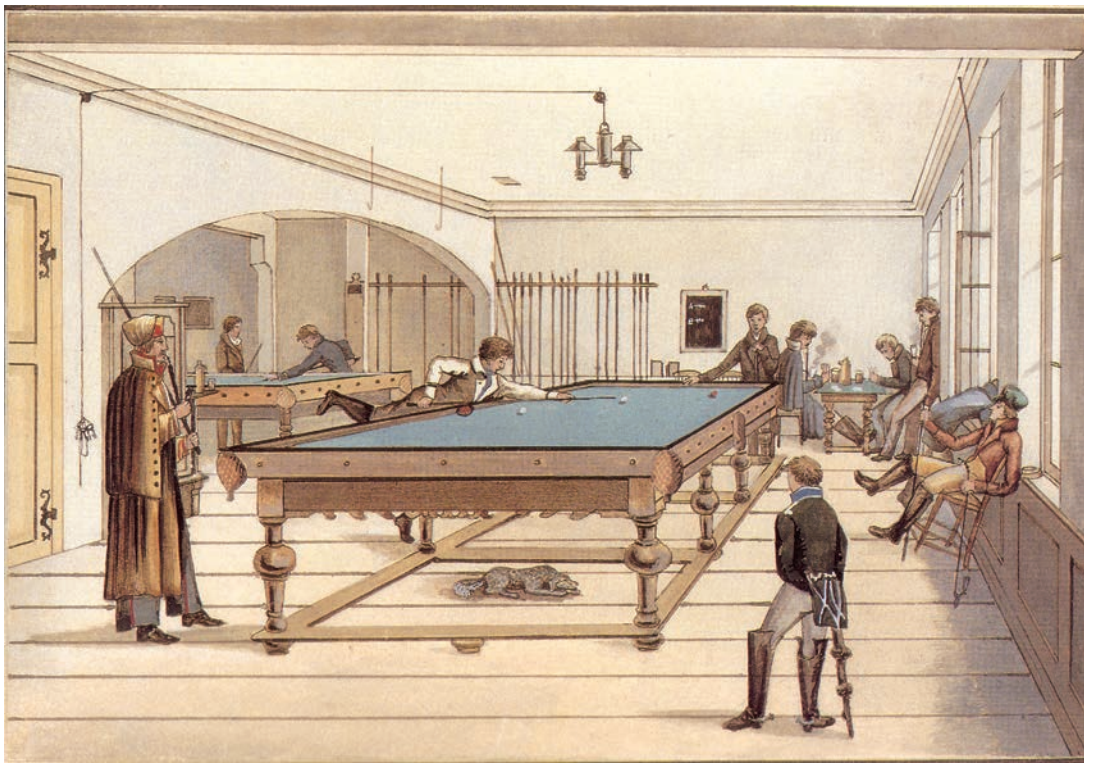
# CELLULOID
## *A Firm Maybe*

BY DENNIS ELLINGSEN

***This Case knife from the 1950s self destructed all on its own. When I hold this knife, I experience a burning sensation on my fingers, This is caused by the off-gassing of acidic chemicals that are used in the making of celluloid. Nitrile surgical gloves are an absolute must for me. This also suggests that if you handle a celluloid handled knife — wash your hands.***



***I use a 6" x 3" railroad car axle for my base burn tests of celluloid. The small 5/8" square sample of handle material from a 1930s Ka-Bar makes a dense flame that leaps up three inches and burns for a full minute. Fumes and burned ashes are to be avoided.***

Pocketknives or razors which have celluloid handles are colorful, bright, durable and ornamental. This synthetic material was widely used from just before the turn of the century until about 1940. You might hear some negative comments from collectors concerning celluloid, all of which are most likely true; but for the most part, the average knife collector knows little about this handle material. I am hopeful that this article will clarify some of the aspects of celluloid; but more importantly, I want to make everyone aware that all celluloid knife handles are a potential time bomb. A ticking time bomb, which no doubt, can and could destroy some special knives that you have in your collection.

