SCOPOLAMINE-MORPHINE

SEMI-NARCOSIS DURING LABOUR

WM. OSBORNE GREENWOOD

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BY

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TO

PROF. J. B. HELLIER, M.D.(LOND.)

DEAN OF THE FACULTY OF MEDICINE AT LEEDS

AS A MARK OF GRATITUDE

FROM A FORMER PUPIL

PREFACE

THE subject of the following monograph has been very variously received by the profession. By some it has been violently condemned, by others it has been just as enthusiastically eulogised. An intimate knowledge of the history of this method of treatment shows that a good deal of sympathy must be extended to each of these opposite opinions, hence the brief history given in the first chapter. The earlier experiments were admittedly haphazard, and it would have been remarkable if the results had not been as various as the different methods of using the drugs. As will be pointed out later, some allowance must also be made for the impurities present in the earlier preparations of scopolamine.

So many of my fellow-practitioners have written to me asking for full details of the technique, etc., that the most logical plan seems to be to put my own experiences into a permanent form, available to all who wish for them; for it is impossible, in the confines of a letter, even to indicate a full account of the technique and draw attention to

the many small points which at first sight appear trivial, but which nevertheless contribute so largely to the best success.

I am aware that among those who have discountenanced this method of treatment there are the names of several eminent obstetricians, the chief of whom perhaps are Bumm, Hocheisen and De Lee; but there are also many other eminent leaders who have given it the most unstinted praise. As this monograph is not intended to be polemical beyond the barest necessity, it is enough to point out that no amount of criticism can negative the excellent results that have hitherto been obtained and can be obtained. An apt analogy may be pleaded by saying (what every medical man knows) that a negative culture from a throat does not prove the absence of diphtheria, while a positive culture does prove its presence.

This monograph is based on two sources. Firstly, I have carefully read all the literature on the subject which is at present available. Secondly, it is a record of the method as I have used it for considerably over two and a half years. Under the former heading I wish specially to acknowledge the historical sketch by Dr. Hellman for some details which would otherwise have been difficult to obtain at present. With respect to the latter, I may say that during the whole of this time I have made every case an earnest and careful in-

dividual study, and it did not take long to discover that this was the only way to obtain the best success.

It is only fair to say that in a busy general practice it may often be impossible to devote the time to each case which can be given in a hospital or a nursing home, and in many poor people's cottages the conditions are far from ideal. But the same objection applies to these conditions in the ordinary conduct of a labour in such cottages; and it is surprising what measure of success can be got by a resolute determination to make the conditions as good as the circumstances will permit.

The personal note in a monograph of this kind is unavoidable, because it embodies so much essentially personal investigation, and I can only express the hope that these observations will be useful to those who are anxious to know as much about the subject as our present state of knowledge will allow.

WM. OSBORNE GREENWOOD.

September 1917.

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SCOPOLAMINE-MORPHINE

CHAPTER I

History

NO movement in the attempt to advance the science and art of medicine and surgery is devoid of interest. Even if such an attempt prove to be futile the interest still remains, as it marks a stage in the general evolution of effort. The whole history of the discovery and attempted development of vaccines, antitoxins and serums is full of illustrations. The very diverse opinions as to the value of tuberculin shows that we have not yet reached the stage where tuberculosis can be said to have its specific in the same sense as diphtheria has. And yet the recent history of the struggle with tuberculosis is fascinating.

So, too, whatever may be the eventual verdict of the profession as to the general value of the scopolamine-morphine treatment during parturition, it at least indicates a serious attempt to diminish the suffering incidental to labour. This

monograph is intended to show that the suffering is reduced and the risks vanish to a negligible quantity when reasonable care is used.

When the combination of scopolamine-morphine was first applied to obstetric work it was by no means new. Korff had already used it in surgery and Schneiderlein had experimented with it in mental diseases. Steinbüchel had observed this usage, and he was the first to conceive the idea of applying the drugs to midwifery practice. His caution was commendable, for he first, in 1902, considered fully the therapeutic action of scopolamine-morphine as far as it was then known. Before actually beginning his experiments he drew up a theoretical scheme as to what he considered the drugs ought to achieve and what dangers must be avoided in their use. He therefore laid it down as imperative that this combination of scopolamine-morphine—

1. Must appreciably reduce the pain of labour ;
2. Must not check uterine contractions ;
3. Must not interfere with general anæsthesia, if this be subsequently needed ;
4. Must be safe for the mother ;
5. Must not harm the child ;
6. Must not cause post-partum atony of the uterus.

He then began to use these drugs at Graz University, where he had his clinic, and the following

year, 1903, reported his first 20 cases. He took the precaution of using smaller doses than had been used in surgery, and made separate solutions of the two drugs which were sterilised by boiling; but he later combined the two, and had the solution put up in ampoules. The dosage he gave was morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{200}$. One or two doses were given as he deemed needful; but if a second dose were given he allowed two or more hours to elapse.

An analysis of Steinbüchel's 20 cases shows the following results: One was entirely unrelieved, in 3 partial relief was obtained; so that it would appear, from the patient's point of view, that 80 per cent. were successful. If this were the only consideration, such a result would have justified a widespread adoption of the use of scopolamine-morphine in parturition, but, as will be seen shortly, other points called for a careful and judicial weighing. In 12 of Steinbüchel's cases the uterine contractions remained normal; in 2 the intervals between the contractions were lessened; in 6 the intervals were longer, but the duration of each contraction was not adversely affected. There were 3 cases of atony of the uterus, but all these had also had chloroform, and Steinbüchel rightly hesitated to attribute the atony to the scopolamine-morphine alone. In the 20 cases, 7 of them proved to be forceps deliveries, 2 being for an after-

coming head. One child in a protracted forceps delivery was born asphyxiated. Shortly after, Steinbüchel reported a further 11 cases, and on reviewing the whole series of 31 cases, he considered the results satisfied his original dicta.

At the Jena clinic Wartapetian conducted 20 cases, some of whom had five injections, all following Steinbüchel's method as to dosage. Half the children were born in a dazed state, a condition Wartapetian rightly ascribed to the amount of morphine he had used. He affirmed there was little, if any, interruption to the normal course of labour, the suffering was greatly lessened, and it was safe for the mother. It seems to be a logical conclusion that he was at least somewhat uneasy about the condition of some of the children, but the repetition of the morphine amply accounts for this.

From the same clinic Raining reported 36 cases, in the earlier ones of which he began with a dose of morphine gr. $\frac{1}{9}$ and scopolamine gr. $\frac{1}{200}$. As this gave no adequate results, he doubled the dose of morphine. All the cases but 3 were relieved, and one child was born asphyxiated.

Weingarten at Giessen conducted 45 cases. He only gave one dose—morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{120}$. In 38 cases the pains were lessened and in 6 cases they were partially so. In 16 cases he states the pains were steadied, from which it

may be concluded they were somewhat tumultuous before the scopolamine-morphine was administered. Four of the children were asphyxiated, but in no cases were the drugs accredited with this. There was no case of post-partum hæmorrhage. Four of them were cases requiring forceps, and there was one case of version.

Ziffer next reported 31 cases, in a third of which he noted a "slight and unimportant delay." Among these cases 5 of the children were born asphyxiated. There was one maternal death, due to premature separation of the placenta. Ziffer's verdict was that the mothers were certainly relieved.

In 1904 Puschnig conducted 62 cases. He employed a dosage of morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{120}$, and this was seldom repeated. The effect of the drugs he divides as follows: Diminution of pain was extreme in 15 cases, *i.e.* in 24 per cent.; great in 42, *i.e.* 66 per cent.; slight in one case; absent in 4 cases. According to the present estimation of "success" it is difficult to gauge exactly what Ziffer meant, but by putting the total failures to obtain any effect at 8 per cent. we may gain some idea of its usefulness. Uterine contractions were unaffected in 36 cases. In 19 cases the contractions were weak before the injections were begun, and in 13 of these the contractions were improved. No mention is made of

the effect of the drugs on the remaining 7 cases. There were 8 still-births, and 6 of the infants were asphyxiated. So far from attributing these deaths and effects to the drugs, Ziffer spoke of the method as "a work of mercy."

In 1905 Laurendeau apparently selected a series of 15 cases where he meditated operative interference, forceps or version, before beginning, and gave morphine gr. $\frac{1}{5}$ and scopolamine gr. $\frac{1}{50}$, the dosage of scopolamine thus approximating closer to that used for surgical purposes.

Müller, in 1906, used morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{600}$ in a series of cases, obtaining analgesia and drowsiness, noting no complications, but a decided benefit to the uterine contractions.

This marks the close of the earlier history, and up to this time the sole aim had been the relief of pain—the success of the method was judged entirely by the proportion of cases where analgesia was complete or partial. It had indeed been noted by Steinbüchel that a few of his cases had little or no recollection of the process of labour, but he looked upon this as an accidental and incidental matter, and so failed to grasp what has proved to be the most valuable feature of the method.

