7. A Casting-Method for Palaeontological Purposes

By

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Introduction

To produce satisfactory plastic reproductions of fossils, especially of small internal casts, has often proved difficult and sometimes even impossible. In order to obtain good results the author has worked out a method, the dibutylphthalate-polyvinylchloride method, the description of which is given below. Preliminary accounts of the method are found in Bull. Geol. Inst. Uppsala, vol. 35, 1953, pp. 201–3, and The Sino-Swedish Expedition, Publ. 37, 1953, pp. 106–9, both out of print. In order to satisfy demands received from outside these earlier notes are here reprinted with slight alterations. The section on reconstructive casting is new.

The dibutylphthalate-polyvinylchloride method has the following features:

1. In fluid condition the casting material possesses a relatively low viscosity, so that the liquid can easily enter into rather small and narrow cavities.

2. The impression is elastic, can be easily removed from the mould, and without breaking be withdrawn also from narrow cavities and undercut parts. This property is of great value, particularly with regard to internal casts of brachiopods, the cavities (e. g. of crural plates) of which generally project more or less deeply into the internal cast.

3. The impression is unshrinkable.

4. The surface of the impression exhibits such minute details that it may be studied satisfactorily also under magnification.

5. The impression is tough and, as far as can be judged from our experiences, suffers no change during a long lapse of time.

6. No solvent which has been tried by us has been found to act upon the compound.

7. The outer layer of the impression is partly transparent. It is therefore appropriate to apply a thin coat of ammonium chloride in order to produce an opaque surface when studying it and taking photographs.

Description of the Method

Open Mould

The following material is required: Plaster (alabaster, dental); dibutylphthalate (soaphthal B can also be used); fine-ground polyvinylchloride; plasticine or clay.

Fig. 1 shows an internal cast of which an impression will be made.

A roll of clay or plasticine of about the length of the circumference of the internal mould or fossil is formed and rolled out into a ribbon about 20 mm broad and 3 mm thick. The edges are cut straight and clean with a knife. The ribbon is then mounted like a wall around the fossil. This is what is called "fence" in the technical language of the sculptor. Observe that the fence must fit closely to the stone, and this is accomplished when by the careful use of a fine knife its outside is made as even and smooth as possible. Fig. 2 shows the mounted fence.

Water of about the same volume as the 3 mm thick fence is poured into a bowl of rubber or china, and as much well loosened plaster as can be absorbed is strewn by hand into the water without stirring, or one proceeds until small islets of dry plaster are forming upon the surface. After about 20 seconds the compound is stirred with a spatula in order to mix the plaster with the water as homogeneously as possible. A 2–3 mm thick layer of plaster is now applied with a spatula to the outside of the fence, and like the latter closely attached to the stone. The layer or coat of plaster must not be too thick as it will have to be removed later on.

Fig. 3 shows how the coat ought to look. The fence is now carefully removed with a thin knife so as not to damage or detach the coat of plaster (Fig. 4). If small clay or plasticine particles should adhere to the specimen they can be removed without damaging it with a pointed piece of clay or plasticine which is carefully pressed against the particles until they cling to it.

The stone with the adhering coat of plaster has now to be immersed into water and left there till it is thoroughly saturated whereupon it is taken up and all superfluous water blown off, so that the stone and the plaster show an evenly moist surface.

About the same quantity of dibutylphthalate as the bowl formed by the coat can hold is poured into a jar of glass or china. Under constant stirring fine-ground, well-loosened polyvinylchloride is strewn into the dibutylphthalate till the compound shows a white, smooth, creamy consistence. At this stage it is now ready to be poured into the bowl formed by the coat. Let the compound flow slowly down the inner side of the coat, and spread evenly upon the moist fossil avoiding the formation of air-bubbles. In order to prevent air-bubbles in narrow deep cavities, the latter can advantageously be filled with the compound by means of a sliver of wood or a hair from a

Fig. 1.

Fig. 2.

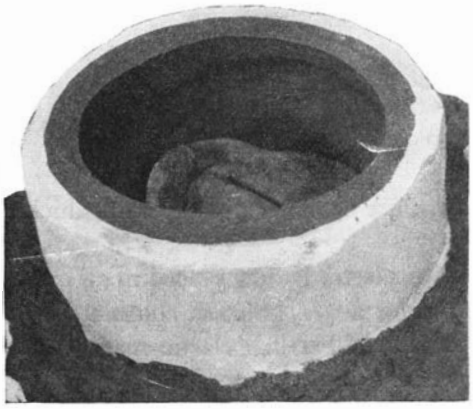


Fig. 3.

