: END!

smell of, whose strength and yellowing and performance you can live with. If you buy plastics as resins, that is as pure sold plastics, then you can mix up glue, using the appropriate solvent, as thick or as thin as you like; furthermore, you can mix up as much as the present task requires. Solid resins keep much, much better than solvented plastic solutions, and by making up only what you need you can save money in the long run. No more rock hard one third full tubes of Duco to throw away. And, these resins are simple, pure, single ingredient plastics, not mixtures, and generally contain no plasticizers, fillers, perfumes, pigments or magic unknowns. Therefore, you know exactly what you start out with, what you add to it, and what you end up with. With very little luck, it'll be better than Duco.

A wide range of plastic resins and pre-formulated adhesives is available from Conservation Materials, 240 Freeport Blvd, Box 2884, Sparks, NV 89431.

ARCHAEOLOGICAL CONSERVATION FORUM

Reported by
Curt Moyer

THE DUCO DIALOGUES

"But why do you hate Duco so much, anyway?"

I paused to marshall my arguments. It's been so long since I actually used the stuff that the reasons behind my dissatisfaction have lost their immediacy. I can rattle them off without taking a breath, but sometimes I forget why, or if, I really mean it when I say: "I can't stand Duco cement!"

"Well, there's a right way and a wrong way to mend ceramics... " I begin tentatively.

"Yes, but if you take the trouble you can do mends properly, even with Duco."

This is true, up to a point. But the fact remains that beyond that point, I cannot call an acceptable adhesive for mending ceramics. To completely justify my dislike of the product involves arguments tending in several directions. And, like it or not, I will have to take several deep breaths to get them all out.

Deep breath.

Duco is a proprietary adhesive sold by the Devcon Corporation, but for many years associated with its original developer, E. I. DuPont de Nemours & Co. Because the formulation is proprietary, its exact nature cannot be known outside the bounds of Wilmington. The package offers the following information: it contains acetone, butyl acetate and oil of mustard. Duco is in fact a celluloid adhesive, a so called intermediate synthetic because its feedstock is cellulose derived directly from plant sources (chiefly wood pulp) and not synthesized entirely from petroleum. The cellulose fibers are treated with nitric acid to form a cellulose nitrate ester, from which a plastic polymer is synthesized. This plastic is what forms the bond when is used. In order to be applied it must be soft and liquid, so the plastic is dissolved in a mixture of acetone and butyl acetate. And that's Duco.

"But there's that oil of mustard."

Oh, right. It's in there to prevent your High School volunteers from getting off on the stuff. For those of you with short memories, there was a time before crack when young people actually sought a thrill by sniffing glue, and their elders actually put oil of mustard into glue in order to prevent this. That's what they tell me.

"So, that's Duco?"

Well, not quite. Which brings me to candy bars. If, like me, you feel a near compulsion to read while you chew, read anything, then the words ". . .may contain one or more of the following. . ." probably strike a familiar note. This is because candy bar formulations, like Glue formulations, are proprietary mixtures. They belong to the manufacturer, and he can do whatever he wants with them. Cheese, by contrast, belongs to the universe, or the public, and if you change the product beyond certain limits you have to call it cheese food, or cheese-like food, or synthetic cheese spread. Three Musketeers belongs to M & M/Mars, Inc. , and they can do to it what they will and still call it Three Musketeers. This includes buying cottonseed oil, or palm oil, or coconut oil, or soybean oil, or any other fat which is cheapest on the day that they call up the edible oil broker's. Duco is the same way: it's a proprietary mixture and Devcon can do whatever they like to it and still call it Duco. They can put oil of mustard in or take oil of mustard out; since it's not sold as an edible product they don't have to list ingredients. And there are possible and probable ingredients we haven't discussed--plasticizers, chiefly, but also extenders, fillers--any number of chemicals which affect the way the product performs. Whether any of these are present or not I can't say. They aren't listed on the box, but if there are any, and if one plasticizing agent is cheap today and expensive next week there is nothing to prevent Devcon from putting it in today and substituting something else next week.

Conservators tend to be conservative types, at least when it comes to conservation: once they find a material which they like, whose working properties have withstood the test of time and experience, they like to stick to it. In the real world, where "new and improved" is everyone's favorite marketing tool, this can be difficult; in the world of proprietary mixtures, where these improvements and substitutions need never be listed or even indicated, it can be nearly impossible. And if you cannot predict with confidence the working and structural and ageing properties of a substance, you really shouldn't be using it, or using it only with extreme care and prejudice.

"But you've got brand names all over the lab. Some of the conservation materials you use everyday are proprietary. Why pick on Duco?"

That's simple. Most of these materials are formulated for the art, restoration and conservation markets and the makers know that their customers want to know what the contents are and when they change. Furthermore, many of these products are not mixtures but reasonably pure basic materials, such as plastic resins. They don't even have names, just mad science code designations like "B-67". If the manufacturer develops a new and improved polymer resin they give it a new and improved code name, like "B-68". Generally, in order not to confuse themselves internally, they don't change the direct relationship

between a polymer and its code. (what does get confusing is when the makers feel the need for different codes or designations for the same plastic in different Countries or markets. This has led to some rather surrealistic conversations between consumer reps and myself.)