At this time Gauss, with the consent and under the direction of Krönig at Freiburg, took up the

subject. He early realised how much depended on the purity of the drugs and the correct dosage of them. He was the first to realise the outstanding merit of amnesia and to devote less attention to analgesia. To the ideal condition he gave the name "Dämmerschlaf"—a condition of cerebral cloudiness from which the patient could be roused at any moment, this rousing, provided the stimulus used were not too powerful or abrupt, being afterwards completely forgotten. In 1906 appeared his paper "Geburten in Kunstlichen Dämmerschlaf." As numerous references will be made to the whole of Gauss's work only the full aims need be given in this historical sketch. Gauss specified:

I. With regard to the mother:
   1. It is necessary to obtain a considerable reduction of pain—a reduction perceptible to the patient.
   2. Disagreeable secondary effects should not occur, but, if unavoidably occurring, they should
      α. Not injure the patient;
      β. Not be out of proportion to the degree of alleviation obtained.
   3. Especially must there be no considerable disturbance of the subjective state of health of the mother (nausea, etc.).

4. The regular birth process must not be interfered with by unfavourably influencing
   - α. The muscular action,
   - β. The bearing down,
   - γ. The after pains,
   - δ. The functions of any organs during nursing and involution.

II. The child must not be injured
1. During intra-uterine life ;
2. During extra-uterine life ; *i.e.*
   - α. At the beginning of its new functions,
   - β. In the course of the first few weeks,
   - γ. In its later development.

On the publication of Gauss's first 500 cases there ensued a fierce controversy between Gauss and Krönig on the one hand and Bumm, with his assistants Hocheisen and Bardeleben, on the other. The results in 100 cases were published by Hocheisen, 40 of which he attended himself ; the remaining 60 were attended by Bardeleben. They took no note of the technique which Gauss had so painstakingly worked out, Hocheisen stating in a discussion that the drugs were given until the patient showed no more signs of pain. With such an admission it is obvious that, judged by the standard of Gauss, Hocheisen's cases do not carry the weight they might have done had the

investigation been strictly impartial. Indeed it is rather surprising the results were as good as they claim, and if these demonstrate one thing more than another it is that the method allows more latitude in its application than is generally conceded. Hocheisen's results are given as follows:

Absence of analgesia	18 per cent.
Partial analgesia	21 ,,
Complete analgesia	61 ,,
Prolonged labour	50 ,,
Hæmorrhage	5 ,,
Expression of placenta	4 ,,
Still-birth	1 ,,
Died after birth (infants)	3 ,,
Forceps cases	6 ,,
Extraction of fœtus	1 ,,

It will be observed there is no mention of amnesia, and it is scarcely surprising to find Hocheisen reporting 18 children as suffering from oligopnœa, 15 suffering from asphyxia.

It is enough to say here that the Berlin obstetricians were not in the least interested in a technique that Gauss claimed was so successful in his hands, and in their wide departures from it they are hardly entitled to affirm that "Dämmerschlaf" was a failure.

The obstetric world was certainly very much divided in opinion about this time, and the con-

trast between Hocheisen's view and that held by Müller shows the divergence clearly.

Cremer was apparently the first to use the drugs in private practice, and he definitely says they are harmless when used with care. He appears to have been somewhat more courageous than most of his predecessors, for he gave morphine gr. $\frac{1}{6}$ with scopolamine gr. $\frac{1}{200}$ repeated in an hour if necessary, and again in $2\frac{1}{2}$ hours. In his 134 cases, reported in 1908, he affirms that in no case did he observe any harm to mother or infant. He also suggested the possible value of the combination in eclampsia.

On the other hand, in the same year, Bertino describes its use in 400 cases. He obtained analgesia without any disturbance of the normal course of labour in 45 per cent. of his cases, while there was total failure in 36 per cent. His dosage was morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{120}$. After the injection he says the uterine contractions ceased and remained absent in about 70 of his cases for a time varying from 7 hours to a few days. The infants were often born apnœic or asphyxiated, so that he finally disapproved of the method.

At this time, too, many of the American obstetricians were busy in the new field. The notable feature of these numerous American experiments was the freedom of action they assumed. Gauss had laid down a certain broad technique and had emphatically declared that to transgress

this to any great extent was to court failure and even disaster. The method was acclaimed and enthusiastically used by the Americans partly because a number of patients went from the States to Freiburg and on returning gave glowing accounts, tinctured perhaps with the national trait of whole-heartedness. There was, consequently, an eager race to be early in the field, and the majority of the obstetricians approached the subject from the standpoint of original investigators. They virtually began where Steinbüchel did; their failures were numerous; so within a short time the treatment was as vigorously denounced as it had been enthusiastically taken up. During the last three years the subject has been more soberly pursued in the States, and a juster estimate of its value is being obtained.

Meanwhile, in Britain the few who were interested had gone much more quietly to work, and the little that is recorded in the literature here has the appearance of being of more permanent value. At the same time, the earlier workers here did not by any means scrupulously follow the Freiburg technique.

As far as I have been able to discover, the whole of the literature in this country, mainly in the form of short papers, is to be found under the names of Buist, Berkeley, Sir J. H. Croom, Corbett, Cotterill and Thompson, Fairbairn, Giuseppi, Hedley, Innes, Johnstone, Kapp, Lawrence, Leed-

ham, Constance Long, M'Call, Swift and Haultain, Solomons and Freeland, and a short notice by the writer. The various views and results contained in these contributions will be mentioned later, but it may be noted they date from 1908 to the present date (Sept. 1917). On the whole, the keynote of the British investigations has been caution, and perhaps, in view of the undoubted impurity of scopolamine in the earlier days, the uncertainty of the dosage on this account, and therefore the risks attendant upon these two factors, this attitude has been the wisest. At the same time this caution has not infrequently prevented the attainment of the best results, as will be pointed out under the headings of technique and dosage.

Some difficulty was experienced at first in obtaining reliable preparations. Solutions were prepared separately, and these solutions were used from as they were needed. Then the scopolamine and morphine were combined in one solution, but the combination was found to suffer rapid disintegration. The addition of carbolic acid made no difference to the disintegration. It was then discovered by Straub that the solutions were stable if made in a 10 per cent. alcoholic solution of mannite, and this method, together with the preparation of tablets of scopolamine-morphine and of scopolamine alone, gives a choice of perfectly reliable preparations.

CHAPTER II

Chemistry and Action

THERE is scarcely any need to discuss the chemistry and action of morphine alone.

Scopolamine (or, as it is usually called in this country, hyoscine) is an alkaloid obtained from a number of plants such as *Hyoscyamus niger*, *Hyoscyamus albus* (Nat. Ord. Solanaceæ) and *Scopolia carnioca*. The alkaloid itself is but sparingly soluble in water. Its formula is said to be $C_{17}H_{21}NO_4$. The hydrobromide is found to be the most suitable salt, and is the one invariably used for narcotic purposes. This salt is freely soluble in water and in alcohol, only slightly so in chloroform, and is insoluble in ether. From its solution it crystallises in colourless transparent rhomboids. A solution of scopolamine hydrobromide is acid to litmus, and to the taste is bitter and acrid.

It is to be observed that scopolamine belongs to the same class as belladonna (and therefore atropine) and stramonium. Like these, in poisonous doses, it is an active deliriant. It has been

stated that atropine does not exist as such in the belladonna plant, but is a conversion product from hyoscyamine during the process of extraction. This tends to show how closely belladonna (atropine), stramonium (daturine) and hyoscine are related chemically. It may be incidentally mentioned here that in cases of hyoscine poisoning (*e.g.* children who have eaten parts of henbane plants), in the absence of pilocarpine, the administration of morphine is regarded as the best medicinal treatment. The significance of this fact will be reverted to later.

Scopolamine furnishes an interesting example of stereo-isomerism. According to this theory an organic body may exist in two forms; the atoms and radicles of these forms are the same, but their disposition about the nucleus is such that one form is the exact mirrored image of the other. It follows that at least one carbon atom must be combined with four *different* atoms or radicles before the body can exhibit stereo-isomeric characters. The one form in solution rotates the plane of polarisation of polarised light to the right, and is called the dextro-rotatory form (d- or +), the other rotates it to the left, and is the lævo-rotatory form (l- or −). Wherever the substance under consideration can be crystallised from its solution the crystals of the d- and l- forms are found to be identical, except that the one is a mirrored image of the

other. Such crystals are said to be enantiomorphous.

This is strictly the case with scopolamine hydrobromide, and the uncertainty of action in the earlier experiments in surgery and obstetrics was probably due partly to definite impurities and partly to the fact that the d- and l- forms were mixed. For it has since been found that the lævo-rotatory scopolamine hydrobromide is physiologically the more active. It is not necessary to pursue the subject of stereo-isomerism any further than to mention that the more complex organic bodies may even show four forms, viz. dextro-, lævo-, meso- and racemic.

That a similarity or even apparent identity of chemical composition and physical properties does not necessarily connote the same physiological action is proved by many concrete examples. Not to transgress the scope of this monograph, a striking instance is found in the similarity of atropine, stramonium and hyoscine (already touched upon) —all are derived from plants of the Nat. Ord. Solanaceæ. In quite a number of cases the usual dose of hyoscine has been supplemented by an adequate dose of atropine during parturition, as recorded, for instance, by Giuseppi in the *Practitioner* for July 1911. Reasoning from the similarity in composition of the two drugs it might almost have been expected that the atropine would

have had some effect towards accentuating the action of the hyoscine—in other words, to have been somewhat equivalent to increasing the dose of hyoscine. On the contrary, however, no difference whatever has been noted by any observer. Those who have tried the combination scopolamine-morphine-atropine have all come to the same conclusion, and in recording their observations they all add that the atropine was discontinued in the later cases of the series. There is, therefore, no reason, *a priori*, why the dextro-rotatory scopolamine should be absolutely identical with the lævo-rotatory form in physiological action; and hence we may be quite prepared to find the lævo-rotatory form is the more active.