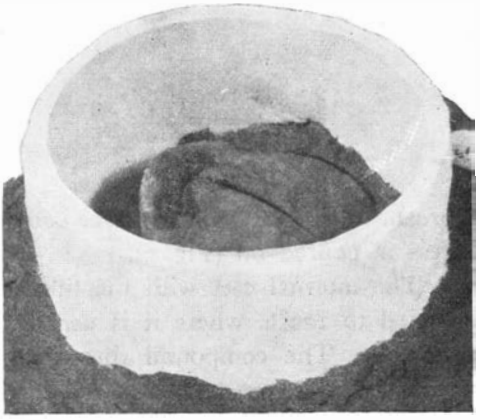


Fig. 4.

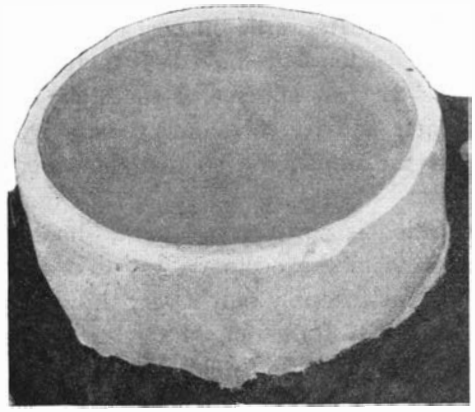


Fig. 5.

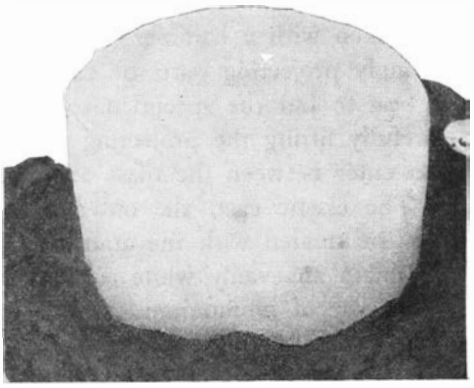


Fig. 6.

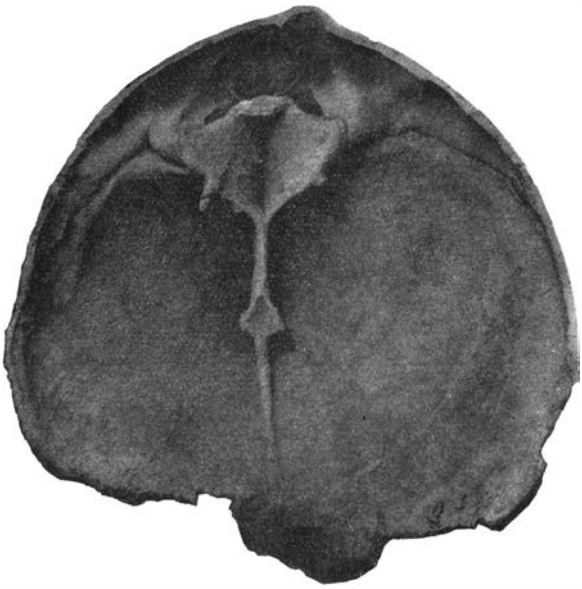


Fig. 7.

brush. When the whole surface is covered more compound up to 2 cm thickness is poured on (Fig. 5).

The internal cast with the filled coat of plaster is now placed in an oven heated to 120°C where it is usually baked for 2–2 $^1/_2$ hours at constant temperature. The compound then turns into a rubber-like elastic mass. The baking time given applies to moulds in which the thickness of the compound does not exceed 3–4 cm in any place. When casting larger specimens where a greater thickness of the compound is required the baking time has to be increased correspondingly. The necessary experience is soon acquired. The final consistency of the compound is the decisive criterion. The whole specimen is then immersed in cold water to cool. Afterwards the coat of plaster is broken with a hammer (Fig. 6) and the elastic cast removed. If there are strongly projecting parts or cavities where the cast adheres to the stone it is best to put the specimen back into water and try to remove the cast by carefully lifting the projecting portions of the impression so that the water can enter between the mass and the stone.

