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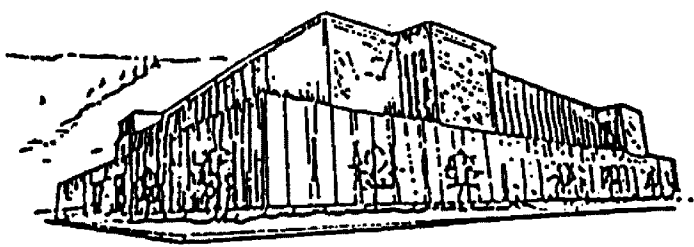
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**NON-SEXUAL REPRODUCTION OF HUMANS  
CASTING TECHNIQUES, METHODS AND MATERIALS**

**By**

**Garry Kerr**

**B.A., University of Montana, 1985**

**Presented in partial fulfillment of the requirements**

**for the degree of**

**Master of Arts**

**The University of Montana**

**1994**

**Approved by:**

*Randall R. Shilo*  
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**Dean, Graduate School**

9-13-94  
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9-28-94

**NON-SEXUAL REPRODUCTION OF HUMANS  
CASTING TECHNIQUES, METHODS AND MATERIALS**

**Garry Kerr  
Dept. of Anthropology  
University of Montana  
Summer 1994**

**Non-Sexual Reproduction of Humans, Casting Techniques, Methods and Materials (76pp.)**

Chairperson: Randall Skelton *RS*

**Casts of human remains, fossils, artifacts, and other objects are for sale and on display worldwide. Museums, educational institutions, law enforcement agencies, and individuals all covet high quality, finely detailed casts. Casts can be produced that look identical to the original specimen but, in many cases, are much more durable. Also, with casts, multiple copies can be made so that many people can study the same object simultaneously.**

**Most casting methods are very similar; a mold is made by covering an object with a flexible substance, a release agent is used to prevent materials from bonding to each other, after removal of the original, a material (usually liquid) is poured into the mold and allowed to cure, the cast is then removed. While casting methods are similar, the materials vary widely and new ones are frequently being discovered. I tested a couple of dozen different casting materials and have listed their various attributes as well as how they can be aquired.**

**Taking a human skull as a sample object, I detail, step-by-step, how to make molds, casts, and endocranial casts using latex and plaster. Staining, protection, and storage of casts and molds is also addressed. I intend to show the reader that it is possible to make high quality casts at a resonable cost. A section on how to set up a casting lab with an equipment list and costs is also included. For those wishing to purchase casts, I've gathered ten (10) different sources, with addresses at the end.**

**Anyone with an interest in fossils, museum work, anthropology, archaeology, theater, art, human evolution, or education, in addition to many other fields should have an understanding of the basics of the casting process.**

**"IF YOU ARE CLEVER AND YOU KNOW  
YOUR BUSINESS YOU CAN FAKE A BONE  
AS EASILY AS YOU CAN A PHOTOGRAPH."  
(Doyle,1912)**



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I wish to thank a number of people for their efforts, over the years, in getting this project off the ground and seeing it through to its completion. Everyone I talked to involved in casting was more than happy sharing their particular methods and materials, this is important as it saves duplication of effort and avoids wasting time. Without the assistance of the following people, listed alphabetically, I would not have delved as deeply into the enjoyable world of casting. To each I extend a sincere 'Thank You', and the offer to cast their skulls at a later date.

<b>Madame Azoulay</b>	<b>Muse'e de L'Homme, Paris, France</b>
<b>Marlene Bitton</b>	<b>Muse'e de L'Homme, Paris, France</b>
<b>Michael Black</b>	<b>Institute of Human Origins, Berkeley, Calif.</b>
<b>Dr. Michael Charney</b>	<b>Colorado State University, Ft. Collins, Co.</b>
<b>Dr. Yves Coppens</b>	<b>Muse'e de L'Homme, Paris, France</b>
<b>Pam Ehli</b>	<b>Bigfork, Montana</b>
<b>Dr. Jack Horner</b>	<b>Museum of the Rockies, Bozeman, Montana</b>
<b>Dr. Donald Johanson</b>	<b>Institute of Human Origins, Berkeley, Calif.</b>
<b>Dr. Darshan Kang</b>	<b>University of Montana, Missoula, Montana</b>
<b>Clara Seley</b>	<b>Ithaca, New York</b>
<b>Dr. Randall Skelton</b>	<b>University of Montana, Missoula, Montana</b>
<b>Dr. Sandy Smith</b>	<b>University of Montana, Missoula, Montana</b>

I would also like to thank the following suppliers, for generously sending me samples of their products to evaluate, as a graduate student many would have been unavailable to me otherwise.

<b>Air Products</b>	<b>Kinderprint Co.</b>
<b>Conap Inc.</b>	<b>Silmar®</b>
<b>Dow Corning</b>	<b>Smooth-On, Inc.</b>
<b>George Mann &amp; Co. Inc.</b>	<b>REN™ Plastics</b>
<b>Kerr Manufacturing Co.</b>	

## **CHAPTER 1**

### **Introduction : Why cast and who needs casts?**

**The need for quality casts is worldwide and touches many fields beyond science. There are also many reasons for making casts; some are obvious, but some may not be realized until the future. A common reason for casting a skull or other object is to preserve and duplicate the original so that many may study it simultaneously. Globally, colleges, museums (Burcaw, 1984), high schools, law enforcement agencies, industry, and individuals have created a demand for inexpensive, durable, accurate, highly detailed casts of human and non-human skulls, bones, and cultural artifacts (Indian Arts and Crafts Board, 1978).**

**Around the world, human evolution and human variation courses are being taught to ever-increasing numbers of people. Casts should be readily available for in-depth, hands-on study in addition to display. Casts can efficiently illustrate; sex, age, trauma, disease, pathology, racial variation, and many other features that people find of interest. Because of this, safe, inexpensive, and easily-available casting systems need to be accessible.**

**Is it necessary to purchase expensive casts, often costing more than \$100 each, and to pursue high-tech casting systems with dangerous new-age materials, or can other, simpler, safer, and cheaper**

methods and materials such as plaster and latex be used with no noticeable compromise in quality? My purpose is to explore casting options, their strengths and weaknesses, and to take a detailed look at specific casting systems.

Educational institutions from the grade school level to universities need quality casts for teaching. Scientists and academics frequently use casts when original specimens are unavailable (Skelton, 1992). Casts can show to first-graders tooth wear and dental caries brought on by improper oral hygiene, possibly imprinting a lifetime of good habits. Casts are a frequent sight around high school drama departments, especially when <sup>MacBeth</sup> ~~MacBeth~~ is staged (Adix, 1956). Due to the rare and fragile nature of fossils, casts of human ancestors, as well as other casts, are used by colleges and universities around the world (Lewin, 1987; Spencer, 1990). Books can provide photographs and text (Coppens, 1976), but there is no substitute for a hands-on approach to teaching evolution of, and variation among, animals.

Museums would be lost without casts. A large portion of most natural history museum displays are composed of casts (Smith and Latimer, 1985). After all, there is only one original. How many museums around the world display "Lucy" (Australopithecus afarensis discovered by Dr. Donald Johanson (Johanson, 1981; Larsen, 1991)) or the famed La Chapelle aux Saints Neanderthal (Constable, 1973; Leakey, 1977; Larsen, 1991)? In each museum, university, or other collection a cast is being offered for viewing. The original remains of

**"Lucy", following custom, and law, have been returned to their country of origin: Ethiopia.**

**Human remains that are housed in museums, or are accidentally unearthed, may provide valuable information to present and future generations. Unfortunately many peoples, including Native Americans, have strong spiritual connections with human remains that prohibit their being left unburied. In response to this, many museums and collections have repatriated (Select Committee on Indian Affairs, 1990) their identifiable remains to concerned and related tribal representatives (National Geographic, 1994). Casting may provide the future with an excellent, non-destructive, spiritually safe, replica of long-dead-and-buried peoples.**

**The work of Dr. Jack Horner, a noted dinosaur paleontologist, with dinosaur skeletal material (Horner, 1988) highlights an attractive feature of casts: weight. The weight of a complete tyrannosaurus skeleton would be many tons; because the processes of permineralization and fossilization make the bones weigh much more today than they did when the dinosaurs were using them for support (Horner, 1994). Dr. Horner, and others at the Museum of the Rockies, in Bozeman, Montana, display full-scale, articulated dinosaur skeletons which can be readily moved and reassembled. This would be an awesome logistical task if the bones were real. They use hollow casts, painted and stained to resemble the original, but without the incredible weight. The casts are also easier to assemble and, if**

something unfortunate happens, each piece is replaceable (Horner, 1992).

I was once both startled and comforted when I viewed a cast of a Neanderthal skull in a Chinese museum the original of which I had just recently studied in France. Unfortunately, in the 20th century, museums are having to address the problems of theft and senseless destruction on a scale unheard of in the past. Casts are less attractive targets of attack and are usually replaceable. Insurance on a cast (Lewis, 1976) is negligible and security measures (National Park Service, 1990; Keck, 1974) for display are greatly reduced. Changes in temperature, and humidity levels are not a problem with casts as they can be with real bone (Thomson, 1986).

The advertising industry frequently uses casts in commercials and displays. They even have talking dummies drive cars into walls to illustrate various concepts. The television and movie industry relies heavily on casts. Very few horror films are lacking scenes in which casts, skillfully doctored to appear real, are the subjects of some dastardly, stomach-tightening, deed. The most gory shows televised are the made-for-television police reenactment movies that are so popular. It is fortunate that casts are available for illustrative purposes, as the alternatives are limited.

Law enforcement agencies and forensic identification provide persuasive reasons for making casts. Bullet penetration through hard materials often leaves a castable entrance and/or exit hole. Scrape,

cut, pry, and other tool marks are often clues left behind at crime scenes. These are often cast and used as evidence to exonerate the innocent and to convict the guilty. Alan Boehm, the Tools, Weapons, and Ballistics expert at the Montana State Crime Lab in Missoula, Montana (Boehm, 1993), uses a Mikrosil casting substance from the Kinderprint Company to record various traces left behind by those involved in criminal acts. He uses it to collect and preserve important forensic information left on such surfaces as bullets, walls, door jambs, clubs, automobiles, and even to preserve bite marks left on a variety of surfaces.

Forensic identification of John (or Jane) Doe remains sometimes <sup>SP?</sup> calls for facial reconstructions. Casts as the underlying support structure for facial reconstructions are much preferred over real bone for a number of reasons. Some people feel contact with real bone is unnecessary and possibly dangerous to their personal, spiritual, and physical safety, although the process of preparing skulls for facial reconstruction and casting are quite similar, and both render the bone biologically and bacteriologically inactive. Upon accurate identification, the skull is included with the rest of the remains to be buried or disposed of as desired by the family. Reconstruction of the face might be less traumatic to the family when it is done on a plaster cast. Most importantly, there is only one skull issued per person.

When a facial reconstruction for identification of an unknown decedent is requested, there is usually no indication of the individual's

weight. Therefore, obese, emaciated, or any condition in between, would look the same on the skull. Instead of doing facial reconstructions on one skull three times and photographing each; one can, with casts, do three reconstructions concurrently and display all of them simultaneously. Many mystery authors, like Aaron Elkins, weave facial reconstructions into their books (Michaels, 1987). They have even appeared on television in episodes of MacGyver, Quincy, and other shows.

