The Plastic Operation.

Plastic operations on the mandible are rendered especially difficult by irregular scars in which it is impossible to bury a graft without opening the cavity of the mouth, and by septic scars in which operative interference precipitates a relapse of infection. We have considered the possible means by which these difficulties may, perhaps, be combated.

Aseptic union will, however, probably always be exceptionally difficult to attain, and it thus seems a reasonable precaution to make special efforts to maintain the vitality of a graft implanted in the jaw. To attain this object an obvious method is the use of pedunculated grafts. Such grafts can be provided by excising a piece of bone to which a muscle is attached and using the muscle as a pedicle. Parts adapted for such a purpose within reach of the mandible are the attachment of the sterno-mastoid, splenius or trachelo-mastoid to the skull, the trapezius and the levator anguli to the clavicle or scapula, but especially the attachment of the sterno-mastoid to the inner end of the clavicle. The bone here closely resembles the mandible in texture, the upper half of it with the broad attachment of the muscle lends itself to detachment and to displacement without undue difficulty into the gap in the jaw. It is unnecessary to indicate the technical steps of such an operation; the graft should obviously be measured exactly and drilled for screws before detachment. In a presumably aseptic scar there would clearly be no objection to the use of a Lane's plate if thought desirable. In a suitable case where the anterior part of the jaw had been destroyed I should not hesitate to make use of a graft from each clavicle, joined in the middle line by a suitably bent plate.

Conclusion.

In this very summary sketch it has been attempted merely to apply principles gathered in a prolonged experience and study of operations upon the jaw undertaken in civil practice in cases where large parts of the bone have had to be removed. In such cases the plastic reconstruction of the jaw has not proved to present insurmountable difficulties as a rule, and grafts, taken almost invariably from unaffected parts of the jaw itself, have been found an easy and satisfactory method of re-establishing the continuity and stability of the bone. It should be added that as in these cases some part of the thickness of the bone usually is available for use as a graft, even in the affected region, the two-stage operation is not often necessary; it is, in fact, only quite recently that one has become interested in its possibilities and in the development of its technique.

One cannot, of course, do more than suggest the technique that might be found applicable by those who have opportunities of dealing with gunshot wounds on a large scale. It seems certain, however, that the primary and immediate operation giving full access to the fracture with the purpose of limiting haemorrhage, sepsis and necrosis and attaining a limited and relatively aseptic scar, is an indispensable preliminary to a systematic application of plastic bone surgery to large destructive lesions of the mandible. It would obviously be irrelevant in a more or less speculative paper such as this to attempt to embody all the many minor details of practice one has found useful in what I have called the primary operation as carried out for tumours. If the surgeon keeps clearly in mind the principle that protection of raw surfaces in order to secure rapid union must be the first consideration, the minor procedures that facilitate this will suggest themselves readily.

SOLVENTS FOR DICHLORAMINE-T.

BY

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AND

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(Report to the Medical Research Committee.)

DICHLORAMINE-T is a slightly yellowish solid, readily soluble in most organic solvents with the exception of the paraffin hydrocarbons. It is a powerful antiseptic, and when dissolved in oily media has found useful application in the treatment of infected wounds¹ and for nasopharyngeal disinfection.² Although, as first stated,

dichloramine-T readily dissolves in most organic solvents, the majority of these solutions are of no value for practical purposes, since the dichloramine-T contained in them is rapidly decomposed. Among the few solvents which give reasonably stable solutions many had to be rejected on account of their proving too irritating, so that it will be realized that the selection of a suitable solvent for dichloramine-T is a somewhat difficult problem.

In our earlier experiments we made use of eucalyptol which had been previously lightly chlorinated to reduce its avidity for chlorine. The solution thus prepared was diluted with paraffin oil which had been chlorinated in similar fashion.³ Eucalyptol prepared as described is a good solvent for dichloramine-T, and the solution is reasonably stable if protected from light. Thus an 11 per cent. solution after standing in a corked amber bottle for six months still contained 6 per cent. of unchanged dichloramine-T. The addition of paraffin oil to the mixture is apt to reduce its stability, especially if care is not taken to select a suitable oil. It appears worth noting that liquid paraffin oils vary greatly in their suitability as diluents for dichloramine-T solutions. The Russian oils containing much naphthenes are unsuited for this purpose, while some grades of American oils contain considerable quantities of olefines as well as naphthenes.

The best oils with which we are acquainted are Pennsylvanian oils which have been well purified by agitation with fuming sulphuric acid and then washed and dried. Such oils are readily obtained in the open market, and on light chlorination, as previously described in this JOURNAL, furnish a very satisfactory diluent.