The elastic cast, the outer layer of which is partly transparent, should now be treated with the ammonium chloride in the ordinary way in order to obtain an evenly white surface. Be careful to apply only a very thin and even coat of ammonium chloride, avoiding the formation of thicker local accumulations which would obscure the finest details. After whitening the cast is now ready for examination and photography (Fig. 7).

Should plaster replicas of the elastic cast be required it is, of course, not

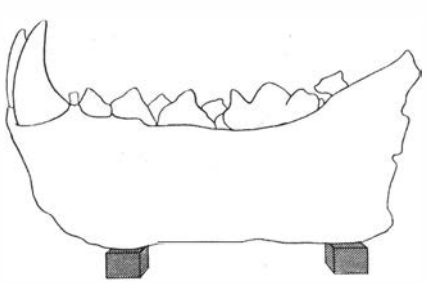


Fig. 8.

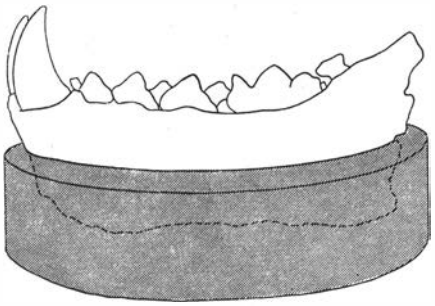


Fig. 9.

I Plasticine or clay II Plaster III Plastic

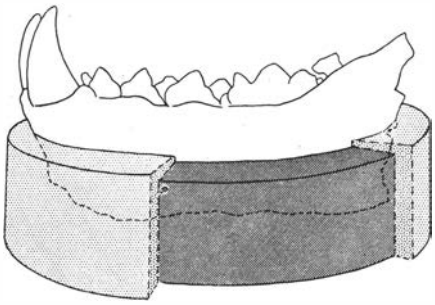
necessary to whiten it. When removed from the stone it is first covered with a thin layer of plaster. On pouring the plaster the cast is knocked against the table so that the plaster can penetrate into every cavity and accidental air-bubbles may loosen. More plaster is poured on up to the required thickness. For plaster casting the plaster is mixed in the same way as described above.

In order to obtain a plaster impression identical with the elastic one made directly from the fossil, first a 3 mm thick plaster cast of the elastic impression is made. This cast is then dipped for about one minute into a solution of one part of potash to 25 parts of water. When the surface of the plaster is moist, but free from accumulations of water more plaster up to the required thickness is poured over the cast treated with the solution. Finally, the first, thin plaster is carefully removed with small chisels so as not to damage the plaster impression.

Divided or Compound Mould

A description will now be given of how to prepare a so-called divided or compound mould as required in casting skulls, jaws, and other three-dimensional objects. In addition to the materials enumerated above a piece of thin sheet-metal for working upon is required. The object to be moulded, e. g. a mandible, has to be supported 5–10 mms above the working surface. This is best done by putting some small lumps of plasticine upon the sheet and arranging the mandible upon these (Fig. 8).

Next a roll of plasticine or clay is shaped as before, its length equalling the circumference of the object. This roll is then flattened into a ribbon 5–10 mm thick, its width corresponding to the height from the sheet to the middle of the object, or to the line where the parts of the mould are to meet. The edges of the ribbon are cut clean and straight with a sharp knife. After



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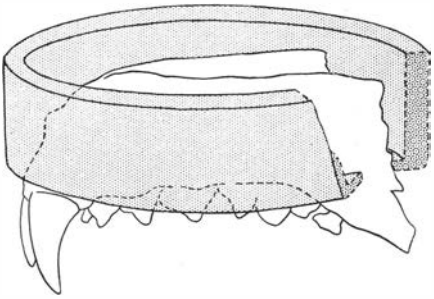


Fig. 11.

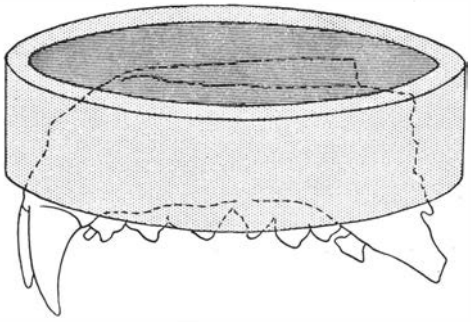


Fig. 12.

