What a Bloody Miracle!

The next World Skeptics Congress will be held October 8–10, 2004, in Italy. For this reason, I will devote this and the next three columns to popular Italian mysteries. Should you come to the Congress you could also take advantage of your trip to visit these famous enigmas.

Italy has a long tradition of "sacred relics." There are bones and skulls of famous saints, as well as some of their mummified bodies. Even personal garments that belonged to martyrs and saints are still kept and worshiped in various Italian churches. What usually strikes visitors the most, however, are some extreme relics: body parts like teeth, hair, nails, hands, feet, hearts and tongues (the most famous of which is certainly St. Antony's tongue kept in Padua); or some unlikely ones like the tears of Jesus Christ, pieces of the Cross, feathers of angels, and the tail of the donkey on which Jesus entered Jerusalem.

Of all these relics, only the blood of early saints exhibit some kind of alleged supernatural activity.

Clustered just around Naples, for example, there are some 190 blood relics (Alfano and Amitrano 1951). A small number of these samples liquefy from their usual clotted state—in a purportedly paranormal manner—on specific occasions, usually during religious ceremonies.



The Church of St. Maria in Amaseno, where the St. Lorenzo relic is kept.

When blood is drawn from a living body and poured into a container, the soluble serum protein fibrinogen forms a network of insoluble fibrin, which in turn forms a jelly-like clot. This clot can be mechanically broken down, but when this has been done once, no further change of state can reoccur. Thus, the resolidification of a blood sample would be even more surprising than its first liquefaction (Garlaschelli 1998).

The most celebrated of these miraculous relics is a vial containing a dark, unknown substance said to be the blood of St. Januarius, which has been liquefying once or twice a year since 1389 in Naples (Alfano and Amitrano 1924). St. Januarius was an early bishop of Benevento who was beheaded during the persecution of the Emperor Diocletian in A.D. 305. The relic representing his blood appeared in Naples more than ten centuries later, around 1389. Other relics of this kind, wherein the phase transition is evident and genuine, are the blood of St. Pantaleone in Ravello (Avellino) and that of St. Lorenzo (St. Lawrence) in Amaseno, whose visual properties and behavior seem very similar (Alfano and Amitrano 1951).

Some years ago three members of CICAP (the Italian Committee for the Investigation of Claims of the Paranormal), Luigi Garlaschelli, Franco Ramaccini, and Sergio Della Sala (1991; 1994) proposed in *Nature* magazine that thixotropy may furnish an explanation for the properties of the Januarian blood. Thixotropy denotes the property of certain gels to liquefy when stirred or vibrated, and to solidify again when left alone. The very act of handling the relic during the ceremony, repeatedly turning it upside down to check its state, can provide the necessary shear force to trigger its liquefaction. In support of this hypothesis we succeeded in preparing thixotropic samples closely resembling

Massimo Polidoro is an investigator of the paranormal, author, lecturer, and co-founder and head of CICAP, the Italian skeptics group.

the Januarian relic, using materials and techniques available in the fourteenth century.

Although the Januarian relic is subjected to many mechanical stresses, the large vial containing the blood of St. Pantaleone (becoming liquefied around 27 July) is never moved, as it is locked behind a grate; and that of St. Lorenzo is gently moved only once a year, on August 10, from its niche to the altar. In these cases, then, thixotropy cannot be the explanation. Moreover, it appears that the liquefaction begins days before the feast day, and ends much later (precise day-to-day records are lacking).

The Blood of St. Lorenzo

My good friend Luigi Garlaschelli, a chemist at the University of Pavia and one of the leading experts in the investigation of claims related to the supernatural, has had the rare opportunity of testing first-hand the liquefying blood of St. Lorenzo.

St. Lorenzo was martyred on August 10, 258 A.D., under the Roman Emperor Valerian, by being charred on a grill. His popularity as a saint was always great during the Middle Ages and continues today. The most famous of the relics of St. Lorenzo still existing is a small flask which allegedly contains his blood and which is venerated in the collegiate church of St. Maria in the small town of Amaseno (near Frosinone).

The relic is normally locked in a silver tabernacle in the right wing of the church. A few days before the saint's feast the niche is sometimes unlocked and the state of the relic inspected. On the morning of August 10, the relic is brought near the altar, put onto a baroque stand, and locked in a glass cabinet. There, the worshippers can witness any further transformation of its state. A ceremony is held, on that same day, in the presence of the bishop from Frosinone; at night the relic is locked again in its niche, and sometimes its further changes in the following days are checked by opening the safe a few times. No physical, chemical, or spectroscopical tests have ever been performed on this relic.

On August 10, 1996, Garlaschelli was officially invited to examine the small flask on the occasion of a television documentary. Garlaschelli took along with him a number of instruments: a camera, a caliper, an electronic balance, a test-tube whirler, some chemist's clamps, laboratory metal stands, thermometers, and beakers.

Testing the Relic

The relic consists of a small glass flask, 15.3 cm high and weighing 141.8 grams (mean of three measures on an Acculab electronic balance). It has the shape of an



The relic of St. Lorenzo.

inverted cone, connected to a long, 2.5 cm diameter neck. The bottle is closed with a cork that cannot be removed, secured by red strings, red wax seals, and an old discolored bishop's label. However, the cork is clearly not airtight.