Casts are often preferred when using the Scanning Electron Microscope (SEM) (Rose, 1983). The SEM produces greatly enlarged images of minute objects or traces. Normally, a specimen must be stabilized, then coated with gold, before being subjected to the SEM. The gold coating allows electrons to bounce back so that an image may be recorded electronically and/or photographically. The SEM literally bombards the object with a dense beam of incredibly high-speed electrons; fragile objects often cannot withstand the electron barrage. I have successfully cast old teeth and ancient, delicate bone for work with the SEM. The teeth showed scratches in the enamel that indicated the diet of its previous owner. The bone was old bison bone from a bison jump site. By using the SEM and casts of the butcher marks on the bone, compared to test marks from modern tools, I was able to tell that the bison had been butchered by non-metal tools, and that the tools were not made of chert or flint (stones local to the site), but of obsidian that had to be carried a great distance to the butcher site.



**Each tool, metal or stone, left a characteristic mark that was made obvious by the greatly enlarged image produced by the SEM. In both cases it is questionable if the original teeth or bones would have survived the SEM process; the casts survived easily.**

**I will test various mold, cast, and other materials as to the following properties: durability, strength, price, shelf-life, accuracy, fidelity, safety, and complexity. I will also examine the many applications of latex, a widely used substance, and test it to see how to get the greatest number of reliable casts from each mold. I will include a detailed explanation of how to cast a human skull from start to finish, and discuss the creation and maintenance of a casting lab. Costs, space requirements, utilities, materials and storage will be addressed.**

## CHAPTER II

### Casting : Methods and Materials

Casting is a fairly easy process, but it is necessary to understand a few basic concepts and terms before we proceed. Casting methods (with the exception of large-scale industrial casting) are all quite similar. One of the most well-known classic casting programs for high quality plastic casts is the Wenner-Gren foundation, (Cartmill, 1973). After the examination of many different methods, this is the one that I use. The goal is to accurately reproduce the original item without accelerating its destruction. A cast is simply a copy of the original. It comes out of a mold, which is formed around the original piece; a mold needs to be flexible and to spring back into shape with no distortion after repeated use, often over many years. I will refer to this ability as "memory". A plastic ice cube tray is a mold with excellent memory; it will produce identical casts (ice cubes) almost indefinitely.

A "back-up" mold is a jacket that fully surrounds and supports the mold within; it maintains the integrity of the mold so that each cast is the same as the original. The back-up mold is usually very stiff and non-flexible, composed of more than one interlocking parts. A normal back-up mold for a skull is made of five pieces of plaster, poured to overlap.

Another extremely important material used in the casting process is a release agent. A release agent facilitates the removal of

**your original specimen, as well as future casts, from the mold. Without a release agent one might hopelessly glue a 3.5 million year old fossil into a lump of silicone.**

**There are many different materials suitable for making casts, molds, and back-up molds. I will discuss the strengths and weaknesses of a number of them in this and the following chapter. Refer to the table at the end of Chapter 3 for quick reference and comparison of materials. In other literature mold may be referred to as the primary mold, and the back-up mold as the secondary mold; some find these terms to be confusing, so I will refer to mold and back-up mold.**

### **Cast Materials**

**Plaster is an excellent material to use for making casts (Chaney, 1973; Cowley, 1973). It captures fine details, is durable, and is fairly inexpensive. The better the grade or quality of plaster, the better the cast will turn out. "Plaster of Paris" is not the best for casting; dental casting plaster (available at hardware stores) is much better for durability and retaining detail. The best plaster is Hydrostone or Silky stone dental plaster, used in orthodontics for making tooth molds from impressions. The better plasters have a finer grain size and a stronger bonding agent. They have a smoother, more finished surface texture compared with Plaster of Paris and other less expensive plasters.**

**Foam is an interesting material to work with, producing balloon-like, lightweight, fairly durable casts that take paint well. I**

tried insulating foam in a can and "Mountains in Minutes™". Mountains in Minutes™ is available at most toy and hobby shops for making volcanoes and mountains for small-scale landscapes. Part "A" is mixed with part "B", resulting in an increase of 30 times its original volume. It is very economical. The label on the can states:

**"These cans will produce up to 10 square feet of mountainous layout. Liquid foam components yield one cubic foot of hardened rigid foam weighing two pounds - equivalent by volume to approximately 75 pounds of plaster." ©1987**

Foam in a can is easier to use as there is no mixing and it is dispensed from a nozzle. I am partial to Great Stuff® Minimal Expanding Foam Sealant as it is inexpensive (~\$3.50/can) and available nationwide. Foam has a tendency to expand more than expected and can, if left unchecked, expand the mold out of shape until the cast is no longer accurate. To prevent this, add foam a little at a time, starting at the places farthest from the exit/fill hole. Foam has many other uses, including filling hollow casts to make them more stable for shipment and handling. It can also be used as the material for sturdy, lightweight, back-up molds.

Latex is another good cast material, it makes highly detailed, flexible casts of many objects. It can be used to cast various body parts; hands, feet, life-masks, death-masks, as well as to make flexible bone casts. See Chapter 4 for the use of latex in making endocranial

casts. Rubber, Room Temperature Vulcanizing silicone compounds (R.T.V.s)(Chaney,1981), Polyester and Urethane resins, epoxy, and silicone products all can make sturdy, durable, long-lasting, and detailed casts (Reser, 1981).

This is also true of a number of plastics, although some of the plastics are not as accurate for fine detail. The manufacture of plastic casts usually involves a large initial financial outlay, for the mold materials (often metal) and equipment, but the individual casts (material-wise) are relatively inexpensive. Rubber, R.T.V.s, Fiberglass, Silicones, rigid Epoxy's, and other products can be used in many inexpensive molds (i.e. Latex, silicone, etc.) yet they are fairly expensive on a per cast basis. They have an advantage of allowing one to select the hardness and flexibility as well as the cure time. Most are two part systems with a base and a curing agent or catalyst; adjusting the amount of catalyst changes the cure time and, sometimes, the final properties. Unfortunately, many of the catalysts are hazardous to human health, and even limited exposure is ill advised. Labs that do not have vented fume hood systems and established safety procedures should tread lightly when it comes to hazardous chemical agents. Often, the results of exposure will not surface for many years, but they are devastating and irreversable. This is the main reason that I have concentrated on the safer materials.

**Wax has been successfully used as a cast material. It has a low melting point, which is both good, for pouring the cast, and bad, for long-term storage and display. Gelatin can be used for endocranial casts, giving detail and, if its specific gravity is known, actual brain weight (Ross,1988). Occasionally, even water (ice) is used as a cast material, although it has a very limited shelf life. To avoid bubbles in the ice, start with cooled, boiled water; boiling helps release some of the oxygen that is dissolved in the water.**

### **Mold Materials**

**Materials for making molds also come in a wide variety. Price, safety, accessibility, durability, and many other factors will influence which materials you finally choose. Molds can be made of materials that are destroyed in use and that only produce one cast, or that can be reused hundreds of times. Generally, molds should be fairly flexible, although in die casting and other industry, rigid metal (Calvert, 1982) is used as a mold material.**

**Latex is one of the most popular mold materials. It is readily available, natural, has lasting memory, is safe, inexpensive, versatile, and it produces excellent detail. Latex can be bought at hobby shops and arts & crafts stores for less than \$50 per gallon, which is enough for 3 or more good molds of human skulls or similar-sized objects. Latex is sap, tapped from rubber trees, that cures when exposed to air; it is safe to handle gloveless and, in fact, can be safely painted on the skin. Latex can be used for many different types of molds and**

**casts. Casts from latex molds have excellent detail and are very flexible. Use only raw liquid latex with no dyes, pigments, or additives for the best results. Well-made latex molds can produce dozens of quality casts over many years. Latex is my personal favorite mold material for use in casting for the above and other reasons. See Chapter 4 for a detailed look at the use of latex in molds and endocranial casts.**

**Silicone is very popular with Dr. Jack Horner and others as a mold material (Horner, 1992). It is easy to acquire and use, it cures rapidly and it produces long-lasting molds. Dow Corning® silicone caulking #732 & #734 in cartridges is very easy to work with and fifty dollars will go a long way, a human skull can be cast for under \$25. The MSDS advises the user to avoid skin contact and inhalation of fumes given off during curing. It cures fairly quickly and can be reinforced with strips of gauze or handiwipes, and thickness can be built up in layers. Silicone molds have excellent memory and can last for dozens of years with infrequent use, but when they finally wear out, they tear. The detail captured is as good as with latex, but silicone is not as flexible. A good release agent is paramount when using silicone, as its original uses were, and still are, as strong adhesives. I recommend testing your release agent on a small piece of the mold material before you commit a priceless fossil to permanent entombment in silicone.**

**R.T.V.s are a type of silicone and, based on a tip from Michael Black of the Institute of Human Origins, Berkeley California, I have had great success with Dow Corning Silastic® E RTV Silicone Rubber Kits. The molds appear to last forever even with frequent use, and storage can be as simple as stacking on a shelf. It is an expensive product compared to other silicones and it is recommended that you use each kit within six months. Another drawback is that it is best used in conjunction with a vacuum that draws 29 inches of mercury. Bubbles are trapped in the mixing process and must be degassed under vacuum, many small labs or temporary casting projects do not have access to vacuum equipment.**

**Metal molds are used in industrial process (Calvert, 1981) and, therefore, I have never worked with them directly. Many mass-produced plastic casts on the market are made from metal molds with a hot liquid plastic injected to make a cast. These metal molds are used thousands of times, but they are very expensive to set up initially and the detail is not always good.**

**Around the world, wax has been used for thousands of years as an inexpensive and easily available mold material (Lenz, 1933). Wax is safe and simple to work with and it can be remelted and reused. As long as temperatures are not too hot, storage is not a problem. Its main drawback is that most wax molds are useful only once; and, a new mold needs to be manufactured for each cast.**



**Sea Gel™ is an alginate (see glossary) available from dental supply sources. Sea weed is pulverised, processed, and made into Sea Gel™ powder. It is very safe to work with; dentists stick it in peoples' mouths daily. It is fairly cheap, produces excellent detail, and it stays flexible long enough to make amazing quality casts, but only once. I have cast human hands saluting, and even clenched fists, and gotten great fingerprints and wrinkles on both sides of the cast; but to get the cast out, one must destroy the mold. If alginate were reuseable and did not rapidly dry out, it could challenge latex and silicone. High quality dental stone casting plaster compliments alginate nicely as a casting material.**

### **Back-Up Mold Materials**

**The back-up mold is present only for support of the mold. It does not need to contain fine detail and it can be made of the less expensive materials. Plaster is a common material for back-up molds and it can be the cheapest grade without affecting the quality of casts. I like my plaster back-up molds to be between 1/2" and 3/4 inch thick. If too thick, they are heavier than necessary, and wasteful of materials. Back-up molds that are too thin break frequently.**

**The thicker, stiffer, least flexible silicones can be used as back up molds, but casting a large object can be needlessly expensive. An incredibly lightweight back-up mold can be made from insulating foam. Cover the mold with cellophane wrap and no release agent is needed. Make sure to remove each piece of a back-up mold before**

making the next piece. All pieces should interlock, holding each in place, a large rubber band or section of bungee cord will keep them all together.