A better appreciation of the action of scopolamine during parturition will be gained by a brief review of the general therapeutic action of the drug. It is a powerful cerebral sedative, achieving this by distinctly depressing the higher functions of the brain. It is usually stated to have but a comparatively feeble cardiac action, but in contradiction to this statement I have noted that in a great majority of the cases who are in an ideal condition of amnesia during parturition the cardiac action is somewhat slowed and improved. In some cases the slowing of the pulse-rate is marked. It may easily be conceived that the slower pulse is possibly due to the lessened apperception of pain,

but the improvement in its character can scarcely be attributed to the same cause. The explanation is rather to be found in the next accepted statement, namely, that hyoscine increases the peristaltic contractions of the intestine and at the same time relieves griping. The significance of this fact will be seen when it is remembered that uterine muscle is of the same histological character as intestinal—*i.e.* involuntary; and probably, in this instance, the remark applies equally to cardiac muscle. At all events the circulatory improvement is exactly what one would expect to follow the administration of a cardiac stimulant.

With respect to the effect of scopolamine on the uterine muscle many diverse opinions have been expressed. If hyoscine is admittedly a cerebral sedative it does not follow it is in the least inhibitive of uterine activity. To decide the question to my own satisfaction I have made a very large number of bedside observations with the object of determining whether, during the "pains," there was any diminution in the intensity of the uterine contractions. Where the semi-narcotic condition is well established and the state of amnesia ideal, though there is not nearly the response apparent on the part of the patient to the recurring labour pains, yet the uterus contracts quite as forcibly as in labour without this semi-narcosis. The statement, therefore, that scopolamine increases

peristaltic contractions of the intestine needs the wider inclusion, "peristaltic contractions of involuntary muscle." These observations do not, of course, apply to obstetric overdosage.

As many more features of the action of scopolamine-morphine will be discussed more fully under the chapter on effects on the parturient woman, reference need only be made here to one other point. There are not a few indications that the combination acts, at least in some respects, as a new drug and not as two separate entities with their parallels and antagonisms.

CHAPTER III

Objects of this Treatment

THE justification of any more or less routine treatment during a part or the whole of labour must rest upon a real necessity for it. If the experience of our obstetricians and general practitioners were that labour is a trivial process in the great majority of cases, and that women almost universally faced the prospect of regularly recurring parturition with at least an undisturbed equanimity, there would be very little need to enter upon any discussion of a method the avowed object of which is to relieve the suffering incidental to the process. A great deal has been said of late, both in our own journals and in the lay press, about labour being a normal physiological process. That it is a physiological one cannot be gainsaid, but our whole opinion must be based upon the interpretation of "normal."

Concrete examples will be of some help in allowing us to frame this opinion. Leaving out of consideration the human, the humane and the individual factors, and confining the inquiry for the moment

to practice among the educated and cultured classes, in what proportion of labours has chloroform (or any other general anæsthetic) hitherto been a true obstetric necessity? On the other hand, in what percentage of cases in such a practice is chloroform actually used? Every one with the least experience must admit that the discrepancy is very wide. Indeed, so universal has become the resort to an anæsthetic that the proverbial "whiff of chloroform" has become a household phrase. Every class of the community will ask for, and even stipulate, its use. And no matter what anæsthetic is used in labour, the physiological process so interfered with can scarcely be called normal.

As in so many other things, it is not easy to draw a sharp line and say this cuts off the normal from the abnormal. It is not outside the bounds of possibility that a multipara may complete the whole of her labour within an hour; it is equally possible for a primipara of, say, 35 years or more to spend an agonising 48 hours and even longer. Since taking an interest in this work I have made more specific inquiries and have been astonished at the number of former labours in multiparæ that have been completed with the help of forceps but without any anæsthetic at all. It would be unjust to criticise any accoucheur on the bare statement of a disappointed patient, but assuming

it was unwise for some specific reason to use any of the usual anæsthetics, it only emphasises the confession that there is room for a more ideal means of reducing or abolishing the suffering during labour.

Every obstetrician is only too familiar with the type of woman consulting him in whom there are neither signs nor real symptoms which can be referred to any definite disease. Their complaints are based on some supposed mischief connected with the generative organs and date from some previous labour. The origin of it can usually be traced to what the patient calls a previous "bad time," coupled with the fear of its recurrence. This is essentially a field in which one must draw on strictly personal experiences. It may be illustrated by an analogous case. A patient recently under my care had four married sisters, all of whom have had children. In every case the sisters were in bed over a month—in one case the time drew out to 7½ weeks. The patient, therefore, had come to the conclusion, logical enough to her, that her family was fated to experience "bad times." Hence her anxiety to have scopolamine-morphine administered. She is quite oblivious of the whole of her labour, and travelled home within three weeks of her infant being born. If it is claimed her fears had a neurasthenic basis, the least one can say is that the scopolamine-morphine treatment

has cured this. There is, however, a much more positive physiological reason to be dealt with later.

Until recently the anæsthetic which almost universally held the field in midwifery practice was chloroform, as is well known. Fortunately, owing mainly to the concomitant cardiac hypertrophy, parturient women tolerate it well even in the presence of grave disease. It has the disadvantage that in an overwhelming majority of cases the time during which it can be used in a long labour is very limited. The relaxation which it causes in involuntary muscle, certainly increasing the risk of post-partum hæmorrhage, is a further objection. Ether has the additional disadvantages of being more nauseous and producing a definite dilatation of vessels. The numerous other anæsthetics and analgesics are much more limited in their scope and suitability and need not be seriously discussed.

At the present moment, therefore, the choice of an anæsthetic in midwifery lies between chloroform and scopolamine-morphine. It may not be strictly accurate to speak of the latter as an anæsthetic, but it is convenient to do so when discussing the relative claims of the two. These may be set out in tabular form.

CHLOROFORM.	SCOPOLAMINE-MORPHINE.
1. The total time it may usefully be employed is limited.	1. It may be used during the whole process of labour.
2. If it is given in effective doses it produces atony of voluntary and involuntary muscular fibres.	2. Used in obstetric doses it does not produce atony in either voluntary or involuntary muscle.
3. Especially in the later stages (the very time when it is most generally used) this atony predisposes to post-partum hæmorrhage.	3. Atony being absent, there is no increased tendency to post-partum hæmorrhage.
4. Pain ceases, the "pains" cease.	4. Pain ceases or is greatly diminished, the "pains" do not cease.

A fuller discussion of the subjects of analgesia and amnesia will be entered upon later, but it cannot be too strongly emphasised that to aim at analgesia is most certainly a wrong procedure, and as long as this is persisted in the results will be far from ideal. Moreover, it at once introduces the element of danger, an element which is entirely absent if only amnesia is attained.

In spite of the little importance apparently attached to the subject by the recent National Birth-Rate Commission which inquired into the causes of the declining birth-rate, it is to be apprehended that the fear of the actual process of labour is a very powerful factor. The accumulated evidence that I have on this subject of "fear" is astonishing, and we cannot alter the fact by roughly brushing it aside in an unsympathetic

indifference. The question for the profession to face honestly is whether the scopolamine-morphine method of conducting labours has sufficient claim, with a reasonable absence of danger, to warrant its adoption to the extent of removing this fear. While the social and economic causes of a falling birth-rate cannot be laid at the door of the profession, it will at least be some satisfaction to know we have done our part in attacking a cause that does concern medical science. Reverting to the report of the National Birth-Rate Commission, the only important reference to the question of the fear of childbirth occurs on page 78, para. 8: "The fear of the pain of childbearing is admitted as one of the reasons why some women refuse motherhood. They may be assured that medical knowledge and skill can so relieve travail that it can be made at least bearable. More natural conditions of living would make this natural function less painful and perilous than it sometimes is to women living under the artificial modern conditions." In a report occupying 450 pages this seems a very inadequate attempt at dealing with one of the important causes of a declining birth-rate. The use of chloroform has been known and appreciated for many years among every class of society, yet it has done little to dispel this "fear." The explanation is to be found in the limited practicability of the employment of chloro-

form, and it is looked upon as being only for special or exceptional or operative cases. One of the objects of the scopolamine-morphine treatment, if its claims can be substantiated, is to remove this obstacle ; and my own experience has shown how effectively it has already begun to achieve this.

There are several other points that might logically be mentioned here, but they will be more conveniently discussed in the chapter on the " Effects on the Mother "

CHAPTER IV

The Technique

So much depends on the way in which scopolamine-morphine is administered that the examination of this important subject must be made somewhat exhaustively. So many different methods have been used, so many modifications adopted, that it is small wonder the reports as to the success or failure of the method should be so varied. The first tentative experiments, when observers were very rightly cautiously groping their way towards a theoretical goal, may be dismissed with the observation that they are interesting in a historical sense. (See Chapter I.)