The vial contains an estimated 35 ml of a mixture of substances. On the bottom there is a lumpy, tan-colored layer, possibly containing sand or earth. A very tiny piece of darker material in this layer was traditionally interpreted by believers as being a particle of the coal on which the saint was martyred. A few observers even claim to see a piece of the saint's charred skin (Giannetta 1964). A second layer is above, normally in the solid state, also brownish, topped by a third, thin, more amorphous layer. When liquefied, the middle layer becomes clear, changing color to ruby red, and flows freely if the flask is tilted slightly. The bottom layer always remains solid and the top one sometimes becomes partly liquefied. When Garlaschelli examined the relic, the middle layer was liquid while the other two layers remained opaque and solid.

Garlaschelli whirled the ampoule for ten seconds on a Maxi Mixer test-tube mixer to check for a possible stress-induced thixotropic phase transition, but the only result was that the two uppermost layers became slightly mixed. The bottom layer remained unchanged, and a further ten seconds whirling failed to alter the fluidity of the viscous contents.

Garlaschelli then cooled down the small flask by clamping it at the neck and immersing its lower part into a water-ice bath. After a few minutes, the entire contents solidified into an opaque tan-colored mass.

Finally, Garlaschelli slowly re-warmed the water bath again to the initial room temperature by placing a hair-dryer under it, while monitoring its temperature. The contents of the flask melted again, and its color turned red, thus clearly demonstrating that the observed change is simply a temperature-related effect of a low melting-point compound.

The Results So Far

The red substance cannot possibly be blood, since whole blood is typically opaque; even a clear haemoglobin solution would have decomposed and lost its bright red color over the centuries; and a water solution would have dried up from the imperfectly sealed flask (and would not freeze at 30°C).

Garlaschelli's conclusion was that the softening temperature and the overall look suggest that the relic consists of fats, waxes, or mixtures thereof, possibly containing an oil-soluble red dye. As a matter of fact, this relic is described in the church consecration act scroll (1177) as *reliquia de pinguedine St. Laurentii Mart* ("relic from the fat of the martyr Saint Lorenzo"). The liquefaction phenomenon was not observed until the seventeenth century, when it became dubbed "fat and blood" and finally just "blood." This fact might even raise the suspicion that the early relic was at that time substituted for the present one (possessing evident liquefying properties).

It is interesting that one of the hypotheses about the blood of St. Januarius was that the unknown substance is simply a mixture with a low melting point. Solid when stored in a somewhat cooler place, it would melt when taken to the warmer altar, near burning candles, amidst a fervent crowd. This hypothesis was first recorded as early as 1826 (Salverte 1826) and was quickly supported by numerous recipes, mostly based upon waxes, fats, or gelatins (plus suitable dyes). A practical, era-appropriate solution was suggested by Nickell and Fisher (1993). In any case, mixtures such as these have a constant melting point, whereas the blood-liquefaction ceremony can be performed at different room temperatures (such as during May, September, and December). Thus Garlaschelli's opinion that, in the case of the Januarian blood, the thixotropic hypothesis seems more plausible.

However, unlike the Januarian relic, the "blood" of St. Lorenzo is not contained in a sealed flask. A tiny drop of the substance, extracted with a syringe through the somewhat loose cork, might easily be analyzed by standard spectroscopic and chromatographic methods, determining the nature of the red dye and the identity of the low melting point mixture.

Almost any substance melting in that range would do; it is tempting, however, to think of fats or waxes. Fats, in particular, would be rather easily analyzed. The type and the relative amount of the different fatty acids obtained by hydrolysis of triglycerides (fats), in fact, are a sort of "fingerprint" often allowing the identification of the specific oil or fat. It could distinguish, for example, among sunflower, linseed, or coconut oils, tallow, etc.

The "blood" of St. Lorenzo looks very similar, for example, to the so-called "red palm oil," a vegetable fat extracted from the plants *Elaeis guineensis.* This alimentary fat contains reddish-orange carotenes, is yellowish when solid, and deep orange when liquid; this color change, and its exotic origin, might well have elicited fantasies about its miraculous properties. Its melting point (around 17°C), however, is lower than that of the unknown "blood," and its color seems to be more orange than red. Thus, unless it was mixed with other higher-melting compounds, better candidates might exist: coconut butter, tallow, etc. These fats are colorless and would call for the addition of suitable dyes.

Chemically, a preponderance of saturated fatty acids in the triglycerides leads to substantially higher melting temperatures. Saturated fats are also more resistant to oxidation, which creates rancidity. Since the relic's substance appears to have been fairly stable through the centuries, one should suppose a large amount of saturated fatty acids in it. Even more stable are waxes, which, however, generally have a higher melting point.

The first fat-soluble red dye that comes to mind, which has the appropriate red hue and was widely used during the Middle Ages, is "dragon's blood," a vegetable resin extracted from the plants *Daemonorops propinquus* (The Merck Index 1989); *Dracoena draco* (Thompson 1936; Edwards, Farwell, and Quye 1977); or *Calamus draco Willd.* (Villavecchia-Eigenmann 1977).

Clearly, these are just speculations. As stated above, the relic representing the blood of St. Pantaleone in Ravello also seems to behave in an exactly similar manner, and has the same visual properties. It would be even more interesting to obtain exact data on both of these maybe-not-so-miraculous substances.

The simplest check—one that Garlaschelli recommended to the relic's keepers—is a regular daily record of the state of the substance *versus* the temperature. Conclusive analysis, of course, should be of a chemical and instrumental nature (Edwards, Farwell, and Quye 1977).

After his initial test done for TV (which, by the way, never aired because of the mundane results obtained) Garlaschelli asked permission to perform further tests on the relic. So far the church authorities have denied further access to it.

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