### Release Agents

Possibly the most important material for successful, stress-free casting is a high-quality release agent. This can make the difference between easy assembly/disassembly of molds, back-up molds, and casts, and total failure. Many release agents are available, Vaseline<sup>®</sup> is one of the easiest to use, cheapest to buy, and it works well. Thick layers keep back-up mold pieces from sticking to the mold and to each other. When casting a skull or other bones, I apply Vaseline<sup>®</sup> everywhere on the bones, and then rub off the excess with a damp cloth or paper towel. The idea is to leave an extremely thin film that will allow any mold material to release.

Pam<sup>®</sup> 'no-stick cooking spray' is another commonly available release agent; it has the advantage of being available in a spray can for easy dispensing. Spray lightly and remove any excess as Pam<sup>®</sup> can leave a greasy residue, and it tends to drip and pool. Pam<sup>®</sup> and plaster, given the right conditions of temperature and humidity, promote the growth of destructive fungus and mold. Mold spores are a common contaminant of all but the purest mountain or filtered air.

CRC<sup>®</sup> Industrial Extreme Duty Silicone spray release agent works well between molds and back-up molds, but may be too thin a layer for endocranial casts. It also tends to puddle in low spots while

not thoroughly covering overhanging areas. George Mann Co. has some high quality products including Aqualease™ 6100 and Ease Release™ 400. Aqualease™ works well but, since one must pour it into the mold, shake, and pour out any excess it can leave a thick coating and be expensive. Fortunately it can be diluted and applied with a cloth or brush. I found more applications for Ease Release™ in a spray can. I used it for a number of functions including cast release, mold release, and to keep surface bubbles from forming on casts. It is an excellent product and each can contains hundreds of releases.

CONAP MR-5002 release agent works well for general purposes and very well with most Conap products. When using a casting material, check with the manufacturer, as to which release agent is recommended. Airid release agent by Deepflex Plastics comes in a pump spray bottle and works well as a release agent; it also keeps bubbles from forming on the surface of plaster casts. Unfortunately Airid leaves casts with a green stain. To find the best release agent for each material, experiment a little with as many products as you can find. I routinely use three or four different release agents, for different purposes, on any given day. Some release agents, if used too liberally, make the cast resistant to stain or paint, clean the cast with an appropriate solvent before finishing the cast. Do not make the mistake of finding out too late that you should have applied a quality release agent.

### **CHAPTER III**

#### **Materials Tested, Results, and Sources**

**I have tested many different materials that are in some way related to the casting process, the following is an alphabetized list, by product name, of the majority of those materials. Each product listed will be assigned to a classification of; Mold Material, Cast Material, Mold/Cast Material, Release Agent, or Misc., at the end of the chapter are three charts for quick comparison of the various materials in each major classification. Listings also include a brief description of the material and its uses, as applicable to the casting process, and the manufacturer's or distributor's name, address, and phone number.**

**Because of constantly fluctuating prices (usually price increases) I have not included costs, of each material, other than in general terms. Contact the individual distributor for prices, catalogs, samples, and the Material Safety Data Sheets on products in which you are interested. The MSDS information is necessary to be fully informed on each product and can be life-saving. I usually ask for MSDS information before ordering any samples, and in the cases that I found the chemicals presented too much of a health hazard, I did not order a sample and they have not been listed. The following is an incomplete list, as there are many good products that I have not heard of, or that were not available in small lots.**

**Acrylic Paint****Misc.**

Acrylic paint can be used to finish casts made of many different materials. I am partial to burnt umber on plaster casts to "age" them a few million years. Paint it on in desired darkness, I dilute with water and test various pieces of 'waste' plaster first, until it is the right color. When dry the paint will not easily come off.

Golden Artist Colors Inc.  
New Berlin, New York  
13411

**Alginate 1st Impression™****Mold Material**

Alginates make flexible molds that capture excellent detail. It is very safe (dentists put it in peoples mouths daily), inexpensive and handles overhangs and undercuts with no problem. Unfortunately it rapidly dries out after mixing and can only be used once, to get the cast out the mold is destroyed. It is an excellent material for making single, highly detailed, casts of unique objects.

Wykle Research Inc.®  
2222 Hot Springs Road  
Carson City, NV 89706  
(800) 854-6641

**Airid****Release Agent**

Airid release agent comes in a pump spray bottle and works well on plaster, R.T.V.'s, ureathanes, plastics, and other

materials. Unfortunately Airid tends to leave porous casts (like plaster) with a green stain. In addition to a release agent it helps keep bubbles from becoming a problem. It has a long shelf life.

Deepflex Plastic Molds, Inc.  
Fort Worth, Texas  
76110

### **Aqualease™ 6201**

### **Release Agent**

Aqualease™ 6201 is a dilutable liquid, water based solvent, that works well with polyurethanes, epoxies, polyesters, R.T.V.'s, and other smooth surfaces. It provides an excellent release, that is safe, inexpensive, easy to work with, and can be applied with spray, brush, or by wiping the surface. It is not as effective on porous materials such as plaster and dental casting stones. The shelf life is limited to six months from date of shipment.

George Mann & Co., Inc.  
Formulated Products Division  
P.O. Box 9066  
Providence, RI 02940  
(401) 781-5600

### **Armor-All®**

### **Misc.**

Armor-All® can be used to stabilize casts of latex, rubber, and other similar products. It protects against damage done by; ozone, oxygen, and ultra-violet rays as well as repelling; dust, dirt, and static. It works best if it is applied every three or four months. If it is only

applied once the casts (latex especially) will deteriorate faster than untreated control casts. Treated casts stay flexible longer than untreated ones. Armor-All® can also be applied to molds to keep them in good condition over many years. It is easily applied as it comes in a pump-style spray bottle.

Armor-All® Protectant  
©1984 Armor All Products  
A Division of McKesson Corp.  
Irvine, California 92713

### **Castolite**

### **Cast Material**

Castolite is a clear plastic resin useful for embedding small, fragile objects and fossils. It would be cost prohibitive to cast a solid, large, skull-sized, specimen and the clear casts tend to yellow over time as well as show some internal lines or structure. When hollow casts are poured they tend to be brittle and yellow over time, bubbles are also a problem. Sunlight and heat accelerate the aging process.

Teeth, fossils, small bones, and other stable, dry objects can easily and permanently be embedded. The addition of a little coloring or a background base tends to hide the eventual discoloration. These displays last almost forever, even with frequent handling.

Edmund Scientific  
101 East Gloucester Pike  
Barrington, New Jersey  
08007-1380  
(609) 537-6250

**CONAP MR 5002****Release Agent**

**CONAP MR 5002 release agent works extremely well with Conap products, and also urethanes, plastics, rubbers, silicones, and other materials. It can be poured, wiped, or sprayed, and it stores well.**

**Conap Inc.  
1405 Buffalo Street  
Olean, New York 14760-1139  
(716) 372-9650**

**Conathane® TU-965****Cast Material**

**Conathane® TU-965 is a two-part, liquid at room temperature, cast material that captures excellent detail and is resistant to most acids and solvents. It is very tough, takes paint well, and casts resist chipping and last dozens of years. Solid casts are cost prohibitive, but with the aid of a spincasting machine (Parsons, 1973) hollow casts are reasonable in terms of price. It has a long pot life (mixing & work time) of 15-20 minutes and cures overnight with heat or in a few days at room temperature. It is an exotherm so do not be alarmed by the heat given off during the curing process. Degas after mixing and before curing if possible as bubbles can be a problem. Unopened containers have at least a 12 month shelf life, while cured casts last indefinitely.**

**Conap Inc.  
1405 Buffalo Street  
Olean, New York 14760-1139  
(716) 372-9650**



**Conathane® TU-4010****Mold Material**

**Conathane® TU-4010 is a two-part, liquid, mold material, even after curing it is soft as a marshmallow. It has excellent memory and reproduces fine detail and is resistant to most acids and solvents. It will stretch three to four times its original size and bounce right back, undercuts are no problem. Use a recommended release agent as this material will sometimes stick to itself. Degas the material before final cure if possible. Shelf life is 12 months unmixed and I have found that fully cured it only maintains stability for a few years before "melting".**

**Conap Inc.  
1405 Buffalo Street  
Olean, New York 14760-1139  
(716) 372-9650**

**CutterSil® Light****Mold Material**

**CutterSil® Light is silicone impression material used in dentistry, it captures fine detail and remains flexible while retaining good memory. It works well with a number of cast materials for preparing SEM specimens. Casting a skull-sized object would be very expensive as a toothpaste tube sized container costs in excess of \$25. Small objects such as teeth, small jaws and bones are relatively inexpensive to cast and the detail is excellent. It has a long shelf-life.**

**Columbus Dental®  
1000 Chouteau Ave.  
P.O. Box 620  
St. Louis, MO 63188  
(800) 343-5336**

**Dental Casting Plaster****Cast Material**

Dental casting plaster from a hardware store or Dental supply house is better than Plaster of Paris or lesser grades of casting plaster. It captures fine detail and is very durable. The addition of Gypsum Hardener makes even stronger casts. Hollow skull casts cure fast enough that their molds can be rotated by hand. The casts take paint and stain well and can be finished in a variety of fashions. See Ch.4 for a closer look at plaster. Plaster that has not been exposed to water will last for many years, once cured plaster casts are stable for decades. Plaster is available at most hardware stores.

**Devcon® Flexane®****Mold/Cast Material**

Devcon® Flexane® 94 and Flexane® 80 are two-part easy to mix, liquid, urethane casting materials. Both produce black, flexible casts with excellent detail that are resistant to most acids and other solvents. Flexane® 94 is a fast curing, fairly rigid urethane that works well for casting long bones and other rigid objects. It works as a mold material but is very stiff and intolerant of undercuts. Flexane® 80 is a more flexible urethane with a long working time. It makes flexible casts and also works well as a mold material. Trapped air bubbles can be a problem. Degas if possible.