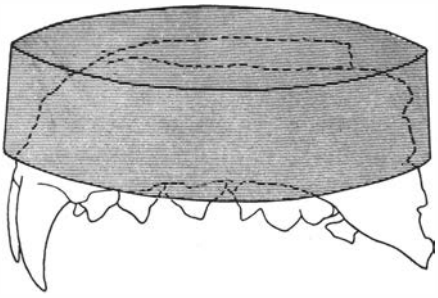
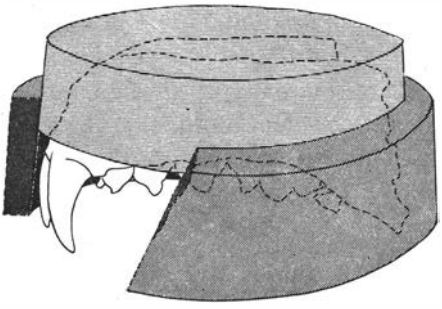


Fig. 13.



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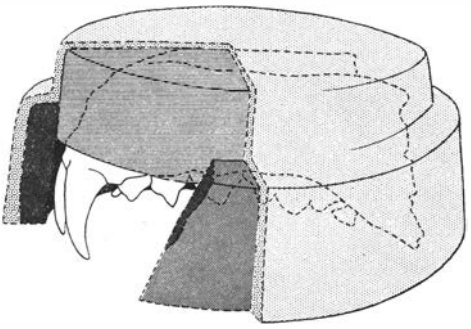

Fig. 15.

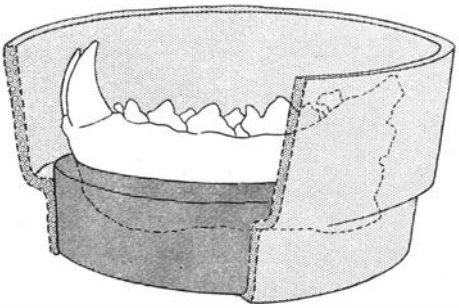

Fig. 16.

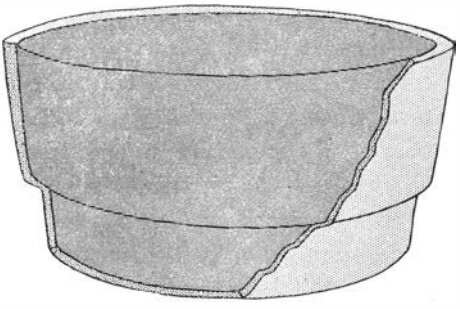

Fig. 17.

that it is placed on edge and closely around the mandible, forming the fence (Fig. 9). Next, plaster is mixed and spread with a spatula in a thin layer (3–5 mm) all over the exposed surfaces of the plasticine. The resulting plaster cap must touch the mandible everywhere, and at the line of contact with the object must not be thicker than 3 mm as it has to be chipped off later. Fig. 10 shows the plaster cap. When the plaster has set everything is detached from the supporting sheet, best by a slight bending of the latter. Carefully remove all plasticine, both the supports and the fence, without damaging the object or the plaster cap. The plaster cap now forms a kind of dish or basin with half of the jaw protruding from its bottom (Fig. 11). This basin will receive one half of the mould. Be careful to fill even the smallest crevices before the cap is filled to the brim (Fig. 12). No air must remain anywhere. The whole is then baked as above.

After withdrawal from the oven, the plaster is broken with a hammer and removed. Fig. 13 represents the first half of the plastic mould with the mandible half embedded. The mandible must not be removed until after the completion of the entire mould. Now, taking a sharp knife, cut some wedge-shaped notches in the plastic mass next to the object. These will guarantee the correct juxtaposition of the parts when the mould is assembled for casting.