Celluloid was cheap, easy to work with, tough and colorful. Some say the reason for the change to celluloid was to replace the ivory used in making billiard balls. However there was a bit of a problem because a perfect shot could cause the celluloid ball to explode. Celluloid was combustible and extremely flammable. After all, its chemical composition is very close to certain explosives!

The raw materials required to synthesize celluloid include cellulose fibers, nitric acid, sulfuric acid, water, alcohol, camphor, colorant and fillers. For a more technical treatise on celluloid, go to the *Journal of the American Institute for Conservation* (*JAIC 1991*, Volume 30, Number 2, Article 3 (pp. 145 to 162).

The use of celluloid to make commercial products of all sorts started after its invention in 1869, however the real popularity of this material came in the 1920s and '30s. There were many products that were made from the celluloid material, but we will only address the issue of knife handles made from celluloid. The handles of the red white and blue patriotic scout style knives of the early 1920s were made of this material, as were the clear handled picture knives and the Christmas colored knives. Razor collectors will also note the numerous variations on a theme of the celluloid used as handles on straight razors. You might also recognize celluloid on advertising knives, as they were easier to mark with names and slogans. The material had its followers, however there were some who affectionately referred to certain varieties of celluloid as "Genuine Mother-of-Toilet Seat."

We call this material celluloid, but that


***Around 1870 there was a search for a material that would replace the ivory billiard ball. Ivory then was thought to have become scarce. Enter the celluloid made billiard ball. It worked fine except when a ball was hit hard, it exploded. Just one of several drawbacks to the use of celluloid.***

is a trade name similar to Kleenex. The first synthetic plastic material was synthesized in 1856 by Alexander Parkes (Parkesine), and then later was developed as a commercial product in 1869 by John Wesley Hyatt. Cellulose nitrate, or pyroxylin, was blended with pigments, fillers, camphor and alcohol to make this unique synthetic material. When heated, it is pliable and can be made into a variety of shapes and forms. In the paste form, it can be colored, rolled or formed into shapes. This was an absolute dream material for knife handles, except for the few problems that

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***From top to bottom: IKCO 1920s Christmas tree celluloid handled knife; Ka-Bar light colored celluloid pearl like handles; 1930s LF&C Official BSA knife with celluloid "Perfected Stag" handles; Remington Red White & Blue celluloid (pyremite) handles.***

***These are 1920s knives with celluloid handles. They show no sign of decomposition. Under proper storage they might/maybe never deteriorate. From the one o'clock position and going clockwise: L.F. & C. (Universal) with celluloid "Perfected Stag" handles; Remington Pyremite R-W-B patriotic handles; New York Knife Company Buffalo Bill handles; Schrade Cutlery patriotic R-W-B handles; Valley Forge Army Knife; Imperial (IKCO) R-W-B patriotic handles.***

came up over the course of time.

To be more accurate, we should refer to knife handles made of celluloid as cellulose nitrate or pyroxylin; however I see little harm in using the general term celluloid as we have in the past. Sometime in the 1940s or 1950s, the use of celluloid on knives was discontinued. The fact was that any of the nitrate products have a special characteristic called flammability. Cellulose nitrate is kissing cousins to cellulose trinitrate (nitrocellulose) which is guncotton. Guncotton is an explosive substance and a propellant. The early makers of celluloid handled knives used terms for their products like pryremite, pyralin, perfected stag, shell, "pearl," ivoroy, composition and other names that they found suitable for the purpose of marketing. In looking through the catalogs, the word celluloid is usually avoided. Maybe the reason would be the flammability issue. If you dissect the pyremite and pyralin terms used by Remington, you will discover the word pyro, which means fire. I suspect that the public did not make note of this when they purchased a knife with this type handle material.

Whenever I purchase a celluloid handled knife, I await the day that decomposition and destruction of the handle will start. The decomposition can take many forms. The most noticeable is the rusting of the knife blade or metal parts of the knife. If you open the blade of a suspect celluloid handled knife, you will note rust or a rust stain on the upper part of the blade (opposite the blade edge), while the balance of the blade will not be rusted. Without care and attention, the whole blade will rust. The next problem associated with celluloid handles will be the self destruction of the handle itself; it will shrink, crack and crumble on the frame of the knife. I have tried numerous tricks to save a celluloid handle, but to no avail.