Leaving these earliest investigators and confining our attention to the later ones, we may broadly define three groups. And as the technique used by them differs so radically it is as well to have one's ideas of the three thoroughly crystallised. The three groups are—

I. The " one-dose " school.
II. The " standardised-dosage " school.
III. The " individualisation " school.

It must be admitted that, after the earliest days, the "one-dose" school is represented largely by British obstetricians. Weingarten and Puschnig were among the earlier ones to adopt this procedure on the Continent. Innes, M'Call and some others are the chief exponents of this practice in Britain during recent years. M'Call states she has "given mostly only single doses, and I do not feel inclined to increase the amount." As no reason is given for this limitation as to dose, her objection to its repetition cannot be discussed, but it will become abundantly clear later that rationally repeated doses have no dangers for either mother or infant. She adds, in the same paper, "it often seems to lengthen out the labour, which is a grave disadvantage." By referring to a later chapter and to the accompanying specimens of charts, it will be seen how unjust a statement this is, especially if we note primiparæ, say, of 30 years of age and over.

As Innes has recorded his experience of the "one-dose" modification at some length he may be taken as typically representing the school. To the first few cases he gave atropine gr. $\frac{1}{150}$ in addition to the morphine gr. $\frac{1}{4}$ and hyoscine hydrobromide gr. $\frac{1}{100}$, but soon discontinued the atropine, remarking that without it "the results are, if anything, superior to those derived from the

former combination." Of his first case he says: "An injection was given to a very neurotic patient whose agonising cries while still in the first stage of labour were terrible. The action was very wonderful, the patient falling into a restless sleep, only to wake up when the pains came on with a perfect regularity, the os dilated well, and then the state of anæsthesia seemed to pass off; labour was terminated with the use of forceps, and a healthy child was delivered." The criticisms to be passed on this case are: It is not stated whether the case was a primipara or a multipara; at what exact stage the injection was given; how long the effects of the drugs lasted, and therefore at what stage intervention was decided upon; whether the use of forceps was due to the renewed agonising cries or some other indication; and it is not specifically stated whether chloroform was administered or not. Viewed in this light, one can only say the single injection is merely a minor palliative covering in many cases only a small fraction of the time occupied by the whole labour. Innes continues: "At first I repeated, in about three hours after the initial dose, the same amount of the drugs in those cases where one had not procured the usual result, but no effect was derived so far as relieving the patients' pain was concerned . . . the second dose is absolutely useless, and therefore not to be given." His conclusion

is in almost exactly the same words. But if only the one dose must be rigidly adhered to in every case, of what real use is it in a prolonged primiparous labour? It may be urged that in such a case an occasional light chloroform anæsthesia would secure some mitigation of the suffering if it were severe. But there are not a few objections to this procedure. The undoubted prolongation of an already protracted case, if chloroform is used, is a grave one, for in these cases the best practice appears to me to be that if chloroform is necessary in addition to a semi-narcosis which is passing off it is an indication, in many of them, for operative interference. Then, too, many of the cases on which my conclusion is based have been 30, 36, 48 or even more hours. If any marked effect is produced by the single dose and this dose has been given early, say when the os uteri is about the size of a florin, this effect has passed off in three or four hours and we are faced with a further 26 to 44 hours during which a light chloroform anæsthesia has to be maintained either constantly or more or less intermittently. Moreover, if the one dose only be used and no chloroform afterwards, by much the most severe suffering of the labour has still to be met, and it seems irrational to relieve the earlier stages, which are not so acute, and do nothing during the severer ones. I am, of course, assuming that any obstetrician

who has given one dose of scopolamine-morphine has at least signified by this one dose his willingness to relieve the pains of travail. The aims of scopolamine-morphine are totally different from this hybrid of semi-narcosis and chloroform anæsthesia, and it is impossible, as a routine practice, to secure them on the "one-dose" theory.

The "standardised-dosage" modification (Group II.) is an attempt to reduce the scopolamine-morphine treatment to a rigid routine which an experienced nurse could equally well carry out, and so dispense with the continuous presence of the accoucheur; at all events, this has been given as an avowed intention. If this could be adopted with equal success in all cases it would certainly relieve the obstetrician of much tedious attention. Siegel has tried this method at Freiburg and reported on 220 cases. Instead of the ordinary morphine he substituted narcophine, a meconic acid compound of morphine and narcotine, because it is considered less poisonous than morphine. Most observers who have seen it used state it is less potent than morphine. A solution of it deteriorates rapidly and needs the addition of some preservative. In Siegel's cases a time-table was drawn up, based largely on average times from Gauss's cases, and successive doses were given irrespective of anything else: the memory test

was dispensed with. The table here given is Siegel's procedure.

First injection		.	Scopolamine gr.		$\frac{1}{130}$; narcophine gr.	$\frac{1}{2}$		
$\frac{3}{4}$ hour	after first	.	,,	,,	$\frac{1}{130}$			
$1\frac{1}{2}$	,,	.	,,	,,	$\frac{1}{100}$	,,	,,	$\frac{1}{4}$
3	,,	.	,,	,,	$\frac{1}{100}$			
$4\frac{1}{2}$	,,	.	,,	,,	$\frac{1}{100}$			
6	,,	.	,,	,,	$\frac{1}{100}$	,,	,,	$\frac{1}{4}$
$7\frac{1}{2}$	,,	.	,,	,,	$\frac{1}{100}$			
9	,,	.	,,	,,	$\frac{1}{100}$			
$10\frac{1}{2}$	,,	.	,,	,,	$\frac{1}{100}$	,,	,,	$\frac{1}{4}$

and so on.

Hedley has recently stated he uses morphine hydrochloride gr. $\frac{1}{4}$ and hyoscine hydrobromide gr. $\frac{1}{150}$ for the first injection, and repeats the hyoscine gr. $\frac{1}{450}$ every hour subsequently until the termination of labour. This " has no obviously bad effects on the mother or the child." He further remarks: " All the patients to whom I have given this treatment have been primigravidæ. In the majority of cases the amount of suffering is decidedly decreased, and in many there is only a hazy, if any, recollection of the process of labour." No statistics are given, and it is clear the memory test was not systematically used. Indeed, having once decided to repeat a certain dose in a certain fixed time, any testing of the patient is superfluous, for the testing of a patient presupposes we are attempting to decide as to the mental condition of the patient for the express purpose of determining the amount of and the

time for the next dose, and if we have already arranged a time-table to which we rigidly adhere the testing will not induce us to abandon the time-table.

Haultain and Swift have recently given a fairly full account of the method of fixed dosage as carried out by them in a series of 40 cases, 36 of whom were primiparæ. In 36 of the cases the initial injection was hyoscine gr. $\frac{1}{150}$ and morphine gr. $\frac{1}{4}$. In 3 cases the initial dose was hyoscine gr. $\frac{1}{150}$ and morphine gr. $\frac{1}{6}$. The remaining case was begun without any morphine, followed by two doses of hyoscine gr. $\frac{1}{150}$, but as these three doses appeared to have no effect, morphine gr. $\frac{1}{4}$ was then given and the case became one of normal character. In all their cases they repeated the hyoscine gr. $\frac{1}{150}$ at intervals of an hour, their dosage thus being identical with Hedley's, and closely approximating to Siegel's scopolamine dosage, but differing from it in not repeating the morphine or one of its derivatives.

A glance at Haultain's and Swift's results will be instructive. They state that in 30 cases (75 per cent.) they obtained amnesia and analgesia; in 18 per cent. slight amnesia; in 12 per cent. no amnesia. Post-partum hæmorrhage occurred in one case, but it was easily checked. There were 14 cases (35 per cent.) of forceps. Of the 40 infants 5 were still-born, an infant mortality

of 12½ per cent., but a review of the cases shows they were probably to some extent the victims of an unavoidable perverse fortune. The still-births were as follows:

1. A case of contracted pelvis with a prolapsed cord. The infant was turned and extracted with difficulty.
2. A badly nourished premature fœtus. The mother had a bad heart lesion.
3. A case of craniotomy for contracted pelvis.
4. A premature seven months' fœtus.
5. An apparently normal labour where the mother had eleven injections in all.

Four of the children born living required artificial stimulation. They deprecate beginning the treatment late in labour, as they believed this had a tendency to produce oligopnœa. While the average number of injections in their 40 cases was eleven, they had one case in which the total number was forty-five. Including the initial dose this patient would therefore receive a total amount of slightly more than $\frac{1}{10}$ gr. of hyoscine. These joint authors contend that hyoscine, in the obstetric doses under consideration, has no effect on the child. They are not afraid to allow a reliable nurse, under supervision, to undertake the injections. According to their observations the uterine contractions are not diminished, and there are no contra-indications to the treatment beyond the marked rest-

lessness they occasionally noted. The conclusions they came to are :

1. Give the first dose to primiparæ when the os externum will admit two fingers. Begin as early as possible in the case of multiparæ.
2. Give the second and subsequent doses of hyoscine gr. $\frac{1}{150}$ every hour.
3. This is quite a safe procedure.
4. Don't repeat the morphine late in labour. If anything beyond the hyoscine is needed give a whiff of chloroform.
5. Keep the friends away ; darken the room and insist on quiet being maintained.
6. If the patient is thirsty give plenty of water.
7. Catheterise patients in long cases.
8. Remove the child as soon as it is born.

This particular report has been dealt with rather fully because it is one of the most recent contributions on a modified technique and because it strongly advocates standardisation of doses. But the defects of this modification will become patent to all who earnestly consider the subject, as will be seen in a moment.