To produce the next part of the mould place the exposed part of the mandible upon the metal sheet, supporting it with lumps of plasticine as before. Again a ribbon of plasticine is prepared and placed on edge, now around the half of the plastic mould. Its upper rim should reach about 1 cm above the lower edge of the plastic (Fig. 14). Next everything, both mould and plasticine, is covered with plaster as shown in Fig. 15, the thickness being the same as in the previous step. The plaster having set remove the whole from the sheet, and carefully pick out the plasticine. We now have a plaster basin in two stories with the completed half of the mould in its lower part (Fig. 16). The exposed surfaces of the plastic are now brushed with a solution of soap. The filling of the upper half of the plaster basin with the liquid plastic is carried out as before. The heat-treatment will take some more time as this half of the mould is as a rule heavier than the first (Fig. 17).

It is of great importance that the mould should be cool before the separation is attempted. First knock off the plaster. By careful bending and kneeding movements the seam between the two parts of the mould is made to open. They are then taken apart, and the object removed. The mould is now ready for casting. This can be done in either of two ways. In the first case a hole, or ingate, is cut in a spot, where there are no fine details or structures which would be lost in the necessary subsequent touching up. In this method it is advisable to tie up the mould between two flat boards to prevent it from yielding. The second method requires no ingate. It has the advantage that reinforcements with strips of fabric or metal rods are easily put in their right place. The halves of the moulds are filled separately with

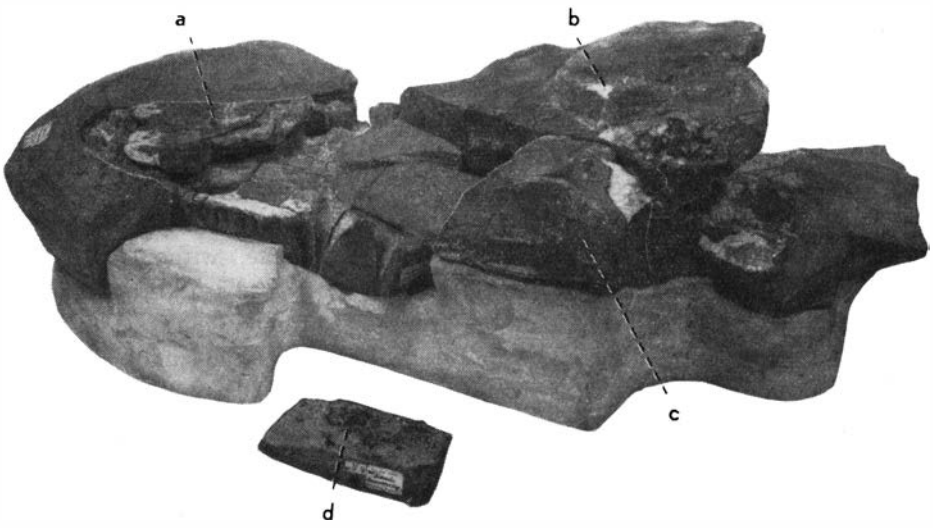

Fig. 18.

plaster, and when this is just about to stiffen slightly the smaller part is turned upside down and put in its place inside the larger. Put a flat board on top of the assembled mould, but beware of excessive pressure so as not to distort the elastic lateral walls of the mould.

An Example of Reconstructive Casting

The study of fossils is now and then complicated by the particular state of preservation, e. g. when part of the material is preserved bodily, i.e. in the positive, and the remainder as impression, i.e. in the negative. In such cases it is frequently impossible to obtain a comprehensive idea of the shape and the appearance of the fossil. The following description refers to such a case and to the way in which it can be dealt with.

Fig. 18 shows the skull of a stegocephalian, the fragments being placed in juxtaposition upon a bed of plaster. The material comprises palate and teeth, mainly in the negative, a natural cast of the nasal cavity (*a*), and two pieces (*b* and *c*) forming parts of the natural cast of the cranial cavity. Several teeth of the right supramaxillary are split lengthwise, the lingual portions being preserved in the matrix, while the labial parts are represented by their impressions in the surrounding rock (*d*). Behind them the impressions of two larger teeth are seen.

In Fig. 19 the loose pieces belonging to the natural cast of nasal and cranial cavity are removed.