What I have done in the past is isolate the knives that are suspect, clean them often and make sure that they do not come in contact with any other knives. This is only a very temporary stop gap procedure, as eventually they can go to total self destruct. So what is happening, and what can be done about these celluloid handles? Are all celluloid handles subject to decomposition? The answer, of course, is a firm maybe.

For years I have asked the question: What is happening to these handles? Very few could even muster a plausible explanation. Even with the help of several research chemists and many hours of research, the answers are vague yet impressive and startling. In the end, the specifics presented here remain in the realm of a firm maybe.

I have attempted to stop the deterioration and decomposition of celluloid knife handles in a variety of ways, but without success. However, I have slightly slowed the effects of the deterioration, even though I haven't stopped it. I do not believe that I will provide a solution to stop this action. So my best bet is to understand and prolong the inevitable without destroying the knife itself.

Norman Chappelie *(Cha-pel-ee)* was an industrial chemist in Eugene, Oregon, who seemed to have a good handle on the celluloid subject. Over lunch one day I laid out numerous samples of celluloid handled scout utility knives for his inspection. Some were heavily decomposed, yet others looked as new, even though they were over 80 years old. The expression that you can't see the forest for the trees certainly fit me this day. Norm was able to draw a conclusion rather quickly based on my samples. (He also suggested that the washing of our hands was in order after handling these knives.)

In short order Norm separated out the obviously decomposed knives and pointed out that all these knives shared one thing in common. Each was light in color or clear. The worst of the lot was a clear handled picture knife that showed evidence of an aggressive attack from rust on the blades and bolsters. It was suggested that the clear or light colored handles did not have binding or filler material and were therefore subject to deterioration. The dark handles or the ones which were more opaque in nature had a binding agent additive. In the process of making celluloid, the 'pretty' that was added to the celluloid acted as a binding or bonding agent, and by accident and not design, acted as an inhibiting agent against decomposition. Or if it does start, it does it at a slower rate which doesn't effect the knives physically.

Norm also pointed out that in the old days, movie film was made from clear cellulose nitrate, and we have all heard that this old film is decomposing. We have also


***These 2 1/2" punch board or carnival knives of the 1920s-1930s show no signs of deterioration. The binding added to the celluloid and good storage can explain why they are stable today.***

heard of the explosive effect that this film has when subjected to heat or flame. The film is clear and has no binding material which could slow or retard the chemical decomposition. It is for this reason that they speak of preserving the old films by putting them on a non-decomposing film that is used today. I heard that well over 50% of the old films have been lost to this decomposition.

Years ago I was on tour at Camillus Cutlery, and it was pointed out that one building was set aside and used to make their celluloid handle material. The roof on the building was metal and was hinged. If the celluloid were to catch fire and explode, the roof would release from the force of the explosion, which would save the building and the surrounding area. This action would direct the explosion upward and not outward. At the time I listened, but it was only later that I understood.

When celluloid was produced, there were several pretty nasty chemicals that went into the product. Sulfuric acid and nitric acid led the list of bad guys. If the resultant celluloid product was well washed and carefully chemically manufactured, the chemicals were fairly inert. If the process was not strictly adhered to, then there could be premature decomposition. Likewise in the making of celluloid, there needed to be a settling time in which the new product could shrink and settle in on its own. If it was used too soon, shrinkage of the material was noted, especially on knife handles. English knives of quality that used celluloid usually had the raw celluloid material left alone for long periods of time to minimize the shrinkage and cracking. But I said minimize, not eliminate.

Time is the ultimate test to any product, and cellulose nitrate doesn't fare well with time. At the time a pocketknife was made, it wasn't thought that it would need to last. In a Remington study, it was determined that the average pocketknife had a life span of three years. So even if they knew at that time that celluloid would decompose, it was not a matter for concern; since all things wear out and will only serve a given workable period of time.

But I have some concerns which bother me. If it was known after the 1940s that celluloid was flammable and subject to decomposition, then why would collectable type knives of recent manufacture be made with this handle material? In the years following 1999, I noted that a commercial manufacturer had introduced a line of knives that it advertises as celluloid. For today's working market and use OK, but for history and collecting, I have concerns.