Devcon  
30 Endicott Street  
Danvers, Mass 01923  
(617) 777-1100

**Dow Corning® 732™****Mold Material**

**Dow Corning® 732™ is a versatile silicone sealant that cures at room temperature. It is packaged in caulking gun tubes that dispense a non-slumping, material that cures overnight into a tough, rubbery mold. Remember to use a release agent as this material is also a powerful adhesive. It captures detail fairly well but does not get into deep holes. A good mold can be made from using Dow Corning®734™ as the first and second layers and then 732™ for final layers. Molds can be made stronger with the addition of pieces of cheese cloth or handiwipes. Unused tubes last for many years, after curing the molds are good for many casts over many years.**

**Dow Corning Corporation  
Midland, Michigan 48686-0994  
(517) 496-6000**

**Dow Corning® 734™****Mold Material**

**"A one-part, liquid-consistency material that cures at room temperature to a tough, rubbery solid....This free-flowing, self-leveling sealant can be used to fill voids, cracks, crevices or conformal coat connections and battery terminals."**

**(Dow Corning,1986)**

**Dow Corning® 734™ picks up and transmits excellent detail, the molds stay flexible for many years. Although not as flexible as latex they do tend to last a little longer before showing signs of wear. Silicone molds tear when they finally wear out but this does not happen for**

**10-15 or more years. Remember to use a release agent as this material is a powerful adhesive.**

**Dow Corning Corporation  
Midland, Michigan 48686-0994  
(517) 496-6000**

**Ease Release™ 400**

**Release Agent**

**Ease Release™ 400 mold release is an excellent liquid release agent that comes in 1-55 gallon containers and non-CFC 14 oz. aerosol cans that seem to last forever. It works with polyurethanes, rubbers, silicones, foams, steel, epoxy, and even plaster. It is safe and can be used with some of the high temperature plastics and exotherms up to 500°F. The aerosol cans spray a fine mist that rapidly, and fully coats the specimen. The cans will last on the shelf for extended periods.**

**George Mann & Co. , Inc.  
Formulated Products Division  
P.O. Box 9066  
Providence, RI 02940  
(401) 781- 5600**

**Extreme Duty Silicone,CRC®**

**Release Agent**

**Extreme Duty Silicone Aerosol is a liquid silicone with Trichlorethane (solvent) and carbon dioxide as the propellant. It is an excellent release agent on most materials from the smooth surfaced to porous plaster. It works well with exotherms and does not breakdown under high temperatures. It is easy to use even with**

unreachable areas like on the inside of a skull. The shelf life is very long.

CRC Chemicals  
885 Louis Drive  
Warminster, PA 18974  
(215) 674-4300

**Extrude-Medium & Extrude Wash      Mold Material**

Extrude-Medium and Extrude Wash are two types of polyvinylsiloxane impression material. They are two-part, paste systems that work well for taking dental impressions and can be used to pick up tool marks. They are useful in retaining forensic evidence when the area is small (1-14 square inches) and capture fine detail. It would be very expensive to cast a skull-sized object in either of these materials, but small objects or impressions are fairly inexpensive. Uncured the material has a long shelf life, and cured they should last at least two weeks, giving more than enough time to make a few quality casts.

Kerr Manufacturing Co.  
28200 Wick Road  
P.O. Box 455  
Romulus, MI 48174-0908  
(800) 537-7123

**Great Stuff®**

**Cast Material**

Great Stuff® Minimal Expanding Foam Sealant is an interesting cast material to work with, it is lightweight, durable, shows fair detail,

and is inexpensive. Available in premixed dispensing cans, it is easy to work with, as it expands leave an escape hole open and do not overfill molds. In cans the shelf life is a few years and after exposure to air the casts last for well over 10 years. Use a good release agent as expanding foam is hard on molds. It takes paint well and is a pleasure to ship because of its strength and weight. See Ch. 2 on uses of foam.

**Insta-Foam Products, Inc.**  
**Division of Flexible Products Co.**  
**1500 Cedar Wood Drive**  
**Joliet, Illinois 60435-3187**

### **Gypsum Hardener**

### **Misc.**

**Gypsum Hardener can be used to replace water when making plaster and dental stone casts. It makes the final cast much stronger and provides a smoother more resistant surface. On very thin casts it appears to make the plaster more brittle. It is especially formulated and recommended for Whipmix Super Die and Silky Rock casting stones. It only adds a few dollars to the final cost of the cast when using it instead of water. It has a shelf life of a few years.**

**Whipmix Corporation**  
**361 Farmington Ave.**  
**P.O. Box 17183**  
**Louisville, Kentucky 40217**  
**(502) 637-1451**

**Gypsum Products****Cast Material**

**Gypsum Products Die-Keen Ivory and O-67 Snow White are dental casting stones. They pick up excellent detail, are extremely hard, and resist chipping. They are an easy to use, two-part, system for making long lasting casts. They should last for decades, even with frequent use, and the casts take paint well.**

**Miles, Inc.  
Elkhart, Indiana  
46515**

**Latex 'Mold It'****Mold Material**

**Latex is one of the best mold materials available. It is safe (the gloves people wear to protect them from hazards are made of latex), resists most acids, solvents and chemicals, inexpensive, easy to use, liquid, readily available, flexible, and cures rapidly. Excellent molds can be made by painting on layers of latex. See Ch. 4 for a detailed look at the use of latex in casts and molds.**

**I am partial to latex as one of the best all-around mold materials available. Latex is excellent at capturing detail and molds can be repeatedly used over many years. It is best to make as many cast as possible in a short period rather than over a period of many years to get the most quality casts out of a mold. Sunlight and time limit the cured shelf life of latex to less than a dozen productive years.**

**Joli Plastics & Chemical Corp.  
14922 Garfield Ave.  
Paramount, Calif. 90723**

**Leisure Clay****Misc.**

**Leisure Clay, a plastalina type modeling clay, has many uses in the casting process. It can be used to form the flange, secure an object and plug unwanted holes. Clay can also be used to reconstruct missing parts of a specimen. I use Leisure Clay when I make Facial Reconstructions as it is a non-hardening clay and many colors including 'flesh' are available. Facial reconstructions can be very useful in forensic cases and you see them appear in more and more movies and books. (Ubelaker, 1992; and Coston, 1992)**

**Leisurecrafts Northwest Inc.  
P.O. Box 80843  
6321 7th Ave South  
Seattle, Washington 98108  
(206) 762-2010**

**Mikrosil****Mold Material**

**Mikrosil 'Casting Material for Forensic use' is an excellent impression material for small areas (1 to 14 square inches) that picks up minute detail. It picks up tool marks, dental wear, bullet trauma on hard surfaces, pry marks, and other marks. It will last unopened for many years and after curing it is stable for dozens of years. It is very flexible and resists most acids and chemicals as well as tearing. On porous surfaces such as plaster it can leave a brown stain behind, even when a release agent is used. Casting a skull-sized object would be very expensive, but small impressions are quite reasonable.**



Kinderprint Co., Inc.  
P.O. Box 16  
Martinez, CA 94553  
(800) 227-6020

### **Mountains in Minutes™**

### **Cast Material**

**Mountains in Minutes™ is a two-part system to make rigid foam for miniature landscapes, and other hobbies. It also makes lightweight, strong, inexpensive casts with good detail that take paint well. Mix part 'A' with part 'B' and within a short period you have a durable cast. Because of its expanding nature the casts may not be accurate for scientific study. Shelf life is a few years unmixed and over 10 years cured. Use a good release agent as foam is hard on molds. Foam can also be used for lightweight back-up molds.**

I.S.L.E. Labs  
Sylvania, Ohio  
43560

### **Pam®**

### **Release Agent**

**Pam® is a good release agent that is inexpensive and available at most supermarkets. It works well with plaster, especially to keep pieces of back-up molds from sticking to each other and wet plaster from bonding with already cured plaster. Pam® tends to pool in low spots if it is sprayed for too long, and can have an oily feel. If mold (fungus) is a problem in your area be careful with Pam® and other plant oil sprays as they appear to allow mold growth when left in**

moist, dark areas. Mold does not seem to be a problem with the silicone based and other release agents.

American Homefood Products  
685 Third Ave.  
New York, New York  
10017

### **Polamine® Oligomeric Diamines**

### **Cast Material**

"The Polamine oligomeric diamine products are amine-capped polyols. They can be liquid-processed at room temperature with monomeric and polymeric MDI or MDI prepolymers as well as other diisocyanates and diisocyanate prepolymers. (When reacted with isocyanate, a polyurea resin is formed, rather than a polyurethane resin.) Pot live values can be controlled and are typically in the range of 1-45 minutes depending upon the specific Polamine oligomeric diamine and isocyanate used.

Polamine oligomeric diamines can be used in room temperature vulcanizates (RTV) or oven-cured vulcanizates for molded products such as castable elastomers and tooling resins.  
(Air Products, 1991)

Both Polamine® 1000, and Polamine® 650 are; safe, capture excellent detail, durable, resist most acids and chemicals, and they take paint well. They are two of a number of Polamine's from Air Products that have short pot lives (under one hour) and cure within 24 hours. When cured at room temperature it takes one to two weeks for full properties. These materials are great for making master casts that other molds will be made from or for making casts that will be frequently handled. Degas before curing as bubbles can be a problem. See Appendix II for a Polamine® 650 cast story.

**Air Products and Chemicals, Inc.  
Polyurethane Specialty Product  
7201 Hamilton Boulevard  
Allentown, PA 18195-1501  
(800) 345-3148**

**REN:C:O-Thane**

**Mold/Cast Material**

**REN™ plastics has a wide range of liquid polyurethanes that cure at room temperature and give great reproduction of detail. They are resistant to most acids and chemicals and vary in hardness from 30 (very flexible) on the Shore "A" scale to 85 (unbendable) on the Shore "D" scale. The materials are too expensive for mass production of large, skull-sized, casts and because of the long working time a machine is necessary to rotate the mold until a hollow cast has cured. (Smith, 1989) The materials are useful for making master molds and molds which are in constant use. The RP-6401 and RP-6405 polyurethanes are very flexible and similar to RTV type silicones. Contact the manufacture for information as some of their products work well as cast materials and some work well as mold materials. Most of them (when cured) have a shelf life well in excess of ten years.**

**REN™ Plastics  
CIBA-GEIGY Corp.  
4917 Dawn Ave.  
East Lansing, MI 48823  
(517) 351-5900**

**Silastic® E RTV****Mold Material**

**Silastic® E RTV silicone rubber kits are one of the best products on the market. They are easy to use, capture excellent detail, work well with undercuts because of excellent flexibility, and are safe. Silastic® E RTV is a two-part silicone rubber system that cures in 24 hours. It is resistant to most acids and chemicals, and is very strong and tear resistant so molds can be used frequently over many years. The kits are not very expensive to use, especially if only small objects are being cast. Many people prefer Silastic® E RTV to latex. I think there are useful applications for both. The shelf life of unopened kits is 6 months.**

**Dow Corning Corp.  
Midland, Michigan  
48686-0994**

**Silmar® S-40****Cast Material**

**Silmar® S-40 is a clear, polyester, casting resin that rapidly cures at room temperature with MEK as a catalyst. The casts are clear, scratch/chip resistant, smooth surfaced and retain fairly good detail. They are acid and chemical resistant and fairly inexpensive. To make hollow casts you need to have access to a cast rotating machine. Bubbles can be a problem, degas if possible. If poured thin it tends to be brittle and can yellow with age. This product is an exotherm, so do not be alarmed by heat given off during the curing process. Uncured**

materials are stable for a few years and when cured last for well over a dozen years.

**Silmar**•  
 12335 So. Van Ness Ave.  
 P.O. Box 5006  
 Hawthorne, CA 90250-0590  
 (213) 757-1801

### **Smooth-On C-1506**

### **Cast Material**

Smooth-On C-1506 is a light brown, liquid, urethane, two-part casting system. Casts are very hard but not brittle and show excellent detail. Parts A & B are mixed, by equal volume or weight, and can be machine rotated to produce hollow casts. Degassing is helpful but not necessary as bubbles are not too much of a problem. Casts darken when exposed to sunlight but show no other aspect of ageing. Shelf life of unopened containers is at least six months.