Group III. includes all those observers who modify their doses more or less in accordance with their deductions from constantly repeated and frequent testing of the patient. This must at once be adjudged by far the most rational, because,

excluding those variations which are wide enough to be fairly grouped under the term idiosyncrasy, there is still a very diverse response to the drugs in different women. And since there are no means of detecting this diversity of response before the actual administration is begun, the only scientific solution of the difficulty in our present state of knowledge is the strictest individualisation. What Gauss said in criticism of the Siegel method is still perfectly true: "If you could trust to having an average woman you could use an average dose, but the dose is easier to regulate than the woman." There is no department of medical work where the individuality of the doctor can display itself better, and the amount of success gained in this method is a fair guide to the accoucheur's capacity to gauge the mentality of his patient.

Gauss and Krönig were the first to appreciate the value of such individual study of all cases, and this, together with their efforts towards purification of the drugs, contributed largely to the great advance in successful results. Since their published reports have appeared, many impartial investigators in Britain and in America have more or less accurately followed their initiative and proved the soundness of their conclusions.

In this class, and among the earlier contributors in this country, is Giuseppi, who reported a series

of 37 cases in 1911. In 16 of these he used a combination of hyoscine, atropine and morphine; in the remaining cases the atropine was discarded and the remark appended: "As far as can be determined, the atropine sulphate had no special effect, and in the later cases was entirely discontinued." The time when the first injection was given is always stated in terms of the dilatation of the os uteri, and it cannot be gathered from his paper how long any patient was under the influence of the drugs, *i.e.* the length of time between the first dose and the completion of the third stage. He remarks: "The time at which the first injection should be given is difficult to determine, and no general rules can be given. Each case must be studied separately. . . . In our series the amount of pain complained of was the chief criterion." And he further says: "To wait to give the first dose until the second stage has commenced is to allow the patient to suffer pain which could easily be alleviated if the first dose were administered earlier." In 16 of Giuseppi's cases the patient had a second injection which in every case consisted of hyoscine alone. No case had a third dose. Thus 21 cases had but a single dose. The statement is made that "the second dose was administered when the effects of the first began to wear off, and the patients, waking up, began once more to complain of pain." Although the amnesic

condition is several times referred to in the paper, and it is further said that amnesia rather than analgesia is to be sought, there is nowhere any reference to a systematic means of determining whether or not amnesia has been attained. The general assertion is several times made that the patient had no recollection of the later stages of labour. Consequently one gets an impression that the repetition of hyoscine was determined in a more or less haphazard fashion. Thus in case 3 of Giuseppi's series, labour, up to the end of the second stage, lasted 56 hours 20 minutes. The initial dose was given when the os uteri was three-quarters dilated. The hyoscine was repeated and the note made—os fully dilated 2 hours later. Since the second stage in this case lasted 2 hours 20 minutes, it is clear labour had been in progress 52 hours when the second dose was administered, but at what relative time the first dose was given cannot be gathered. The same criticism applies to all the cases in his series. The conclusion reached by Giuseppi as to dosage was: "Morphine should never be repeated, but only hyoscine. The best dose is hyoscine hydrobromide gr. $\frac{1}{100}$, morphine sulphate gr. $\frac{1}{4}$."

Johnstone contributed an article last April which deals with the dosage, as it appeals to him, very clearly. His report is based on 70 cases of his own, but he states that through the courtesy

of Sir J. Halliday Croom he has seen over 200 cases. His experience leads him to begin with morphine gr. $\frac{1}{6}$ and hyoscine hydrobromide gr. $\frac{1}{100}$; in primiparæ "as soon as the pains are coming regularly and strongly at intervals of about 7 to 10 minutes, and the external os has definitely begun to open. In multiparæ, the same initial dose is given as soon as the pains are coming regularly and strongly, provided the labour may be expected to last at least four hours." After this he follows no routine, but gives hyoscine gr. $\frac{1}{100}$ to gr. $\frac{1}{200}$ according to circumstances. In a few of the cases he left the repetition doses to the nurse at stated intervals, and remarks: "I do not think I have had quite such good results when I have left a case to routine injections by the nurse."

The initial dose most frequently used by Gauss was morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{100}$. In what proportion of cases this was deviated from is not given in his general publications and cannot therefore be stated, since no access can be had at the present time to any individual records. This initial dose was followed by scopolamine alone in amounts varying between gr. $\frac{1}{400}$ and gr. $\frac{1}{100}$, the time and quantity of its repetition being determined after the most rigorous testing of the amnesic condition.

My own experience, as to the initial dose, is that in this country the quantities not infrequently

need to be morphine gr. $\frac{1}{4}$ and scopolamine gr. $\frac{1}{100}$. Some of the cases can be relied upon to respond sufficiently to morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{150}$, but the larger dose is not fraught with any risk. I have observed that a rough estimate may be formed from the body-weight, women of a smaller general build responding quite well to the smaller initial dose; while of course the following dosage is based upon direct observation. I would venture another remark, too: the smaller dose usually found sufficient by Gauss is probably connected with the generally more phlegmatic temperament of the German woman, while in this country one has oftener to deal with a more vivacious type. A large number of the cases I have had belong to the educated classes, and their mental susceptibility has been shown in a variety of ways. Such women, for example, often exhibit a marked nervous anxiety lest they should not receive the initial injection early enough. For this reason I believe the larger dose will be found more generally necessary in this country among the better-class patients. And further, this is essentially the class among which some degree of restlessness is apt to occur, and the slightly larger dose of morphine is certainly more effective in controlling or preventing this condition. For reasons given later I have also now come to the conclusion that if there is any reason to anticipate

a fairly rapid course of labour, the smaller dose is preferable, reliance being placed on a rather more frequent repetition of the hyoscine, the succeeding doses of hyoscine alone being somewhat smaller too. For such cases I have now had made tablets with the combined dosage, morphine gr. $\frac{1}{6}$ and hyoscine gr. $\frac{1}{100}$.

A glance at the accompanying specimen charts will show that after the initial injection the hyoscine alone has been given in the most varying quantities, ranging from one dose of gr. $\frac{1}{100}$ or less, according to the needs of the case, to as many as seventeen. There is not any reason *a priori* why this number should not be exceeded, if necessary. It will be observed that the greatest diversity exists in my records both as to the intervals between successive doses and the amounts used on the various occasions for different patients. No stronger argument for the individualisation of this work could be adduced than a careful examination of the charts, because the need for every repetition dose was determined solely after gauging accurately the amnesic condition of the patient. The smallest single dose used, it will be seen, was gr. $\frac{1}{150}$ of scopolamine, the largest gr. $\frac{1}{100}$, but I am of opinion that gr. $\frac{1}{150}$ is too small in the vast majority of cases. In the time element the intervals have varied from half an hour in a few cases to 4 hours in a few other cases. The great majority will be found to

be ranged somewhere in the region of 2 hours—say from 1½ to 2½ hours. While the dosage as I have used it was frankly based on that of Gauss—simply because by rationally judging each case he had attained the largest measure of success—yet, especially during the last eighteen months, the utmost freedom of judgment has been reserved, showing that, so long as the root principle is observed, there is no need for slavishness.

As regards the other points in the technique, the one of most capital importance is without a doubt the rigid institution of the memory test. Once the importance of this is grasped and the simplicity of it realised, there can be no apology for not using it. For, in spite of what has been said to the contrary by some observers, the determination of the presence and depth of amnesia is only possible by specific interrogation. A description of the testing as I habitually conduct it will serve best to illustrate the method. As a rule amnesia can scarcely be expected to be complete until shortly after the second injection; so that it is generally only necessary to begin the testing after this second dose. In the few cases where the drowsiness has begun quite early and the sleep between the uterine contractions is complete and as deep as normal sleep, the first test may be made earlier. For at least the first few tests it is better to choose some object that is directly connected with

the infant—*e.g.* some article contained in the infant's basket; the mother is already familiar with these, and as the sight of one of them is likely to impress itself more strongly on the patient's memory than a strange object would, we increase the chances of the mother remembering it. Thus we tend to give the patient the benefit of the doubt, so to speak. Say we choose the infant's hair-brush, then some fifteen minutes or so after the second injection the mother is roused, if asleep, the hair-brush shown to her, and she is asked what it is. It is necessary to be sure she thoroughly visualises it and distinctly recognises it, since in some of the cases dilatation of the pupil due to the scopolamine may set in early and interfere with accurate visualisation. Half an hour later the patient is asked, "What did I show you a little while ago?" Some will unhesitatingly reply, "A hair-brush." Others will appear as though mentally groping, and after an obvious effort will hesitatingly say, "A hair-brush." Others make some answer which clearly shows all recollection of the incident of half an hour ago is obliterated. Replies such as these are common: "I don't know"; "Did you show me something?" "When shall I be asleep?" For it is a curious feature that some of the patients not only forget the pains that have been occurring, but may also forget they have been asleep. We

therefore gain the information that the patient is still almost unaffected, or the memory is now quite clouded and the patient on the verge of amnesia, or the amnesia is now complete. And this information is quite positive and reliable.