In Fig. 20 the piece of the fossil containing the split teeth has been replaced by a replica in plaster, produced in a divided mould as described in

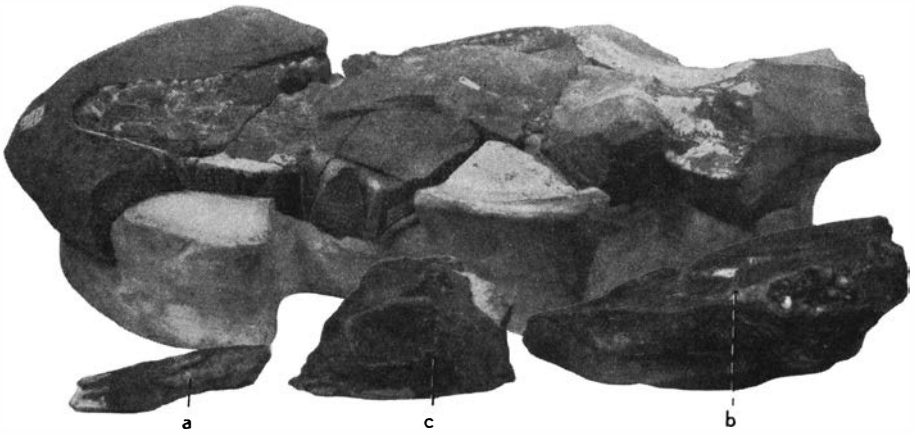

Fig. 19.

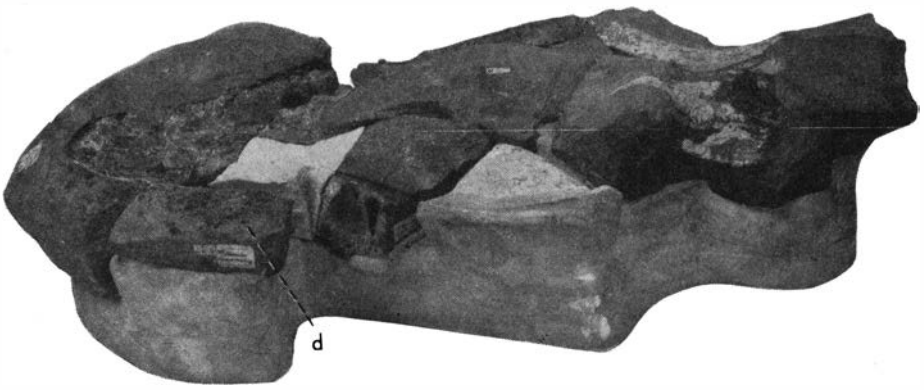

Fig. 20.

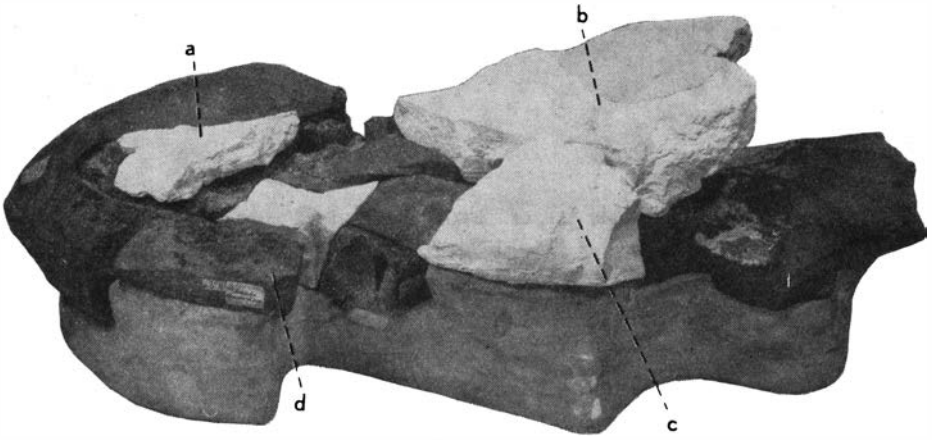

Fig. 21.

Fig. 22.

Fig. 23.