**Smooth-On, Inc.**  
 1000 Valley Road  
 Gillette, New Jersey  
 07933  
 (908) 647-5800

### **Suprastone Blue**

### **Cast Material**

Suprastone Blue and Vel-Mix White Die Stone dental casting stones are among the best on the market. They have a very fine grain size so they pick up incredible detail and have a strong bonding agent which makes them very durable. The cost of the dry mix is not that

much greater than other dental stones but the shipping can get expensive. They use just a small amount of water and cure fast enough so that it is still possible to hand turn a hollow skull cast and not use a rotating casting machine. Casts take stain and paint well and even look good with just a light coat of Vinace. Suprastone Blue is a great material to cast all your master casts in, as its finished color is blue they are hard to mistake and give away by accident. If the original specimen is destroyed or no longer available, a quality mold can still be made from a high quality master cast. Dental stones shelf life is a few years if kept from moisture, and dozens of years cured. Dental casting stones are one of the best and most versatile casting materials available. See Ch. 4 for a closer look at plaster.

Kerr Manufacturing Co.  
 28200 Wick Road  
 P.O. Box 455  
 Romulus, MI 48174-0908  
 (800) 537-7123

### **Triple Beam Balance**

### **Misc.**

An accurate scale is a must in any casting lab. Ohaus makes quality scales that are easy to work with, simple to read, and are extremely precise. Most cast and mold materials require that parts be mixed by weight. The addition of too much catalyst can drastically change the pot life of most materials as well as their finished properties, a good scale can prevent this from happening. Always

clean the scale and put it away after each use, sometimes they develop legs and walk away on their own.

OHAUS Corporation  
29 Hanover Road  
Florham Park, N.J. 07932  
(201) 377-9000

### **True Tone**

### **Misc.**

True Tone Cement and Mortar Pigments are added to dry plaster to produce casts of uniform color. Chips are not as obvious as on stained casts because the pigment is throughout the cast and not just on the surface. The wide color range of pigments can be combined to achieve a variety of finishes including; natural bone, ancient bone, and even tar pit style. Add pigment to dry plaster, then mix with water (or Gypsum Hardener) and treat it the same as if it were non-pigmented. The color will not wash off the cast, and looks really good after a light coat of Vinace.

True Tone Cement & Mortar  
Frank Davis Co.  
Los Angeles, California  
90023

### **Vaseline**

### **Release Agent**

Vaseline makes an excellent release agent and can be used in a variety of situations. It works great to keep back-up mold pieces from sticking together when they are poured overlapping, as it can be

applied very thickly, even on warm plaster. On skulls and other objects it works very well, even if they are porous like plaster. Some release agents do not function well on porous surfaces. To achieve a thin, even, coating, cover the object with Vaseline<sup>®</sup> and then rub the entire surface with a damp towel or cloth to remove any excess. Vaseline<sup>®</sup> can be heated and mixed with Trichloroethane to form a liquid release agent. Vaseline<sup>®</sup> is also good to rub on hands to protect them at various stages of casting. Vaseline<sup>®</sup> can be purchased at most supermarkets and has an extremely long shelf life.

#### **Vinace<sup>®</sup>**

#### **Misc.**

Vinace<sup>®</sup> polyvinyl acetate beads are used to protect and stabilize casts, skulls, and other objects. Vinace<sup>®</sup> is an excellent product with a wide range of applications in the casting field. It resists yellowing and can be dissolved in a number of different solvents. I have used it; to stop old skulls and bones from exfoliating, to protect plaster casts, to protect human and non-human skulls and teeth, as an adhesive, and to provide a shiny surface. See Ch. 5 for a more detailed look at Vinace<sup>®</sup>.

Air Products and Chemicals, Inc.  
Polymer Chemicals Division  
Box 538  
Allentown, PA 18105  
(800) 345-3148



**MOLD MATERIALS**  
A Quick Reference Guide

	Degas Yes/No	Cost \$\$\$	Memory 1-5	Flexible 1-5	Shelflife 1-4	Safety Hazard	Detail 1-4
Conathane® TU-4010	Yes	\$\$	4	1	4		3
Devcon® Urethanes	Yes	\$\$	1	2-5	2	Mild	3
Dow Corning 732		\$	3	2	3		3
Dow Corning 734		\$	2	2	3		4
Extrude Medium&Wash		\$\$	3	3	2		4
Latex		\$	2	2	3		4
Mikrosil		\$\$	3	3	2		3
Ren:C:O Thane Polyurethanes	Yes	\$\$	2	2-5	2	Mild	3
Sea Gele®		\$	5	4	4		4
Silastic E RTV	Yes	\$\$	1	2	1		4
Wax		\$	5	5	4		2
Cuttersil		\$\$	3	2	2		4

**Key:**

**Degas-** Is it desirable to degas the material before curing?

**Cost-** \$ inexpensive, \$\$ reasonable, \$\$\$ expensive.

**Memory-** 1 Bounces back into shape w/no distortion, 2 shows signs of wear after many years, 3 shows signs of wear after a few years, 4 wears out, tears, or deteriorates rapidly, 5 good for one cast only.

**Flexible-** 1 consistency of jello, handles overhangs well, 2 flexible with little or no stretch, 3 fairly flexible, 4 fairly stiff, 5 stiff.

**Shelflife-** 1 Shows no deterioration, 2 lasts over 10 years, 3 lasts 5-10 years, 4 shows signs of deterioration in under 5 years.

**Safety Hazard-** Usually applies to catalyst.

**Detail-** 1 Captures some detail, 2 captures good detail, 3 captures excellent detail, 4 captures and reproduces detail almost identical to original.

**CAST MATERIALS**  
A Quick Reference Chart

	Degas Yes/No	Cost \$\$\$	Durable 1-5	Shelflife 1-4	Safety Hazard	Detail 1-5	Cast Machine	Acid Resist
Castolite	No	\$	3	2	Mild	3	Yes	Yes
Conathane TU-965	Yes	\$\$	5	1	Mild	4	Yes	Yes
Dental Plaster	No	\$	1	2		4		No
Devcon® Urethanes	Yes	\$\$	5	1	Mild	4	Yes	Yes
Great Stuff®	No	\$	4	2		2		
Gypsum Die-Keen	No	\$\$	2	2		5	Yes	
Latex	No	\$	5	4		5		Yes
Mountains in Minutes™	No	\$	4	2		2		
Polamine® Oligomeric	Yes	\$\$	5	1		5	Yes	Yes
Ren:C:O Thane Polyurethanes	Yes	\$\$	5	1	Mild	4	Yes	Yes
Silmar® S-40	Yes	\$	3	2	Mild	3	Yes	Yes
Smooth-On C-1506	Yes	\$\$	5	1		5	Yes	Yes
Suprastone	No	\$	3	2		5	No	
Velemix	No	\$	2	2		5	No	

**Key:**

**Degas-** Is it desirable to degas the material before curing?

**Cost-** \$ inexpensive, \$\$ reasonable, \$\$\$ expensive.

**Durable-** Dropped from six feet; 1 Shatters, 2 Breaks, 3 Cracks, 4 Surface cracks, 5 No effect.

**Shelf-Life-** 1 shows no deterioration, 2 lasts over ten years, 3 lasts five to ten years, 4 shows signs of deterioration in less than five years.

**Safety Hazard-** Usually applies to the Catalyst.

**Detail-** 1 Smooth surface - poor detail, 2 Detail OK, 3 Detail good, 4 Great detail, 5 Excellent detail - almost as good as the original.

**Casting Machine-** Is a casting machine necessary to make hollow casts?

**Acid Resist-** Is this material resistant to most acids, solvents, and chemicals when cured?

**RELEASE AGENTS**  
**A Quick Reference Guide**

	Pourable/ Wipeable	Pump	Aerosol	Cost \$\$\$	Shelf Life	Safety Hazard
Airid	Yes	Yes		\$	Long	No
Aqualease™						
6201	Yes			\$	6 mos	No
Conap MR5002	Yes			\$\$	Long	No
Ease Release™						
400	Yes		Yes	\$\$	Long	No
Extreme Duty			Yes	\$	Long	No
Silicone CRC						
Pam®			Yes	\$	Long	No
Vaseline®	Yes			\$	Long	No

**Key:**

**Pourable/Wipeable-** Can the product be poured or wiped on?

**Pump-** Does the product come in a pump-style sprayer?

**Aerosol-** Does the product come in an aerosol-style sprayer?

**Cost-** \$ inexpensive, \$\$ reasonable, \$\$\$ expensive.

**Shelf-Life-** How long is the unused product stable?

**Safety Hazard-** Is this product a safety hazard?

**CHAPTER IV**  
**How to Cast a Skull, Inside and Out, a Detailed**  
**Look at Plaster and Latex**

**Casting the Skull**

**The human skull will serve as an excellent model to illustrate casting techniques, I will explain in depth how to use latex as the mold material and plaster as the casting material.**

**Skull is the term used to denote the bony supporting framework of the head. It presents the most complex unit of the skeleton because of its function to protect the brain, one of the most vital parts of the body as well as the organs of sight, hearing, smell, mastication and taste. (Bass, 1971)**

**The mold is the most important item in casting; a little extra time at this stage is well worth the investment. In quality and quantity, the original and future casts, can only be as good as the mold from which they come. The following ten simple steps (including materials, illustrations and notes) can be used with only minor changes for casting systems other than latex and plaster. The end result will be; the original skull, a one-piece latex mold, a five-piece plaster back-up mold, and the ability to make dozens of inexpensive, hollow, highly detailed, fairly durable replicas. Allow yourself three to five weeks to complete a mold, depending on how fast you put on layers of latex.**

### **Clean Skull**

If the skull is from a Biological supply house or has already been cleaned skip the following step.

If the skull is fresh ( still has flesh ) macerate as much of the remaining tissue as is possible, then simmer in a Tri-Sodium Phosphate or Biz bleach solution (1Tbs./Gal water) until clean. Soak in five percent (5%) dish-washing soap and water overnight to degrease. Some people use hydrogen peroxide three percent (3%) instead of dish soap, followed by another overnight soak in a fifty percent (50%) solution of household ammonia to bleach and degrease the skull. Rinse. Soak in water overnight, rinse and allow to air dry for a few days. If a colony of flesh-eating beetles has been established in your area, they will gladly clean the skull for you, then you can degrease and rinse the skull as above.