I may here mention two cases which at first seemed to be unsatisfactory. In such case and in almost every test the patient correctly, though hesitatingly, remembered the *last* object shown to her; and it therefore appeared as though the final note on each case would be one of failure. But after the usual sleep following the completion of labour, to my surprise, neither patient could recollect a single incident after the second injection. Probably, if we had only some more delicate test for amnesia to apply, it would be found that in a majority of the cases this would be the most ideal condition at which to aim, a condition in which the amnesia is very light. On the other hand, of the three total failures I have to record, one appeared to be in a satisfactory state of amnesia (judged by the memory test), yet on awaking afterwards she protested she knew all about the labour. This was the second child she had borne, I was called later than an experienced nurse would have sent for me (a midwife was attending the case), and the pains were both severe and tumultuous when I arrived. At the same time it is possible that the recollection was almost

entirely the earlier stages, the severity of which had undoubtedly impressed themselves very deeply on the memory. It was one of my earlier cases, and I was not then sufficiently alive to the need for a careful interrogation afterwards to determine the point. Since then I have had a case somewhat similar, but on investigating afterwards there was no doubt whatever that the recollections were of the pains and incidents prior to the second injection. However, not to put a biased construction upon it, the case stands in my records as a failure. By drawing attention to it others may be put on their guard. For it is as important to be quite sure about the success of a case as the failure.

It is not uncommon to find, after several injections have been given, that the patients, when asked what object was shown them a little while ago, realise that some answer is expected and give a perfectly irrelevant reply, such as, "a church." Probably the amnesia is a little deeper than is necessary in such cases. After the first few tests it is often possible to vary them and not keep to such a rigid sameness as to show an object. Modifications are readily devised, such as the question, "How many injections have you had?" The reply may be, "Two." If the patient has had four the amnesia is thus known to be established. Or it may be asked, "How many pains have you

had the last hour ? " The answer may be, " Half a dozen," whereas three or four times that number may be much more accurate. A vaginal or an abdominal examination may be made the subject of a question, and other things will suggest themselves. The only care is to be sure the question, whatever it is, is appreciated ; if the amnesia is ideal and not too deep there need be little fear about this. Sometimes the patient will gratuitously give proof of the amnesia. A case in point is where one of my patients had already engaged her nurse and preferred to bring her, although she was not familiar with the technique. As the patient was a multipara, and the labour therefore was not likely to be as long as a primiparous one, I was careful to explain, in the patient's presence, that I must be acquainted with the outset of labour as early as possible. During the labour I had on one occasion just tested the patient, and turned to record the results of the test, when the patient looked at her nurse and said, " Do send for the doctor, he'll be so cross." Yet it could not have been a full minute since I was talking quietly to her.

I may here conveniently observe that patients can be roused quite easily, and they will carry on a perfectly rational conversation. If care be taken to do this very quietly, so that the stimulus is not too powerful, the whole incident is forgotten in a few moments.

The next point in the technique is the shielding of the patient, especially in the earlier stages, from powerful sensory impressions of all kinds. A bright light or a loud noise may so rouse the patient that the amnesic condition may not be re-established for some time, during which period a few pains may occur. The particular stimulus, together with the pains, will be vividly remembered, and if this should unfortunately occur several times, the patient will have quite a number of these recollections afterwards. The periods between will be totally obliterated and bridged over, so to speak, so that the really isolated recollections appeal to the patient as a connected whole, and she will probably assert she knows the whole course of the labour. These are the " memory islands " of Gauss. I had a case which forcibly brought this subject home to me in November 1915. The autumn had been marked by a succession of brilliant sunsets, and the patient referred to was in a room the window of which looked westwards. Perhaps not fully realising the importance of the least details I had neglected to have the curtains drawn, and at the moment of greatest colour intensity the patient happened to wake for a moment and remarked, " It's the most beautiful sunset I ever saw," then lapsed into sleep at once. Fortunately the waking was only momentary, and no uterine contraction occurred

just then, and no pain was afterwards remembered, but the vivid colouring remained as the one recollection of the patient's labour.

As all my cases have been conducted in an ideally quiet country district, I have never found it necessary to plug the ears of patients, though I can well appreciate that in a busy city or in hospital wards where many cases are together this may be wise or even essential. In an institution of this sort it may also be necessary to protect the eyes from any possible glare of a bright light. In the former case a tampon of oiled wool serves the purpose, while for the latter smoked or tinted goggles have been recommended and used. These latter seem to be an unsatisfactory and cumbersome way of dealing with a patient who is lying asleep for the most part. In a nursing home or indeed in private houses it is easy enough to dispense with gas or electric light, either of which is almost invariably above the level of the bed, and therefore the glare of it easily finds its way to the patient's face. A light arranged on a table on the side of the bed away from the patient's head is low enough to keep the face in constant shadow, and thus the shielding of the patient from any glare is conveniently achieved. I can well imagine a patient cumbered with goggles, when the drugs are beginning to take effect, would become so irritated with the bridling imposed by

them, that this would even provide stimulus enough to interfere with the amnesia. For it must be remembered we are not seeking a full anæsthesia, but only a very equivocal border-line condition with which a trifling sensory impression may interfere. Gauss says the percentage of cases with amnesia was 65 % in his hospital wards, while the percentage in private ward cases was 95 %. The necessity for goggles would be greater in the ward cases, and it is not unlikely that the artificial protection of the eyes contributed some of the failures. At all events, I have found that the plan of having a light on a low table answers excellently.

As a more or less pronounced thirst may be experienced, in many of the cases copious draughts of water may be given. In the longer cases milk should be substituted. The disturbance caused by allowing a patient to drink frequently is not nearly as great as would be a thirst increasing until it became almost intolerable.

It should be insisted that nurses must be absolutely quiet and refrain from interfering with patients more than is needed. Until they realise this fully they are apt to seize the patient and encourage her under the mistaken impression they are helping her to " bear down." This must be strictly forbidden, as, immediately after the first injection, the patient lies down and is enjoined to go to sleep as soon as she can.

Only in the prolonged cases is it necessary to auscultate the fœtal heart, and, as in these labours at any time, operative interference is only needed on this account if there is any notable variation from the normal rate.

Respecting the time of beginning treatment it is essential the case should be seen as early as possible after the onset of labour, and here it is of great value to have a nurse who has had some considerable experience of this method, or a specially trained staff. In primiparæ it may be begun when pains are definitely and regularly established and the os uteri is, say, the size of a shilling; in multiparæ it may be begun as soon as pains have begun, irrespective of the size of the os. If tablets of the drugs are used, hard water must on no account be used as the solvent; only boiled rain water or distilled water.

The ordinary measures adopted are, of course, strictly observed—a preliminary enema and a hot bath, an antiseptic douche, catherisation if needed, etc.; but as every practitioner is familiar with these routine requirements they need no special mention.

CHAPTER V

Effects on the Mother

THE most obvious effect of scopolamine-morphine injections on the patient, and one that is frequently seen early, is sleep. This may be apparent within half an hour. In most cases, within an hour there is distinct drowsiness and lethargy, soon merging into an apparently natural and refreshing sleep between the pains. As each pain comes on, the patient rouses and may make some remark about not yet having gone to sleep. Later, this rousing is not so pronounced, the pain is complained of less, and the patient is clearly experiencing a more restful condition. At any time during the whole course of labour, if there has been no over-dosage, the mother can be easily awakened.

The most important aim of the treatment, however, is amnesia. It will already have been noticed in the historical sketch that amnesia and analgesia have been inseparably connected, and very often confused, by many observers; and it will therefore be convenient to discuss the two together,

distinct though they are. Even the most recent literature often fails to discriminate between the two. Thus Haultain and Swift, in the paper above referred to (p. 32), say: "In the first instance it should be clearly understood that there is a vast difference between the true so-called 'twilight sleep,' as devised and carried out by Krönig and Gauss, and the ordinary haphazard scopolamine-morphine treatment which has been freely practised by many of us for the last eight years. In the former a complete analgesia and amnesia is the object aimed at in the conduct of labour, so that the patient becomes absolutely free from any knowledge of pain, or indeed of any recollection of the process having occurred." And again: "Total amnesia and analgesia were obtained in 30 out of 40 cases—namely, 75 per cent. This means that the patient had no memory whatever of the labour after the first pin-prick, and so, being unable to remember anything, says she had no pain."

Now this latter quotation shows clearly enough that these two writers appreciate that amnesia is obtained and that analgesia is not perfect, for they remark, "The patient . . . says she had no pain," inferring the patient had pain and responded to it during labour, but did not remember it afterwards. This is an ideal "artificial twilight sleep," but to speak of this as amnesia *and analgesia*

is obviously inaccurate. And what Haultain and Swift really attained was the true Krönig and Gauss amnesia. But these two were at considerable pains to make it quite clear that they sought this amnesia and not analgesia. In the monograph written by Gauss in 1906 he says: "The majority of the patients impress one as being indeed sleepy, but otherwise quite normal. Every pain is accompanied by clearly perceptible, if often only slight, expressions of suffering. The pains and the accompanying sufferings are referred to and felt clearly as such. . . . The term 'semi-narcosis' does not do justice to the peculiarity of this most curious condition of consciousness, which has much more resemblance to the waking condition than to narcotic trance. The patient is in a state of artificial sleep from which she may wake or be awakened at any moment for a short time. At the same time, however, during the whole period of the action of the injections, she displays the amnesia characteristic of this clouded mental condition." And again Gauss observes: "There is a perfect amnesia pertaining to all occurrences taking place while the dose remains effective. There seemed to me to be no doubt that the object of the semi-narcosis must be to put the patient into that kind of twilight haziness of mind after which she will be unable to remember anything that has taken place." Once more, in the same

contribution we read: "The object to be attained by the use of scopolamine-morphine 'Dämmerschlaf' in obstetrics is, in fact, nothing beyond a reduction of suffering and that slight degree of clouding of the consciousness in which impressions are perceived indeed by the patient, but not apperceived." And in his Karlsruhe address in 1911 he remarks, when replying to some criticisms: "Steinbüchel used one rather small dose of scopolamine-morphine, repeating the same dose when necessary. Hocheisen used one dose, generally large, sometimes very large. In some cases he did not repeat it; in others he repeated the full dose as soon as signs of painlessness appeared, though painlessness is a sure sign of overdosing." It may, therefore, be definitely stated that analgesia is no essential condition of "Dämmerschlaf."