Celluloid is fairly sensitive to chemicals, light, moisture and temperature. Shrinkage is also noted, along with splitting and cracking of the material. Even though the product is susceptible to the above, the bonding material used in the celluloid can retard some of the deterioration. But we don't know what or why or how; and that again is another firm maybe.

I have never seen a red white and blue knife, or for that matter any of the 1930s kitsch variegated handled knives, deteriorate. So if you think dark material is safe, that could be a firm maybe. We can speculate about two identical knives; one ravaged with decomposition and the other pristine. Explanations could be that the one was exposed to heat or extremes of heat, chemicals, light, moisture or other


***These 1950s vintage Brownie knives by Kutmaster have experienced off-gassing and handle shrinkage. It is possible they have been exposed to an environmental trigger that has prompted their decomposition. The open knife shows heavy staining on the exposed part of the blade when it is closed. The "Be Wise, Beware" has a double meaning here.***

decomposing products that started the action. Once the decomposing action starts, it becomes auto catalytic, meaning it starts a reaction that is automatic and continues to decompose the material. The theory that a binding material slows or prevents this action is then plausible. However, if we take a dark celluloid material and subject it to extremes or chemicals, then it too could or might be a candidate for decay and deterioration.

I have been to summer flea markets where knives have been on sale displayed in glass cases that have had the sun shining directly on them. The items inside have been exposed, as if in a greenhouse, where extreme heat has built up in very short order. I have often wondered if a celluloid product in these cases wouldn't start its decomposition process as a result of the extreme heat to which it had been exposed. Likewise the same heat generation can occur if a celluloid item is displayed in a store window that is exposed to direct sunlight. The worst extreme here is the rapid heat and then rapid cooling that can chemically affect a celluloid product.

When a knife blade starts to rust, there is a leeching or exuded chemical reaction. This chemical is more than likely an acid, and this certainly explains the fast rusting on a knife blade, backsprings, shield or bolsters. My chemist friend, Norm, stated that his fingers would turn white if he handled this material very much. In my own case, my fingers burn or there is a funny sensation on my fingertips when I handle these knives. I now know that this sensation is due to the decomposition that is

***This German made Fight'n Rooster production knife from the 1980s is headed to the "celluloid rot" graveyard. The handles are shrinking and have developed cracks. Note the rust line on the blade where it is exposed to the air when closed.***


***These Dick Tracy knives glow in the dark and are neat, but they have celluloid handles. The handles are shrinking which creates cracks at the rivets.***

occurring. Nitrocellulose (made from nitric acid and sulphuric acid) and camphor are used in the making of celluloid. One person I talked to said that they could identify celluloid handles by rubbing the handles to get them warm, and then smelling the handles which would give off a distinctive camphor odor. My finger burning lasts the day, so it is noted that there is a chemical reaction to my skin. It is not a pleasant sensation, so I decided to use cotton gloves to handle suspect, decomposing celluloid. Momma apparently did raise a dummy, as the chemicals went through the cotton and proceeded to cause finger burning. Now it is up to using surgical gloves or nitrile gloves (note that I did not say latex) to handle these knives. The term used by the knife community today for this happening is called off-gassing or celluloid rot.

The use of cellulose nitrate was common up until the 1940s. After that time, the use of cellulose acetate became popular. This product was not flammable like its predecessors, but it still had some decomposition and deterioration problems. Here again chemicals, light, temperature and time were partners in this act.

I spoke with someone at a cutlery factory one time, and they stated that the decomposition of handles made from cellulose acetate was caused by putting knives into clothing drawers where the darkness caused acetic acid to leech out and decompose the handles and rust the blades. This person had no doubt heard that at the time, handles were made from cellulose acetate. I questioned this idea, but Norm said that there was possibly truth in this theory. The decomposing chemical in this case would be acetic acid. It is possible that a chemical action could be started from chemicals in the fabrics, and the acid could build up in the confined location. Light colored handles again could be suspect, as they would lack the binding material. In contrast to this would be having the same product out in the open and allowing the gases to dissipate more easily. Which is actually the case is unknown, but the theory causes further thoughts which fall into the realm of a firm maybe.