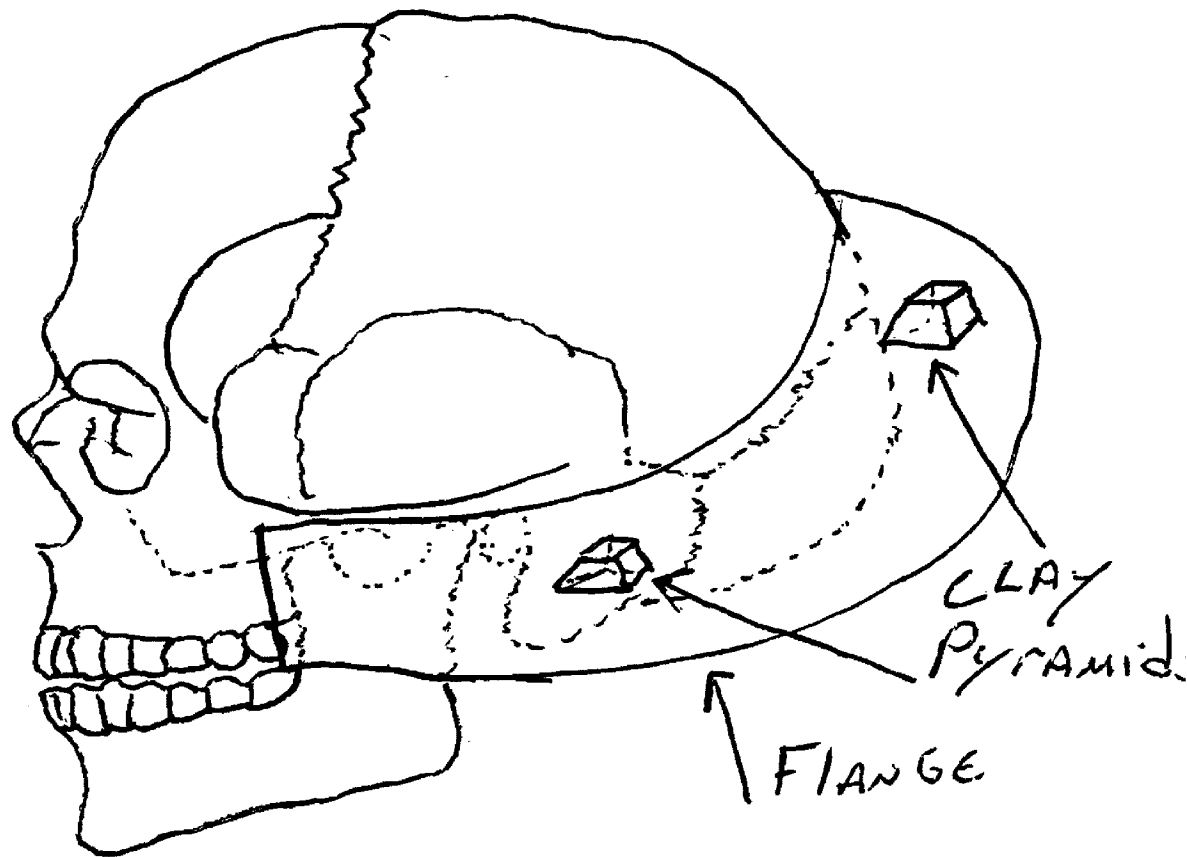
- If the skull is very old and beginning to exfoliate, it can be stabilized with Vinac<sup>®</sup> (see Ch. 5) or Glyptal. Soak the (clean, dry) skull in a ten percent (10%) Vinac<sup>®</sup>/ Ethanol solution. (95percent Ethanol-Not 100 percent pure) After the skull has dried, paint on one or two coats of the ten percent (10%)Vinac<sup>®</sup> solution.

### **Attach Flange and prepare skull-**

-Around the middle of the clean, dry skull attach a three to four inch wide cardboard flange (collar), this keeps the bottom and top parts of your mold from sticking together, and allows for easy removal

of the original and future casts. The flange should extend from the left lateral orbit/inferior zygomatic (cheek bone), through the middle of the zygomata (Gray, 1977), around the widest point of the occipital region, and end at the right lateral orbit. (See figure #1) Place skull over cardboard (manila file folders work best) with it projecting over the edge of the cardboard at the cheekbones. Trace the outline of the skull on the cardboard and cut it out. Now you have a flange. Attach, from underneath, with non-hardening molding clay, (this is the most frustrating and time-consuming step). Use as much clay as is needed to support the cardboard. If you have the jaw, it is best for future facial reconstructions to attach it to the skull with the teeth just slightly parted. Attach it with clay pressed in from the backside of the teeth; you may fill in the entire region behind the jaw with clay and smooth it out at this time.

Place cotton balls or small wads of tissue in the eye orbits and the nose for protection. Gently place clay in these three holes and smooth it out until the clay is a flat surface that the latex cannot penetrate. Keep the flange as flat as possible and, where it is attached to the skull, there should be a very sharp edge ( 90° degree angle where the clay and cardboard meet the skull). Dental tools are useful in edging the clay. Place three or four flat-topped clay pyramids in the middle and around the edge of the flange (see figure #1). Press clay around edges to secure pyramids or use a drop of glue.

**Figure # 1****Release agent**

Lightly coat the top of the skull, the full face, and the top of the flange including the pyramids with Vaseline® to keep the latex from sticking. Wipe skull with a moistened paper towel to remove any excess. You may also try your favorite release agent. Ideally you want as thin a layer of release agent on the skull as possible. I have had good success with spray products, most notably Ease Release™ and CRC high pressure silicone spray.

**Latex-**

-Paint 20 layers of latex on the skull from the chin up, including the top of the flange. Allow each layer to fully dry before painting on

the next layer. It is possible to put two or three layers on each day depending on weather conditions.

Turn the skull over and carefully remove flange and clay pyramids. Place a cardboard tube (the inside of a roll of wrapping paper or tin foil works well) through the foramen magnum and secure with clay; leave about six to eight inches sticking out. Lightly Vaseline® the tube, the bottom of skull, and the latex flange, especially in the voids left by the clay pyramids. They will form a lock-and-key system to keep proper alignment of the mold. Do not get any vaseline on the latex around the chin area, only on the skull and the flange.

Paint twenty (20) layers of latex on the bottom of the skull connecting to the latex already present on the face. Latex the bottom of the vaseline-covered flange at the same time. Allow to fully dry between coats. With a sharp knife or sissors trim off one quarter to one half inch of the flange, all along the outside edge except at the hinge in the front of the face.

### Back-up Mold

Thickly coat the latex mold (with the skull still inside) with Vaseline®. Place the mold face up on stable surface (resting on the rim of a two or three gallon bucket works well). Mix three (3) cups of wet plaster to cooked oatmeal consistency. Plop plaster (drop-pour-slop) onto the face portion of the mold covering the eye orbits, nose, and teeth with a one-half inch thick, large oval of wet plaster. Smooth



out the edges and allow to dry 30 to 60 minutes. Carefully remove; do not worry if little pieces of plaster break off. Replace first back-up mold piece on face. Vaseline<sup>®</sup> the entire surface, especially the edges. Put mold in anatomical position (Frankfurt plane) with first piece in place.

Mix three more cups of plaster and plop on the left side of the top of the mold, slightly overlapping the edge of the first piece. Dry 30-60 minutes, remove, replace, Vaseline<sup>®</sup> the edges, as before.

Mix three additional cups of plaster and plop on the right side of the top of the mold, slightly overlapping the first and second pieces, allow to dry, remove, and return third back-up mold piece.

Flip the mold and pour the bottom two remaining pieces, so that they slightly overlap the first piece, in the same fashion as the other pieces. You should now have five interlocking, about one-half inch thick, pieces to your plaster back-up mold. Tie a bungee cord or large rubber band around the whole back-up mold to keep the interlocking pieces from separating.

### Making copies-

-Take apart the back-up mold. Carefully remove the original skull and cardboard tube. Wipe clean the inside of the mold. Reassemble without the skull inside and set bottom-side up, with the foramen magnum pointing skyward.

**Mix three to five (3-5) cups of dry plaster with water (using only cold water) to pancake-batter consistency, with no lumps; pour through the pour spout, (foramen magnum hole) then tightly plug the hole with a wash cloth. Turn mold in all directions until sloshing stops, and turn for two more minutes. Remove plug and immediately cut out the foramen magnum with a knife. This allows heat and water vapor to escape and keeps a vacuum from being formed inside the mold. Allow to dry thirty to sixty (30-60) minutes. Remove back-up mold and carefully remove the hollow plaster skull by peeling off the latex mold. Air cure the plaster skull cast a few days to attain full strength.**

**The first cast from a mold will clean the mold; generally the second or third cast is the best in terms of detail. A good mold should yield twenty to many dozen good casts if it receives proper care. Clean the inside of the latex mold and allow it to fully dry overnight before reassembly. Store latex molds that are not in use in a cool dry place. Leave them in their back-up molds for protection and avoid storing them in direct sunlight.**

### **Clean Original**

**Clean the original skull to the condition it was in prior to casting. Clay comes off easily with a damp paper towel, use care around and inside the eyes and nose. If desired, you can soak the skull in ethanol to remove Vinace, rinse in ethanol and allow to air dry.**

## **Materials**

**Skull, can be real or a cast.**

**Liquid latex- raw tree rubber. ~\$50/gal, buy from hobby shops.**

**Non-hardening modeling clay. \$10/5lb block.**

**Vaseline®**

**Dental casting plaster. \$25/100lb bag, buy from hardware store.**

**Bungee cord or rubber tie.**

**Vinac® & ethanol. Can also try Glyptal. (Waters,1971)**

## **Notes**

**It is a good idea to wash your hands before mixing plaster to remove any hand lotions, oils, or dirt.**

**Try to remove air bubbles from liquid plaster before it is put into the mold; this is especially important when pouring solid and flat casts. Degassing the liquid plaster in a vacuum will remove trapped air. If you do not have a vacuum you can shake and blow out many of the larger bubbles.**

**To repair small bubbles you can rub dry plaster into the holes of the moist cast (fresh out of the mold) and then rub in water with your fingers.**

**To repair large bubbles you can mix up a small amount of wet plaster and fill the holes and then smooth the surface with dental tools.**

**Always place the back-up mold pieces face down to avoid any plaster spills or contamination that would affect the integrity of the mold. Spilled plaster on the outside of a back-up mold is no problem as long as the pieces fit snugly together.**

**Do not drag your heels once you've started your latex mold; extended contact between the clay and the latex will cause slight discoloration and deterioration.**

**To make casts harder you can add Gypsum Hardner® to plaster instead of water, it adds between two and three dollars per cast but they are stronger and more durable.**

**Avoid colored latex or pigment-added latex; it shortens the life of the mold, use only the purest latex available.**

### **Endocranial Casts**

Endocranial casts can provide us with a great deal of information (Jolly, 1987), even from skulls that are millions of years old (Holloway, 1982). Casts can give us brain weight, symmetry, gross morphology, show evolutionary changes, and many other things (Holloway, 1978). The following are techniques for making latex endocranial casts on hemisected (cut) as well as uncut skulls. Endocranial casts from skulls that have not had their calvaria cut (as in lab models) are difficult but they can be done (Murrill, 1971).

Clean the inside of the skull, with a tooth brush and dental pick if necessary, and fill all holes that communicate from the inside of the skull to the outside (except the foramen magnum) with modeling clay. Spray or pour your favorite release agent through the foramen magnum and shake out any excess. Pour in liquid latex (you can dilute the latex with 5 percent ammonia) and slosh around until you coat the inside completely, pour out excess for reuse. Allow latex to fully dry overnight. Air circulation is very important at this time; you can put a fan nearby to increase circulation. The use of a blow dryer at low setting will speed up the cure time but it reduces the overall life of the mold. Repeat latex coating six to eight times. After the final coat, dry two days. Pour corn starch or talcum powder inside and shake, dispose of excess. If you have access to a high pressure air source put a small hose between the latex mold and the skull and gradually increase the air flow to gently separate the latex from the skull. You

can also use a wooden chopstick or an unsharpened pencil to gradually work the latex mold away from the inside of the skull. If any latex has dripped out any holes, trim it as close to the skull as possible.