The earlier observers strove almost without exception to obtain analgesia; the few who noticed and mentioned amnesia appeared to regard it as an interesting side-issue. If Krönig and Gauss attempted one thing more than another it was to show how distinct analgesia and amnesia are. By some, amnesia appears to have been looked upon as a further and later stage than analgesia, whereas the exact converse is the fact. With a correct dosage, when the amnesia is perfectly established, it is very rare to find a case of complete analgesia. There is doubtless some analgesia

in all amnesia conditions, and this has probably led to the confusion. It is, in these cases, correct to speak of hypalgesia, but the term analgesia should be reserved, as it properly implies, for those cases where there is a total absence of all manifestations of pain, and where, therefore, we may correctly say the process of labour is painless. In the majority of cases it is safe to say analgesia could be produced by pushing the doses. There would probably, however, be an increased risk to the mother in many cases if this were done, and certainly the chances of fatal consequences to the infants would be very grave. As a fact, it is quite unnecessary to aim at analgesia, and therefore we need not court any danger to either mother or child. In administering scopolamine-morphine I am sure the line of demarcation between amnesia and analgesia is narrow—a slight excess of amnesia, so to speak, will generally lead to a notable analgesia —and this is why so many observers confuse the two and speak only of the latter. If the memory test is not rigidly and frequently used it is impossible to express any opinion about the amnesia, whereas the analgesia is patent to the most casual observer.

It is therefore clear that, if one wishes to obtain the best success, it is essential that the obstetrician must remain with his patient from the onset of labour to its completion. It is unfair to expect any nurse to decide continually throughout a

case, not only whether amnesia has been successfully induced, but also whether the amnesia is so deep as to be verging on analgesia. The margin between the two is so small that a delicate judgment, born of an extended experience, is needed.

It is an interesting speculation as to how the amnesia in these cases is produced. It is certainly a cerebral effect, largely, if not entirely, confined to the sensori-motor areas. The familiar experiment with the decerebrate (pithed) frog throws some light on the question. When suspended, some irritative substance, such as a weak acid, is applied to the flank of the frog. The leg of the same side is raised and a definite purposive attempt to remove the stimulus is made. If the leg is restrained, the opposite leg will supplement the attempt. If both legs are restrained and the stimulus be a little stronger, the arms will attempt the removal. There can, of course, be no cerebral consciousness, yet there must be enough spinal cognizance to initiate and pursue very definite purposive actions. Could we afterwards replace the cerebrum of the frog, there would be no impressions of the experiment registered, and therefore there could be no memory of it. And it would be a bold thing to say the frog had suffered any pain as we understand the term.

I have recently examined a number of patients under the influence of scopolamine-morphine,

and find the so-called knee-jerk is markedly exaggerated: Babinski's sign can also usually be elicited. The cerebral cortex is therefore at least partially cut off from the spinal cord. It seems reasonable, then, to assume that in the condition of amnesia and hypalgesia the detachment of the cerebral cortex is at least partial, and becomes more complete the nearer we approach a condition of analgesia. It is, of course, common knowledge that the amnesia due to scopolamine-morphine semi-narcosis is temporary; events immediately before its induction and events afterwards are perfectly remembered. The loss of memory during the semi-narcosis is very similar to that of old age. An old man may still remember perfectly the history of years ago, but cannot store present events. It has been determined that the cortical cells suffer shrinkage in old age, the synapses of the dendrites of the cells must thus be less perfect, the ramifications less intimate. So that, if an impression reaches any individual cell, the stimulus is not passed on so readily to the neighbouring ones; and the diffusion which is probably necessary to complete what we call memory is prevented. It is not at all improbable that in the amnesic state induced by scopolamine-morphine there is a temporary retraction of the dendrites of the cortical cells. This hypothesis readily explains the retention of a vivid impression during scop-

olamine-morphine semi-narcosis — an impression such as that produced by a bright light, a loud noise, a particularly severe pain—for in this case the stimulus is just powerful enough to cross the increased " gap " between the cells ; it overcomes the increased resistance exactly as an electric current of higher potential will " spark " across a gap which is too wide for a lower potential current. This at least gives us a useful physico-psychological basis by which we may understand the mechanism by which means the amnesia is produced.

In view of the above it is not surprising that in an ideal case there should be some response, such as slight movements, a facial grimace, even a groan, on the part of the patient during the pains. Regarding these more as spinal manifestations, we can understand, too, that the voluntary muscles are still completely operative, acting reflexly in response to the necessity for the expulsion of a foreign body—the fœtus.

Judged from the point of view of the successful induction of the semi-narcosis the subject of amnesia is of paramount importance, and no apology is needed for treating it at some length. Indeed, the association of this with correct dosage is the pivot on which everything else moves. Hence the emphasis laid upon the continuous attendance of the obstetrician and the futility of

expecting the best success from a fixed routine dosage for every patient.

I have been at some trouble to observe, in a large percentage of my cases, the exact effect of the semi-narcosis on the uterine contractions. After the first injection it must be conceded that in some cases, but by no means in all, the activity of the uterus may be somewhat diminished: this is due to the morphine. When the second injection has been given (scopolamine alone) and the effect of the morphine is passing off, if the activity of the uterus had hitherto diminished, its full activity is completely regained. In a few of the cases the interval between the pains has still remained a little longer, but almost invariably the intensity of the contraction is increased so that the total effect, by the time labour is completed, is probably indistinguishable from a labour conducted without scopolamine-morphine. The very variety of opinions expressed by different observers on this point proves that the total time occupied by the labour cannot be very different from that in other labours. If it were invariably and appreciably lengthened more unanimity might be expected. Where there has appeared to be undoubted protraction, it can generally be shown the patient has been overdosed. The fact that I have never yet, in considerably over 200 cases, had to resort to intra-uterine manual separation of

the placenta proves that the uterine contractions have not been so materially interfered with as to refuse to expel it within a normal time. In the third stage I make it a practice to hold the fundus uteri, not with the idea of expressing the placenta, but to be perfectly sure no atony occurs, and thus the risk of post-partum hæmorrhage is not invited.

It has been asserted repeatedly that the voluntary contractions of abdominal muscles are apt to be weakened, but this has not been my experience. I can imagine this idea has arisen because the hypalgesia allows the action to continue without as much demonstration on the part of the patient. It may also be noted that in many an ordinary labour the woman has already suffered so much pain in the first stage, and is, too, so exhausted, that when the really useful stage for voluntary abdominal assistance is reached, and she finds her " bearing-down " efforts further intensify the pain, she purposely refrains from helping, and the usual exhortations fall upon unwilling ears. I believe the hypalgesia tends to avoid this " resistance," and is, therefore, actually a help in these cases.

An early sign, universally observed in many cases, is flushing. In the majority this is a general dilatation of the surface vessels and is by no means confined to the face, although this fact has not been generally noted.

The pupils are affected in a majority of the cases. I have never seen a contracted pupil, but, especially after a few injections, there is usually some dilatation. This action of hyoscine is, of course, a perfectly familiar one; the only point of importance in connection with it is that, in the later stages at all events, this disturbance of accommodation, when the memory is tested, makes it imperative for the attendant to be sure the patient has seen and recognised the object she has been shown. Since this disturbance usually persists much longer than the amnesia an element of error is introduced unless special care is exercised.

Thirst is a common accompaniment, and the patient must have frequent drinks of water or milk (the latter especially if the labour is protracted), otherwise the thirst may become so distressing as to tend to nullify the amnesia and leave an unpleasant memory.

In some of the cases restlessness has been commented upon by practically all the writers on the subject. Some go so far as to describe either an active or a low muttering delirium. In any case, when it occurs, it is a further evidence of the inhibitory action of the scopolamine, showing how it really does cut off the cerebrum. Some speak of the restlessness or active delirium being so pronounced as to make it necessary to stop treatment. I have never seen a case of this marked

delirium, and can only say that it appears to me to indicate overdosage, or in very rare cases an idiosyncrasy. The simple restlessness that sometimes occurs can easily be controlled by occasional small inhalations of chloroform. Dealt with in this way restlessness is certainly not any contra-indication. Perhaps connected with this, but usually not in cases of actual restlessness, I have sometimes noticed rhythmical contractions of the palmar muscles and to a less extent the flexor muscles of the forearm. The position assumed by the hand while the contraction is present suggests tetany, the thumb being drawn across the palm and partially apposed to the little finger. I have not noticed that any importance can be attached to this.