So the conclusions that can be drawn are somewhat vague, but some finger hold (acid free) of truth can be extracted. Chemical reactions are at play that can cause decomposition of the handles and rusting of metal. This action can be started by chemical reactions, heat, light, or moisture. Cracking, shrinking, warping and the release of chemical gases can be products of this decomposition in cellulose nitrate based handles. In the case of cellulose acetate handles, we know that the fire or flammable aspect is not a problem; but we can suspect shrinkage, cracking and the release of chemical gases might take place. From my observations these are more prevalent in light colored handles. And that too is a firm maybe.

Likewise it should be noted that light in color or clear celluloid handles may have survived beautifully over the years without decay or decomposition. That does not mean that something cannot suddenly occur that will change this. Call it a chemical time clock or environmental warming or introduced environment changes or whatever... it could happen. Or if you want to take a more Pollyanna approach, you could say that the chemical composition of this batch of celluloid was made so that chemical decomposition will not occur. Right! Now about that beach front Arizona property that dear elayne bought, and we would like to sell to you.

At one time we collected melon, sausage or produce knives. These knives are characterized by long handles and blades. Celluloid was an ideal handle material for these knives. The handles were light in


***This is the classic road to the effects of off-gassing on a celluloid handled pocketknife. The acid corrosion has started on the shield and bolster whereas the main blade has a rust area in the portion of the blade that is exposed when closed. The thing to remember is that the neighbors to this knife in storage are susceptible to this off-gassing or "celluloid rot."***

***I saw this Canton Cutlery knife on eBay and fully understood its physical condition. It was obviously off-gassing and entering the portal of "celluloid rot." This was a three blade tool knife with a picture of the Portland Head Lighthouse under the clear handles. Everything that attracts me in an historic knife. I have wrapped it in tissue and will place it in the freezer in hopes of staving off disaster which I now know is inevitable.***

color for sanitary reasons, and they could be washed without damage. They also lent themselves to advertising, which stood out on the white background. In our collection we were constantly battling which knife was leeching, as it wasn't always the one which was rusted. A celluloid decomposition on a stainless knife could attack its neighbor first if it were made of carbon steel. For years we played the "Who's on First" game until we finally tired of it. We never seemed to win. Here again the telltale clues were the celluloid handles, and the light colored material that was apparently short on bonding additives.

The sad part of this phenomena is to observe collections that have celluloid in them that are under glass or in a leather knife roll and have started the chemical reaction. These can be in museums or personal collections. Of course being under glass can be like being in a greenhouse, especially if there are external lights directed on these cases. The best advice I can offer is to make the curator aware of this, so that the problem can be properly addressed in a manner befitting the collection. The process of destruction is subtle and can go undetected to the casual observer. As knife collectors and makers, we should be able to spot this rather quickly now that we know what to look for.

I contacted several museums in my search for celluloid information, and every curator was very aware of the time bomb effect of celluloid products. The most illustrative example that I heard about was the art object sculpture created of celluloid. This item was quite large and was kept on view in a glass dome case. It was noted at one time that there was liquid pooling in the low spots of the sculpture, and that there appeared to be droplets of liquid on most of the surface. This sculpture was a fine example of chemical decomposition occurring due to a confined enclosure, heat from lights and the ravages of time. I am told that the liquid was high in nitric acid .

One author had a solution to the problem of the decomposing celluloid knife or razor handle. If you see one for sale; run the opposite direction. If you discover one in your collection; throw it away. That is no doubt sound advice, but I can't come to grips with these solutions. I know that heavy oils or protection wax slows the damage but does not completely protect it. Stop gap technology. Of more important note is that some of these chemical cures could be adding to the problem and speeding the decomposition problem. I do not recommend that chemicals, oils or waxes be used on celluloid items.

My attempts at stopping the deterioration have been terribly disappointing. I have placed a single knife in a jar that has

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silica gel crystals in it. I had hoped that the leeching gases or chemicals would be captured by the gel, and it would not get a chance to damage the knife. It didn't take long (weeks) to learn that this method did not work.