Fingers or needlenose pliers work best for the next step. Firmly grasp a large piece of the endocranial cast and twist; slowly pull the latex cast out while you continue to twist. Trim any latex "snakes" that are attached to the mold and trim around the base. Frequent coating with Armour-All™ or other latex life extender may delay deterioration, but sunlight, oxygen, and time will eventually destabilize your cast. Given good care it should last three to eight years. Diluting the latex in the initial stages accelerates aging.

Endocranial casts made with a skull that has had the calvarium cut are much easier. Clean the interior of the skull and fill all holes, except the foramen magnum, with modeling clay. To protect the sella turcica (Gray, 1977) (Turkish saddle) in the center of the skull, put clay around it and smooth it out. Coat the entire inside of the skull, including the cut edge, with a release agent. I have found that Vaseline® works well, as long as you firmly wipe the skull of any excess with a damp paper towel.

Armed with a small paint brush, paint a layer of latex over the entire inside of the skull and skull cap, including a thin layer along the cut surfaces. Do not leave any air bubbles, pop them with a finger while the latex is still wet. Allow to dry overnight. Repeat until you have built up eight to ten layers, but be careful around the cut surface

to avoid a build-up in excess of 1/8 inch. Lightly coat the entire inside of the skull, including the cut surfaces, and while the latex is still wet place the skull cap back in anatomical position. Hold in place with duct tape or a large rubber band. Allow to dry overnight. Pour liquid latex into skull and coat along the seam, dry overnight and repeat. Remove tape and, using a blunt knife or tongue depressor, separate skull cap from latex cast, (a blast of compressed air helps). Gently loosen latex endocranial cast from the base of the skull. Trim along the edge (seam) so that it is flush with the rest of the surface. You may want to add another layer of latex to the inside just to ensure that both halves of the cast are firmly joined together. Treat from here on as you would a cast made with the uncut skull.

An advantage of casting from a solid skull (uncut) is that you get a true endocranial cast with no seam. They are harder to make and can do damage to the skull as it is impossible to protect fragile inner bones. Also it is difficult to plug all the holes from latex leaks, and removal from the skull is more difficult.

A skull that has had the calvarium cut is easier to work with and can be better protected. Also the layers of latex are of an even thickness and have no problem drying. Removal of the finished endocranial cast is much easier. A disadvantage is that you do not have a totally accurate cast of the inside. Because the thickness of the cut varies, your cast may be a little large or a little small. Detail of the thin section of cut bone is also lost.

**To measure cranial capacity with the endocranial cast, fill a mixing bowl with water to the point of overflowing. Place a ballon or latex surgical glove inside your endocranial cast and inflate so that it fully supports the cast without any stretching. Tie or clip the ballon. Slowly immerse the endocranial cast in the mixing bowl, foramen magnum side up, until you reach the cut edge of the cast and can displace no more water. Catch all the water that is displaced by the cast in a large 2500+ cc graduated cylinder. This is the cranial capacity of the skull. A method to perform a quick double check is to fill the skull with birdseed and measure that amount; the results of the two methods should be within 10 to 15 cc.**

**Other methods for making endocranial casts on cut and uncut skulls do exist. (Ross, 1988) described a technique, using gelatin, that can be rapidly set up. While this method only takes a few hours, the casts, have a limited shelf life. People have also had success making silicone endocranial casts in much the same fashion as latex casts.**



## CHAPTER V

### Finishing the Casts and Storage

Options for finishing the cast are limited only by imagination. Depending on the desired end result, pigments, stains, paints, and/or Vinac® all have merits. People finish casts to resemble the original; sometimes old, dry, stained and cracked bone, sometimes fresh, white, recently cleaned bone. When working with plaster and some plastics one can add dry pigment to the casting material while mixing, then the color is distributed throughout the cast. If a tooth is chipped or other damage occurs, the damaged area does not stand out because of a stark white interior, with this method the cast is a uniform color inside and out. Many different pigments exist; contact a plaster dealer to find the ones that are most compatible.

Staining the cast after it emerges from the mold also works well. When the cast is dry/cured, acrylic stains can be painted on in a variety of colors. I am partial to burnt umber diluted with water to "age" skulls so that they appear to be millions of years old. Ivory is another common color to use when trying to emulate bone. Dry pigment can also be rubbed into the cast until the desired effect is achieved and then stabilized with a workable artist's fixitive.

Paint can be used to finish off the cast, but be warned that some detail is lost when using thick coatings of paint. Spray paint is the easiest to work with and a wide range of colors is available. A thin layer of sprayed on paint will not obscure detail as much as a thick layer applied by a brush. 'Ivory' and 'bone' colors tend to make the cast look fairly realistic. I have even finished some pieces, such as Aztec Calanders, in gold paint for an exotic touch.

To preserve and protect stained and unstained plaster casts, I have found that Vinac<sup>®</sup> has no equal.

VINAC resins are small, glasslike beads of high purity polyvinyl acetate used in laminating, label and hot melt adhesives, pigmented and grease-proof paper coatings, overprint varnishes, industrial lacquers and coatings, printing inks, textile sizes and finishes, and numerous other applications. They are odorless, tasteless and non-toxic, are resistant to attack by weak acids, alkalies and salts, but are soluble in many organic solvents.

(Air Products, 1, 1984)

Vinac<sup>®</sup> may be dissolved in a number of different alcohols, ketones, esters, and other solvents. The following is only a partial list of usable solvents, taken from more than 80 different solvents, including; ethanol 95 percent, isopropanol 90 percent, methanol, acetone, methyl ethyl ketone, benzene, toluene and many more. The company can provide a more complete list; their address appears in Ch. III. I found that three solvents are most useful for stabilization and protection of originals, casts, artifacts, and fossils.

**Vinac® beads mixed with ethanol 95 percent (never use 100 percent - as it will not dissolve the beads) at a concentration a of 10 percent solution (100grams/liter) works well for lab use. It dries fairly slowly (sometimes not fast enough for fieldwork) and will penetrate plaster. Ethanol is safe to work around and there is no health hazard associated with contact or exposure. Surface drips and deposits can be cleaned with straight ethanol. Vinac® beads mixed with methanol also works well for lab use, as methanol evaporates slowly enough for the solution to penetrate plaster. The beads appear to dissolve faster in methanol than in ethanol. Methanol can be poisonous, so avoid any contact. Acetone mixes readily with the beads and dries very quickly. This mix is ideal for fieldwork where rapid stabilization as well as protection are necessary, and it can easily be dissolved in full-strength acetone when you return to the lab. Dr. Thomas Foor, Chairman of the Department of Anthropology, University of Montana, in Missoula, Montana is partial to Vinac® mixed with acetone on bison and other bone because it "dries rapidly in the field" (Foor, 1992).**

**Add preweighed Vinac® beads to a glass bottle (two to four liters) already containing premeasured solvent, drop in two glass marbles or agitators and shake until all beads are dissolved and the liquid is clear with no sediment. The beads should stay in solution indefinitely after they have been mixed, and any spills can be cleaned with the straight solvent. A 10 percent solution works well for soaking**

skulls and casts and can also be applied in the field to safely bring fossils back to the lab. A 10 percent solution is made with 100 grams of beads added to 1 liter of solvent. A 20 percent or stronger solution may be painted on in successive layers. A Grizzly Bear paw cast took 7 layers of 15 percent Vinac<sup>®</sup> to achieve a "wet" look and to protect, while a small Venus figurine took only 2 coats. Allow each coat to fully dry before applying another layer. Keep in mind that each time you expose the solution to air it becomes more concentrated, as the solvent evaporates while you are painting multiple casts. A 10 percent solution will become 12 percent-15 percent very quickly if left open. Keep all solvents away from open flame as the combination is explosive.

The shelf life of a mold depends on many factors including, storage, use, temperature, and materials. Depending on your desired specific applications, molds may differ from these averages. Latex, in an unopened can, will last for many years and you can extend its uncured shelf life by purging the opened container with nitrogen (or other inert gas) each time it is exposed to air. Cured latex molds in storage, either not in use or with light use, should last eight to ten years. Heavy use of latex molds limits their life to three to six years; latex will only stretch out and bounce back so many times before it no longer has its original properties.

Depending on the quality of the mold, one should get a few dozen casts to more than 100. An excellent latex mold of a Parisian

**Negro male skull produced well over 150 high-quality casts over a period of 8 years before the latex finally gave out and lost its memory. The latex tore easily and broke down rapidly after this point. To produce the largest number of high-quality casts, it is best to make them as fast as possible, as the mold will deteriorate even when not in use. The casts can be shelved and stored indefinitely.**

**Ideal storage for molds includes storage in their back-up jackets (back-up molds) with the pour hole (foramen magnum) facing upward. Temperatures are best between sixty and seventy degrees, avoid freezing, excessive heat, and sunlight as these weaken the latex. Humidity should be kept low as moisture can cause molds (fungus) that can feed upon the latex rendering it useless.**

**Because of the wide range of other materials it is best to consult the manufacturer with questions of storage and shelf life for specific products. RTV's, silicones, and rubbers generally will last decades with little or no special attention.**

## **CHAPTER VI**

### **How to set up a casting lab from scratch**

#### **Advantages**

**A major advantage of a casting lab, and classes on how to use it, is the fact that there are very few places, schools, or universities that have casting labs and offer classes on their use. It is a major focus of student interest and, in my experience, casting classes fill up every time they are offered. Listing casting classes in university catalogs may draw from out of state (and country), students who would otherwise go elsewhere. Casting labs are easy to maintain once they are established, and take up very little space.**

**There is a steadily increasing demand for quality casts and it is necessary to educate people on their skillful manufacture. As the demand for casts increases so does the demand for those who can make casts. It is a unique, and highly desirable addition to the resume of anyone interested in fieldwork, museum work, fossils, law enforcement, and many other careers.**

**To set up a casting lab from scratch is easier if the room has been previously used as a science lab. Space is necessary, but anything over 600 square feet (not including fixtures, sinks, tables, etc.) is manageable. Two sinks are a must, with separate hot and cold water to each. If you are using any but the most basic materials, a vented fume hood is a safety necessity. Permanent vacuum and compressed**

air stations will banish the majority of air bubbles that molds and casts might encounter.

Bookcases, shelves, cabinets with locks, and glass-fronted cases allow for easy access, organization, display and storage. I have found that an upright freezer in addition to a refrigerator can be useful for storage and rapid cooling. Hair dryers are also useful to rapidly raise the temperature in a confined area. Hair dryers should have multiple heat and fan selections.

The following is a basic equipment list to start up a lab. Each lab set-up is unique, so equipment and space requirements will vary. Prices and estimates are as of Spring 1993 and subject to change without notice; "change" almost always means increase.