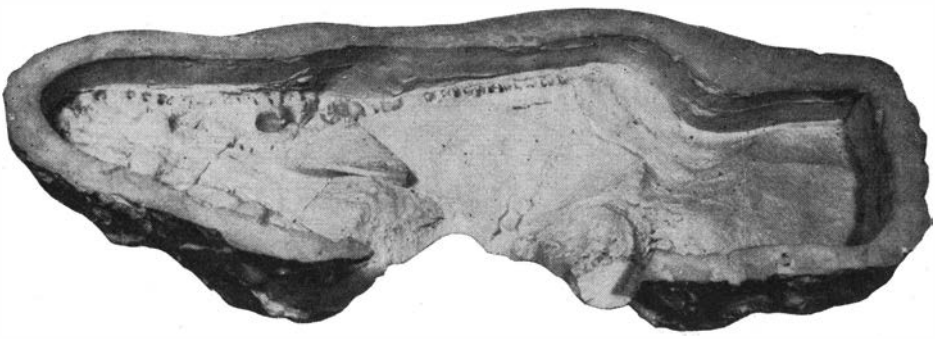

Fig. 24.

the previous section of this paper. From the labial side of this replica the plaster has been cut to the height of the largest among the teeth, and to a width of about 5 mm. The piece of matrix (*d*) with the impressions of the split teeth has been replaced upon the bed of plaster, and now limits, together with the plaster piece, a cavity. In this way a complete negative of the tooth row has been obtained.

Next plaster replicas are made in divided moulds of the natural casts of nasal and cranial cavity. Fig. 21 shows them in their proper places.

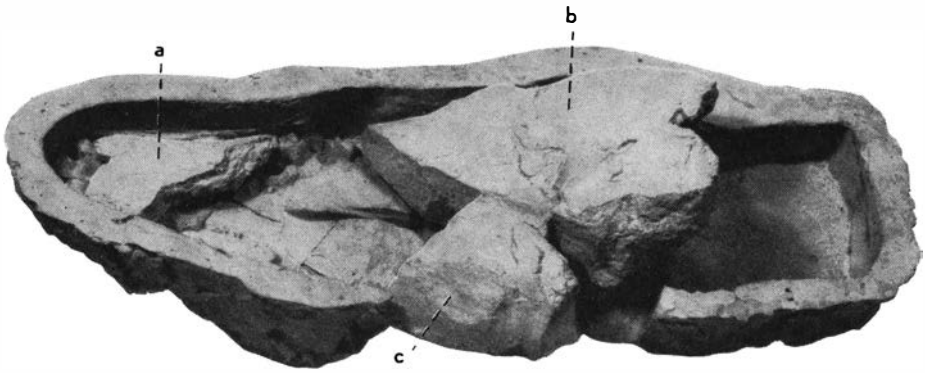

Fig. 25.

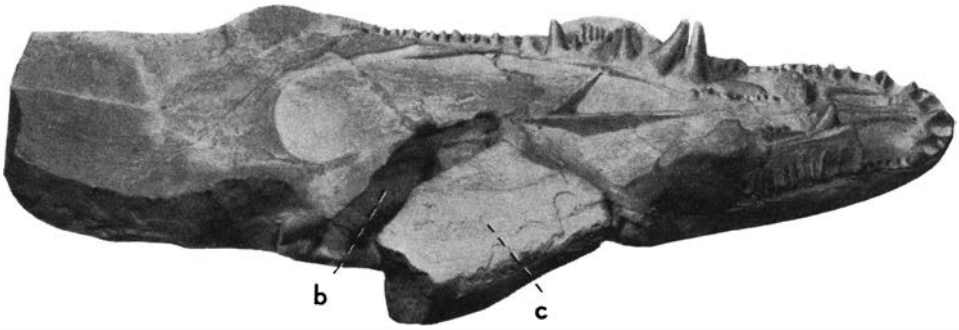

Fig. 26.

In Fig. 22 a rim of about 3 cm height is shown which follows the outline of palatal and dental impressions. The resulting basin, the bottom of which is formed by the ventral impression of the skull, is now filled with the plastic compound in the usual way, and baked as before. Particular care is required against the formation of air-bubbles in the depth of the dental cavities.

Fig. 23 shows the altogether positive plastic cast of the ventral surface of the skull. This plastic positive is now covered with plaster. The thickness of the plaster should be 1–2 mm except along the margins where 1–2 cm are required. This stronger rim or frame supports and strengthens the thin layer of plaster in which the final casting will take place (Fig. 24).

Fig. 25 shows the negative plaster mould with the loose plaster replicas of the pieces (*a*), (*b*), and (*c*) in their proper places. It is now treated with a solution of potash as before, and filled with plaster.

The knocking-off of the plaster mould frees the ready reconstructive plaster-cast (Fig. 26).

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