The use of eucalyptol has two disadvantages. In the first place, it is not as bland and innocuous a substance as might be desired, and its use is occasionally followed by a rash. Secondly, pure eucalyptol is not available in indefinitely large amounts, and at the present time its high price is a definite consideration. The same disadvantages apply to a more highly chlorinated eucalyptol, which was introduced by Lewis and Kraus, obtained by chlorinating eucalyptol with chlorine gas until the oil has a specific gravity of about 1.2. This oil, moreover, occasionally liberates traces of hydrochloric acid on standing, which causes a rapid deterioration of the dichloramine-T solution.

We therefore undertook a systematic survey of other possible solvents for dichloramine-T with the object of finding a cheaper and blander substitute for eucalyptol. This we believe we have accomplished, at least in part, and a description of the new solvent is appended. Early in our quest it became clear that most compounds containing oxygen gave unstable solutions of dichloramine-T unless the oxygen were in an ether-like combination, as in eucalyptol. Many esters, chlorinated aldehydes, acetals, alcohols, and glycerides were tried and abandoned. Chlorinated phenolic ethers, such as dichloranisole, were tried and found too irritating. It appeared improbable that compounds containing oxygen were likely to prove successful, since they usually abstracted chlorine from the dichloramine-T too readily. The choice then practically resolved itself into halogen derivatives of other hydrocarbons of the aromatic, aliphatic, and other series. The chlorine derivatives of aromatic hydrocarbons in most cases were found too irritating for practical use, and the same is, of course, true of some of the lowest members of the aliphatic series, such as chloroform. We therefore turned to the chlorine derivatives of the higher aliphatic hydrocarbons. Heptyl chloride, obtained by the chlorination of purified heptane from petroleum ether, gave encouraging results, and the same was true of many of its homologues; but it soon became clear that the stability of the dichloramine-T solution depended to a considerable extent on the purity of the solvents, and the preparation of these substances in an approximately pure condition is a difficult and costly matter. On attempting to chlorinate higher hydrocarbons, such as those in gasoline, kerosene, vaseline, and purified liquid paraffin oil, we found that with restricted chlorination poor solvents were obtained, while on more extensive chlorination deep-seated decomposition occurred with the formation of thick oils which were unusable. This latter decomposition we believe to be largely due to the presence of cyclic hydrocarbons, so-called naphthenes, in these oils, for these substances do not give simple stable derivatives on chlorination, but undergo far-reaching decomposition.

We therefore experimented with the chlorination of paraffin wax, since this substance is free from naphthenes

and is almost entirely composed of the saturated aliphatic hydrocarbons of the $C_n H_{2n+2}$ series. We found that paraffin wax could be readily chlorinated under easily regulated conditions, and that the product when prepared as described below was an extremely bland rather viscous oil, which readily dissolved dichloramine-T, and that the solutions so prepared were stable over long periods if kept under suitable conditions. As was to be expected, the product is not a single individual compound, but a mixture of isomeric and homologous chlorine derivatives. It is therefore impossible to give a systematic name to the product, and, as the descriptive name "chlorinated paraffin wax oil" seems unnecessarily clumsy, we have provisionally chosen the name "chlorcosane," since the systematic names of most of the hydrocarbons in paraffin wax end with the suffix "cosane."

Preparation of the Solvent "Chlorcosane."

Paraffin wax, preferably melting at $50^{\circ}C$. or higher, is placed in round bottomed flasks and heated to about 120° . Two flasks connected in series, each containing a half kilo of the wax, may be conveniently used. A rapid current of chlorine from a cylinder of the liquefied gas is then passed through the molten wax in the flasks, each of which is provided with a thermometer and the necessary glass tubes. The temperature should be controlled within the limits of $125-140^{\circ}$. The first flask in which the reaction is most vigorous will require but little heating. Chlorination is continued until the contents of the flasks have increased in weight 45 to 55 per cent. of the weight of wax taken. It will be found convenient to complete the chlorination of the first flask and then remove it, and transfer the second to its place, putting a fresh flask of paraffin wax after it. In order to avoid undue discoloration of the product, a minimum amount of rubber tubing should be used for the connexions. Wide glass tubing should be used for passing the gases, and the ends of the delivery tubes are preferably blown into bulbs provided with a number of fine orifices to promote good contact between the gas and oil. Hydrochloric acid is, of course, evolved freely during the reaction. After the requisite amount of chlorine has been absorbed, the oil, while still warm, is shaken vigorously with 5 per cent. of its weight of dry sodium carbonate and then filtered through a dry fluted paper. The clear oil, which has a light yellow or sherry colour and is slightly heavier than water, is then ready for use. It possesses a viscosity intermediate between that of olive oil and castor oil, has almost no odour, and is perfectly bland when sprayed up the nose or placed on skin or wounds.

It will be noted that the materials necessary for making the new solvent are all easily available at very cheap rates.