#### EQUIPMENT LIST FOR CASTING LAB

<u>PRICE:</u>	<u>EQUIPMENT:</u>
\$400.00	Standard lab equipment; glassware, tools, broom, mixing bowls, bags, etc.
\$28.30	First aid kit
\$31.90	Latex gloves, 2 boxes/year
\$150.00	Casting Plaster, 500 lbs/year
\$160.00	Latex, 4 gals/year
\$100.00	Modeling clay, 50 lbs/year
\$500.00	New skeletal material
\$49.99	Wet/dry vacuum
\$19.99	Dustbuster hand vacuum
\$20.00	Buckets; 5 Gal, 3 Gal, 1 Gal, etc.

**Highly desirable equipment:**

<b>\$100.00</b>	<b>Lab coats 4x</b>
<b>\$60.00</b>	<b>Butyl gloves 4x</b>
<b>\$12.00</b>	<b>Safety glasses 4x</b>
<b>\$18.60</b>	<b>Visitor safety glasses 10/cs</b>
<b>\$720.00</b>	<b>Whip Mixer (used- \$600)</b>
<b>\$118.00</b>	<b>Dental Plaster, 200 lbs/year</b>
<b>\$48.50</b>	<b>Whip-Mix stand</b>
<b>\$125.00</b>	<b>Vac-U-Spat for mixing 300ml</b>
<b>\$93.00</b>	<b>Vac-U-Spat for mixing 875 ml</b>
<b>\$14.00</b>	<b>Flex-Rubber mix bowls, 4x</b>
<b>\$70.50</b>	<b>Vac-U-Mix flex rubber bowl</b>
<b>\$410.00</b>	<b>Digital scale, 1200gms</b>
<b>\$279.00</b>	<b>Nova 2 Stir Plate/Hot Plate</b>
<b>\$17.04</b>	<b>Magnetic Spin Bars</b>
<b>\$36.24</b>	<b>Propane burner</b>
<b>\$25.00</b>	<b>Propane tank &amp; gas</b>
<b>\$250.00</b>	<b>Materials for casting; Rubbers, RTV's, etc.</b>
<b>\$75.00</b>	<b>Solvents; Acetone, Iso-Alcohol, etc.</b>
<b>\$7.95</b>	<b>Thermometer</b>
<b>\$18.95</b>	<b>Vise</b>
<b>\$249.95</b>	<b>Air Compressor</b>
<b>\$300.00</b>	<b>Vacuum pump, must draw 29" of mercury</b>
<b>\$495.00</b>	<b>Upright Freezer</b>
<b>\$445.00</b>	<b>Upright Refridgerator</b>
<b>\$29.95</b>	<b>Hair dryer</b>



## Summary

In summary, I am convinced that a system of latex molds and Vel-Mix white, or other quality dental casting stone (plaster), can produce casts of high quality. The mold is safe, reuseable more than 100 times and can be used for more than a decade, if given proper care. The casts capture fine detail and are; durable, inexpensive, simple to make, and stable. Because of the short cure time, hollow casts can be hand rotated, it is not necessary to invest large sums of money in a cast rotating machine.

A \$100.00 outlay could buy one skull cast, or, for the same \$100.00, four (4) latex molds of different skulls could be made, as well as four (4) back-up molds, and 15 to 20 strong stable casts of each skull (80 casts in all). This is assuming four (4) skulls are accessible to cast. It is not necessary to spend large amounts of money for casts. Many people who cast, freely trade casts among themselves, instead of selling them to each other. If you have an interesting skull to cast, casts of it may be tradeable to the academic public.

Silastic® E RTV molds are also excellent but a little more expensive and degassing is helpful. They work well with dental casting stones or a variety of other materials. Smooth-On C-1506 compliments Silastic® E RTV nicely, although you need a cast-rotating machine to make hollow casts with C-1506. Depending upon your specific application any number of materials might work well, it is best to do some experimentation before investing large sums of money or energy. Stay within safety guidelines proposed by the manufacturer and casting should be an exciting experience. Enjoy!!!

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## Appendix I

### Cast Sources

There are many sources for quality casts of humans and other organisms including fossils, dinosaur material, human ancestors, and primate material. Museums and Medical school bookstores often sell casts for study and to raise money. The following are just a few sources for people interested in purchasing casts, write for up to date catalogs and price lists.

**Carolina Biological Supply Company**  
2700 York Road  
Burlington, North Carolina  
27215

**Colorado State University**  
Department of Anthropology, Casting Lab  
Fort Collins, Colorado  
80523

**France Casting**  
20102 Buckhorn Road  
Bellvue, Colorado  
80512

**Institute of Human Origins**  
2453 Ridge Road  
Berkeley, California  
94709

**National Museums of Kenya  
The Supervisor, Casting Department  
P.O. Box 40658  
Nairobi, Kenya**

**Peabody Museum  
Casting Lab, Dept. of Anthropology  
Harvard University  
Cambridge, MA  
02138**

**Skullduggery, Inc.  
624 South B Street  
Tustin, California  
92680**

**Skulls Unlimited  
P.O. Box 6741  
Moore, OK  
73153**

**Smith Studios  
34294 E. Frontage Road  
Bozeman, MT  
59715**

**South Paw Casting  
P.O.Box 3454  
Missoula, Montana  
59806**



## Appendix II

### Castable Items

Many things are castable, if you try hard enough and use the right materials. One of my first casting experiences was over 25 years ago trying to cast ice cubes, in plaster, before they melted. The following are just a few of the many items that people cast:

Human Skulls	Jaws	Animal Skulls	Bones
Paw Prints	Tracks	Arrowheads	Footprints
Venus Figurines	Shells	Bullet Holes	Life Masks
Death Masks	Teeth	Soft Tissue	Endocranial Casts
Human Hands	Lizzards	Bite Marks	Tool Marks
Spear Points	Femurs	Ice Cubes	Fishing Lures
More Skulls	Fossils	Machine Parts	Dinosaur Bones

Some items like Gorilla and Grizzly Bear skulls can be quite a challenge with their thin *Zygomata* and large canines, while others like the human hand can be very easy. The use of a good release agent and quality materials will give you the best results regardless of what you are casting. I made a plaster mold of my left hand and then made a cast using Polamine® 650 with Ease Release™ 400 as the release agent. The detail was excellent and the cast incredibly durable so I sent it as a birthday gift to my stepfather in New York, I wanted to give him a hand. Several months later a Palm Reader was inexplicably 'attracted' to the cast, and while I was 3,000 miles away and never having met her, gave my hand cast a reading. Oddly enough it is fairly specific and an incredibly accurate assesment.

**Long head line shows strong mentality - very intelligent. Because it splits in two you have one foot in the world of the imagination and one in the practical world. Can also see two sides of a situation.**

**Worry lines (below thumb) show you worry alot!! You are also very sensitive (alot of lines) - and are detail oriented. You have to learn to say "so what"!!! Alot of lines indicate many possible paths in life open to you.**

**Large lower mars shows feistyness - bit of a temper - but you have the inner strength to back it up.**

**The strong clear destiny line (vertical line running through the center of the palm towards the middle finger) shows a strong career but more accurately a strong sense of security, or knowing what you want to do as your life's work.**

**Many lines in a hand show not only great sensitivity but a lot of nervous energy racing through - one needs to take time out - quiet time to collect all the excited nervousness and become calm and focused.**

**Constantly on the go - alot of lines prevent one from becoming lazy. (9/5/92 Dorian Bergen)**

## Appendix III

### Glossary

**Alginate:** A gelatinous substance obtained from certain algae, especially the giant kelp.

**Back-up Mold:** A stiff, interlocking support, usually plaster, for a flexible mold. See Ch. 2.

**Bison:** Buffalo- A large, free-ranging, hooved mammal, that once roamed Western North America in large herds. The bison was used by many as a food source.

**Calvaria:** The top portion of the skull - the skull cap.

**Cast:** To form a material (usually liquid) into a particular shape by pouring it into a mold, a reproduction of the original, to make copies of an object.

**CFC:** Chlorofluorocarbons - propellant thought to be harmful to the ozone layer.

**Chert:** A type of stone used in making tools.

**Degas:** To remove trapped air bubbles, with a vacuum, from casting materials before they cure.

**Dental Caries:** Cavities in the teeth, largely preventable.

**Emaciated:** Very thin.

**Enamel:** The strong outside coating of teeth.

**Endocranial:** The inside of the skull.

**Exfoliate:** When bone flakes off due to aging and/or exposure.

**Exotherm:** Gives off heat during the curing process.

**Facial Reconstruction:** Using a cast of a human skull and clay, a reasonable likeness of an individual can be fashioned.

**Female:** The side of the mold that is inverted.

**Flange:** A "collar" of cardboard that goes around a skull in preparation for casting. See Fig.#1, in Ch.4.

**Flint:** A type of stone used for making stone tools.

**Forensic:** Pertaining to legal matters, has a crime taken place?

**Fossil:** The preserved remains of plants and animals that lived in the past.

**Fun:** What you should have while casting.

**Hemisected:** To cut the skull cap (calvaria) off, for removal of the brain, or to observe internal landmarks of the skull.

**Hydrostone:** A high quality type of dental casting plaster.

**John (or Jane) Doe:** The name given by police to unidentified human remains.

**Latex:** Sap from a species of the rubber tree that is excellent as a casting material.

**Lucy:** An Australopithecus afarensis discovered by Dr. Donald Johanson. (Johanson,1981).

**Macerate:** To soak and remove tissue from a bone during preparation.

**Male:** The protruding side of a mold.

**MEK:** Methyl Ethyl Ketone - A solvent and a catalyst, caution should be exercised when using MEK.

**Memory:** The ability of a mold to bounce back into shape after repeated use, over many years, with no distortion.

**Mold:** A form into which casting material is poured to make a cast.

**MSDS:** Material Safety Data Sheet, available from the manufacturer.

**Neanderthals:** An early form of Homo sapiens living from about 100,000 years ago to about 35,000 years ago.

**Obese:** Overweight, in excess.

**Obsidian:** Type of stone that makes the sharpest tools known to man, up to 500 times sharper than a razors edge.

**Paleontologist:** A person who studies fossils and ancient life forms.

**Pathology:** The study of the nature of disease, its causes, and its consequences.

**Pot Life:** The amount of time available to mix a two-part (or more) casting material before it is too stiff to work.

**Release Agent:** Allows casting material to be separated from the cast or from the original.

**Repatriated:** To Return human remains to their related peoples, or area of origin.

**RTV:** Room Temperature Vulcanizing.

**S.E.M.:** Scanning Electron Microscopy - gives a greatly enlarged photo of minute detail.

**Sella turcica:** The Turkish Saddle, where the pituitary gland is housed on the inside of the skull.

**Solvent:** A liquid in which materials are dissolved, after application the solvent usually evaporates.

**Trauma:** A wound or lesion on bone, often produced by a sudden physical injury.

**Vulcanizing:** To improve the strength, resiliency, and freedom from stickiness and odor of (rubber) by combining with sulfur or other additives in the presence of heat and pressure.

**Zygomata:** The cheek bones, they are thin and require special care to keep them from breaking on casts.