So one reason I dislike Duco is that it is a commercial, proprietary product aimed at a fickle and technically informed general consumer who is apparently looking for ease, convenience and novelty. If the company thinks it can better satisfy these ends by changing the formula, or still ensure them while using cheaper ingredients, I do not doubt that they will do so. DuPont and Devcon may neither one have changed the formula of Duco one iota since day one, but they could do so tomorrow and they would never have to tell you about it, other than that red banner on the box that says "NEW!".

"Oh,brother, the world's first glue snob!"

Hey, only the best for these artifacts. Actually, the proprietary mixture issue is only a small part of the reason I don't use Duco. The main reason is its chief constituent, cellulose nitrate, frequently referred to as nitrocellulose. This is a member of the celluloid family, the oldest group of synthetic plastics, whose origin goes back to 1868 and the quest for a replacement for ivory in billiard balls. In the 1920's DuPont introduced Duco as an automobile lacquer. When and how it was transferred to the task of a general household cement I'm not sure, nor whether the transfer involved any transformation of its ingredients. Whatever the course of its own specific history, Duco shares in the drawbacks of the class of plastics to which it belongs.

Cellulose nitrates have some good qualities. They are compatible with a wide range of materials, and their shear strength immediately after setting is moderately high. However, these are more than offset by their drawbacks. They are very inelastic and form a generally brittle bond. Despite their high shear strength, they cannot support much weight and this, combined with their relative brittleness makes them not suitable for many load-bearing applications, such as reconstructing large or thick-walled pots. Most importantly,cellulose nitrates ageing characteristics are notoriously poor. It yellows rapidly and badly and its brittleness increases with time, leading to a high rate of bond failure after elapsed time. I don't know how often you have tried to pick up a several years old Duco mended sherd assembly--not a waist high vase, but three or four sherds lying in a tray--and the one you were holding on to came off in your hand, but its happened to me often enough to make me hate Duco cement.

"But that's as much a fault of the mending technique as of the adhesives, isn't it?"

Quite possibly. Many people do not bother to mend ceramics properly, because it is a bother. And if you're just trying to determine vessel types or minimum vessel counts or list cross-mends within a site or a feature, you probably don't need to take the time to do a proper mend, since adhesion is only ancillary to your true purpose. But, if you are doing mends which you want to last, there is a way to make a bond which has the best chance of supporting the weight above it and of lasting for a while to boot. The method is straightforward, but time consuming. Surprisingly enough, the correct method, in a highly condensed form, is found in the directions on the back of the tube of Duco cement.

The method is, in the case of a porous material such as ceramics, as follows: Have two strengths of the adhesive prepared, one thin (dilute) and one thick (non-dilute). Take your brush--oh yes, you need a set of brushes, you can't make a decent mend by squeezing glue out of a tube--and brush the thin version onto all of the surfaces to be adhered. Let it soak in, and wait until it becomes tacky. You may let it dry completely if you wish: this can be a first step applied to all the sherds to be mended at the same time. If the glue completely disappears into the pores, or if it fails to become tacky as it dries, than you may have the thin version too thin, in which case thicken it up a bit with some more adhesive and try again. Having carefully found the correct sitting of the mends and determined the order of mending--generally from the base up--you begin actual mending with the thick version of the adhesive. The trick is not to mend too many fragments at once. Depending upon the configuration of the mends, you may have to glue three rather than two sherds at a time, but the usual rule is: one mend at a time. Let each mend (or group of mends become well set, at least several hours old, before you begin the next. This can be tricky, because if you have not correctly sited a mend at one place then a future mend higher up may loose its alignment. If the order of mending is not clearly thought out, a sherd may be blocked from its correct position by an adjacent sherd or sherds. Aligning and sequencing each sherd before adhering is essential. If necessary, you can always reverse a mend and start over again.

This, evidently, is not technically difficult, but it is slow. It requires containers for preparing two versions of the adhesive, solvents for thinning, cleaning,(and reversing!), and brushes for applying the adhesive. This is a little more complex than squeezing glue out of a tube. You can even perform this method using Duco. Although Duco's instructions give a strong hint in the right direction, the implication is that you need nothing besides the tube and a pair of white gloves. Easy! Fast! Convenient! No muss, no fuss. Well, doing a proper mend is not necessarily easy, and it is not fast, and you will have to clean your brushes out.

"Okay, if Duco is so irredeemably horrible, what would you suggest using instead?"

Ah, now comes my chance to equivocate. There are a lot of plastic resins on the market; some of them are better for one type of ceramic, some for another. For porous, open bodied ceramics such as earthenwares. I like Butvar, a polyvinyl butyral, which is strong and flexible and is non-yellowing. It generally ages well. It is soluable in ethanol, which is a lot less noxious to work with than acetone or toluene based adhesives. There are some PVA's, such as Vinac B-15, which are alcohol soluable as well. Acrylics are also stronger and have better ageing characteristics than celluloids. although they are solvented in similar noxious solvents. such as acetone. A source for many of these plastics is given below, but they are widely available elsewhere.

The point of all this is, to make the best mend for your situation, you need to find the best plastic for your situation. Live dangerously, blow your budget--buy two or three in small quantities and find one that you like, one whose solvent you can stand the