We have been unable to find any references in chemical literature to a product of the kind described. Lippmann and Hawliczek¹ heated paraffin wax with phosphorus pentachloride and obtained evidence of the formation of mono- and dichlor- derivatives, while Bolley,² by the exhaustive chlorination of paraffin wax, obtained solid products of varying composition. The chlorine in "chlorcosane" is mostly in a firmly bound condition not readily removable by treatment with boiling alkaline solutions. It does not react with metallic magnesium suspended in ether, but on heating with soda lime to 250° unsaturated hydrocarbons and a little fatty acid are formed. Boiling with aniline removes most of the chlorine with formation of complex bases which have not been closely characterized. "Chlorcosane," itself containing all its chlorine united to carbon, has, of course, no appreciable antiseptic action.

Preparation and Stability of Solutions of Dichloramine-T in Chlorcosane.

Chlorcosane at room temperature can dissolve from 8.5 to 10 per cent. of dichloramine-T. For wound treatment a 7.5 to 8 per cent. solution is strong enough for all purposes and is most conveniently prepared as follows: A portion of the oil—for example, a quarter—is heated to 75° or $80^{\circ}C$. and the weighed amount of solid dichloramine-T is then added. The latter substance will promptly melt and dissolve in the warm oil, which is then at once diluted with the remainder of the oil and the whole well mixed. If necessary, the solution can be filtered, but with pure materials this is not required. The clear solution should be at once stored in small amber corked bottles and not exposed to unnecessary heat.

Direct sunlight causes the most rapid decomposition of dichloramine-T solutions, and it should also be noted that blue glass bottles afford no protection. If kept in amber bottles, the solutions remain clear and retain their activity practically unimpaired for many weeks or possibly months.

Two preparations containing initially 8.7 and 8.9 per cent. dichloramine-T, kept for one month in corked amber bottles at laboratory temperature, contained 8.2 and 8.4 per cent. respectively at the end of that time. A similar oil exposed to direct sunlight for four days was completely decomposed, while another sample incubated at $40^{\circ}C$. fell from 8 to 3 per cent. in a month. Under ordinary conditions solutions which are protected from light by amber bottles and from contact with water or excessive heat may safely be used for two months or possibly longer.

The clinical results of dichloramine-T dissolved in the new oil are similar to those already recorded by Lee, Sweet, and others, and the same is true of its disinfecting action in the nasopharynx. The only difficulty that we have thus far encountered is the fact that the high viscosity of the oil prevents its being readily sprayed with a hand spray, though this is easily accomplished with a power spray. The addition of about 10 per cent. of carbon tetrachloride will reduce the viscosity of the mixture to a point at which it can be readily sprayed in an ordinary oil "atomizer." This dilution has no deleterious effect on the stability of the solution and is unobjectionable for wound treatment. It appears desirable to add the carbon tetrachloride only to the oil used in the hand spray and to use the thicker oil undiluted for other modes of use.

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A SKIN INK FOR RADIOGRAPHY.

BY

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RADIOLOGISTS have long been troubled by the thorough way in which some nurses endeavour to remove localization skin marks as soon as the patient returns to the ward; hence the need for a substance which will make an indelible mark on the skin, proof against rough treatment, has been acutely felt in this war. The properties required in such a substance are as follows:

1. It should stain the skin such a colour that it will show up against iodine.
2. The mark should be unaffected when rubbed with spirit, acetone, ether soap, or tincture of iodine.
3. The mark must last, when covered up with dressings, at least five days, and longer if possible.
4. The mark should be quickly and easily made, and making it should not hurt the patient, for it must often be placed on a part that is acutely inflamed and tender.
5. The substance used for the mark must not damage or inflame the skin.
6. The mark should be visible immediately it is made.
7. The materials used must be obtainable.

Condition 4 practically requires the use of a liquid applied with a brush, as the pressure of a pencil often causes considerable pain. The liquid should penetrate the skin well, and evaporate quickly, so that watery solutions are ruled out; and it is advisable, in order to save time, to have a single-solution marking fluid.

Silver nitrate forms a good mark, but it turns white with iodine and is not easily seen. It cannot be seen when first applied, it must be used in aqueous solution, and it may cause a good deal of inflammation when developed *in situ* by photographic developer. This substance cannot therefore be regarded as at all suitable.

I experimented with a number of dyes without finding a thoroughly satisfactory one. A solution of ferric chloride in alcohol, followed by a solution of haematoxylin in alcohol and ether, as suggested to me by Captain C. E. S. Phillips, formed a satisfactory mark, but being in two solutions took some time to apply, and, as haematoxylin is no longer obtainable, it need not be further considered. The least unsatisfactory aniline dye was a solution of methyl violet in acetone and water 50 per cent. followed by a painting with tincture of iodine. Aniline green also gave a fairly satisfactory mark when applied in the same way.

I eventually found that ferric chloride followed by pyrogalllic acid gave a grey mark, which gradually turned a

* The ordinary indelible pencil appears to contain this dye.