I also tried placing a celluloid handled knife in a plastic bag after protecting it with oil. Talk about increasing the chemical decomposition and destruction. The trapped gases made quick work on the vulnerable parts of the knife. So I have resorted to placing the knives out in the open and watching them closely. It stopped nothing but has slowed any observable action a little.

The last test I did was to place the celluloid knife in a jar with silica gel in the freezer. If a rise in temperature increases decomposition, then cold should slow it down. Likewise if light causes decomposition, then the dark of the freezer should also retard decomposition. And it does. Slows it down, but does not stop it. Due to the inconvenience of placing knives in the freezer, this is not a recommendation. Aside from that, the celluloid has an increased tendency to crack at the rivet stress points in the cold environment. Just like the teeter totter; when one side goes up the other goes down. And that is not a firm maybe.

There is another good solution, and that is to replace the handles completely. This solution destroys the historical significance of the specimen, but it does save the metal. It also saves other knives in your collection from being polluted.

The question has arisen as to how does one identify celluloid handles from other synthetic handles. There is no easy way save for a destructive test. That destructive test is to burn the material. If it burns with a dense hard flame like napalm, then it is celluloid. It only takes a very small piece to let you know the explosive nature of this material. A word of caution: do not breath the fumes, as these fumes can be toxic. In fact, unless you have to, don't burn celluloid. Likewise the burned residue is not good for you, either.

With a little help from my friends Mark Zalesky and Michael Yoh, I received numerous pieces of discarded synthetic handles, so I could identify if they were celluloid. Everything I torched was celluloid. This included the yellow handled Case, Imperial, Ka-Bar, Utica and Westco knife handles. I had always wondered about the pearlized Imperial handles, and they too went up in a ball of fire. Landers Frary & Clark (LF&C) made a handle material called perfected stag which I always suspected as being celluloid. Without a doubt, as the ball of fire attested, these handles were made of celluloid. The perfected stag handles were celluloid with a very dark binding material that was molded to look like genuine stag.

The production of European made celluloid handled knives for the collector market started in 1976. Much of the handle material came from Germany, and I would like to think that the potential for deterioration of this material was addressed. These knives are lovely to behold, and the celluloid handles play a part in this beauty.

***L.F. & C. Universal official scout knife with "Perfected Stag" handles.***


***New York Knife Company – Buffalo Bill knife with waterfall calluloid handles. This is a large utility knife measuring about 5" closed.***

It is thought that under proper conditions and storage these knives would present little or no problems. But the big issue here, as stated in this article, is the proper care for these knives and to be aware of a potential problem. However I have been advised that these European knives do decompose as has been observed in some collections.

Many of the samples I was given for testing and burning purposes had all the telltale signs of deterioration and decay. The handles not only looked like they were in trouble, but the cracking and checking was rampant.

Working with and using celluloid requires some special considerations, or you will be courting disaster. Anything that can generate heat can cause a flame with this material. Buffing or cutting celluloid can generate heat, and the results can be ashes in your hands. If you must work this material, do it so that no heat is generated. Again, any gases put off in this process should be considered toxic. Generally speaking, if you don't have need to do anything with this product, then don't.

I have several celluloid handled knives that I fuss over, as I always suspect that for some reason they will start the destructive dance. I exercise some cares and cautions with these knives in hopes that I might be lucky. I try to store these knives in dark drawers that have a consistent ambient room temperature. The knives are also stored on top of acid free paper so that a fabric will not trigger a reaction. Most importantly, I check on these knives often and frequently, so I can watch for the impending doom and disaster. One ounce of prevention goes a long way. How often should you go through your collection? You can't do it too often. Bolsters, shields, handle pins and the exposed parts of blades are first order of concerns. If there is even the slightest discoloration, further examination is a must. Look for a reddish, powdery dusting on knife blades. If the smooth portion of a blade feels just a little bit rough, there is a chance that rusting is starting. Above all, do not put off preventative measures; or you will regret it and that for sure is not a FIRM MAYBE. ❑