One of the most important fears, based mainly on theoretical considerations, was that post-partum hæmorrhage would be more common and more severe. Many of the earlier users of scopolamine-morphine in midwifery stated in general terms that this was actually the fact. Sir J. Halliday Croom was among the first to use it in this country, and he was at first disposed to think the patients were more liable to post-partum hæmorrhage. His later opinion, which must naturally be regarded as his more mature one, is "that post-partum hæmorrhage is not increased." Scopolamine-morphine has been used by him

since 1908, and is still used, as he himself tells me, so that the risk of hæmorrhage is not regarded by him as more than normal. So, too, Giuseppi says: "There is no increase in the incidence of post-partum hæmorrhage." Fairbairn, as recently as January 1917, actually mentions ante-partum hæmorrhage as an indication for the use of scopolamine-morphine. In view of some dogmatic criticisms it may be interesting to give his complete statement (although most of it is concerned with matters other than hæmorrhage): "Special indications for its use are: feeble and ineffective uterine action during the first stage, especially when the patient is suffering from fatigue and loss of sleep, or is nervous and unusually sensitive; rigidity of the cervix, which often accompanies poor pains; ante-partum hæmorrhage, in which mental and bodily quietude are advantageous; the alleviation of the pain and discomfort following many manipulative procedures, such as plugging the vagina or the insertion of a bag; prolonged labour, in which time is required for moulding of the head." It may be noted in passing that not long ago nearly every one of these "special indications" has been given as a contra-indication.

To return to post-partum hæmorrhage and my own experience of it. Among the cases I have had there have been three with definite post-partum hæmorrhage. The three patients were

multiparæ (sixth, fifth and ninth respectively) and in all three there had been severe post-partum bleeding before; in one of the cases it had occurred twice before. An impartial consideration would therefore lead one to say the drugs had no causal relationship with the hæmorrhage, and that there would probably have been severe bleeding in any event. In each case it was quickly controlled by mechanical manipulation and the hypodermic injection of pituitrin. Another case had had post-partum hæmorrhage with a previous child, and during this last parturition it was certainly in excess of normal, but careful watching prevented it becoming really serious. I now usually adopt the precaution of giving a dose of pituitrin to multiparæ at the end of the second stage. In view of my results I am compelled to the opinion that scopolamine-morphine does not increase the risk of post-partum hæmorrhage in the least degree.

The influence on the pulse is variable. I have systematically classified the pulse-rate in the first 200 of my cases with the following results: In 8½ per cent. the pulse-rate was increased; in 34 per cent. it remained the same; in the remaining 57½ per cent. it was diminished. A variation of 10 from the pulse-rate at the time of the first injection was regarded as an increase or a diminution for the purposes of this calculation. In all

except two cases the character of the pulse was at least as good at the termination of labour as at the onset. These two exceptions were complicated by influenza and acute cholelithiasis. This statement is not intended to include the cases of post-partum hæmorrhage in which the characteristic rapid, running pulse was present. The specimen charts illustrate the usual effect on the pulse-rate.

Probably the most striking after-effect on the mother is the remarkable absence of shock and exhaustion. This is striking enough in the case of an ordinary labour conducted under scopolamine-morphine, but in long tedious cases which have occupied anything from 24 to 48 hours or more it is no exaggeration to say the results are little short of spectacular. This is not only my own experience; all those who have used the method as it should be used are agreed on the question, and speak in the most unmeasured terms about the remarkable recovery of severe cases. This must give such patients a great advantage, especially if there has arisen any complication or sequela; for to face such with an accompanying profound exhaustion must seriously militate against the best recovery. The explanation is not far to seek if we accept what is stated above. Painful stimuli have not reached the cerebral cortical cells, and this must result in a great saving of nervous energy which is there for use if needed.

It ought to be mentioned that these beneficial after-effects are quite as pronounced in the cases where amnesia alone has been secured, and that the further stage of analgesia does not appear to produce any better results.

Only one word need be added regarding the ante-natal effect on the pregnant woman. The knowledge of the possibility of having scopolamine-morphine during labour undoubtedly conduces to a more settled state of mind, which must at least react favourably on the mother and the fœtus. A great deal has been said of late about ante-natal care of pregnant women, and rightly so. The advantage to be gained by this knowledge is too positive to be lightly disregarded. If the criticism be passed that such women are probably of a neurotic temperament, the reply is that the class includes the aristocracy, the vast army of the middle class, and not a few of the poor working-class in all civilized countries to-day. It is the inevitable result of progress, and will increase rather than diminish. Moreover, no method of universal application has yet been usefully suggested which will stem the tide of this neurosis.

CHAPTER VI

Effects on the Infant

THIS is one of the most important inquiries among the many interesting ones that arise. It is round this subject that most of the discussion has centred. It is contended that it is here the results have been the least certain, and many obstetricians have refrained from using scopolamine-morphine solely on account of the supposed risks to the infants. With a haphazard or incompetent administration of the drugs the plea has doubtless some grounds, but when it has so often been demonstrated that where reasonable care is exercised the risks are no greater than in ordinary midwifery practice the profession can afford to revise its earlier opinion. The greatest diversity of opinion has hitherto been expressed with regard to the symptom termed oligopnœa, and what is really a further grade, asphyxia. Before discussing these, however, I should like to make a few general observations.

In his essay "Of Death" Bacon made the remark: "It is as Naturall to die as to be borne;

And to a little Infant, perhaps, the one is as Painfull as the other." It has been the habit of the profession not to devote much attention to the sufferings of infants during their passage through a parturient canal that is oftener than not too small for their comfort; but once attention is directed to it, the truth of the latter part of Bacon's observation is probably quite obvious. It is universally admitted that scopolamine-morphine, when administered to the mother, circulates in small quantities in the placenta, and therefore in the infant. And if the effects on the mother are to induce hypalgesia and to reduce shock and exhaustion, the drugs cannot fail to produce some measure of the same effects on the infant. I am convinced that in ordinary practice some of the deaths in still-born infants are due to the pain and exhaustion consequent upon a prolonged and difficult labour. It would be impossible to state any percentages, because no one, as far as I know, has taken the trouble to record the cases where the infant was vigorous at the onset of labour, no injury was inflicted by the application of forceps, no abnormal condition (such, *e.g.*, as prolapsed cord) was noted during the course of labour, no disease was patent at birth, but yet, in spite of apparently healthy tissues and no abnormality except a protracted labour, the infant was still-born. I have carefully watched my cases with

this point in view, and am persuaded infants may have their chances of life influenced for the better by the protection scopolamine-morphine affords (always presuming there has been no overdosage).

In discussing the danger of asphyxia in infants, I would like to observe that the critics of this method appear to lose sight of the fact that asphyxia quite commonly occurs, apart from any treatment by drugs, in parturition. To assume that every case of asphyxia is due to scopolamine-morphine is gratuitous. Every text-book of midwifery contains a more or less elaborate account of the ætiology, treatment, etc., of the condition, and every obstetrician and practitioner must be only too familiar with it. Again it is impossible to state any percentages, and hence we can make no comparison between ordinary labours and those conducted under scopolamine-morphine. To be perfectly just, therefore, we must allow some proportion, at least, of the cases of asphyxia recorded in, and attributed to, this treatment to have been unavoidable whatever treatment had been adopted.

I will preface my remarks on oligopnœa and asphyxia by once more insisting that in the heat of argument writers have not always distinguished between the two conditions. The terms have been used interchangeably, whereas the conditions themselves are distinct. However, as a definite as-

phyxia, in my experience, is quite avoidable, it will be enough to confine my remarks to the now notorious oligopnœa.

It is a condition of the infant which is apparent immediately on expulsion. An inspiration occurs at once, the infant gives one cry, active movements begin, but both the cry and the movements suddenly become abortive. The cardiac action is vigorous and in no way abnormal, but during the periods of suspended respiration the heart slows a little, to regain its normal rate quickly on the next inspiration. The cessation of respiration may last half to one minute, then another inspiration occurs, often accompanied by a sigh. The respiration gradually becomes normal, and the infant usually passes at once into a peaceful sleep. Even with continual advance towards normal respiration this state may last up to an hour—the general appearance of the infant giving one the impression it is lazy or tired. The colour of the infant in these cases differs but little from that of those born after no administration of drugs. Knowing of the condition before using scopolamine-morphine, I kept a sharp eye on the infants, prepared to resort to artificial respiration if there were any real indication for it, yet determined to test to the full the supposed danger of it. The results have justified my confidence, and I can say that it must be a very rare case that really

calls for any interference. Only on three occasions have I resorted to artificial respiration: 1, a difficult forceps extraction; 2, a case where the cord was three times round the neck of the infant; 3, a case of premature detachment of the placenta—on expulsion of the child there was not the faintest pulsation of the cord, the placenta following immediately. Cases 1 and 2 recovered. In these cases I think it will be conceded that the necessity for interference was not due to the action of the drugs.

Apart from the fact that oligopnœa, as I have seen it, is not dangerous to the infant, I may say that the incidence of it diminishes greatly with the increased experience of the obstetrician. A point of practical value that I have observed is this: for many months past it has been my invariable custom to ligature the cord as soon as is convenient after expulsion of the infant. This checks any further absorption from the placental circulation, and the elimination of the drugs already in the infant's circulation begins at once. This is a procedure tending to reduce the incidence and duration of oligopnœa.

To put the matter on as definite and scientific basis as possible, I have calculated the percentage of oligopnœa in my first 200 cases, and added a corrective figure which my later experience fully

justifies. There were 27 cases of the slight oligopnœa above described, *i.e.* 13½ per cent. At first, in some of the protracted cases I occasionally gave a second smaller dose of morphine. Three of these 27 cases thus had morphine gr. $\frac{1}{12}$ in addition to the initial dose. I have since abandoned the giving of a second dose of morphine. Omitting these three cases, the percentage of oligopnœa becomes 12 per cent. Then again, early in 1916 I used eutocine (the detoxicated morphine of Laurent) in four cases. In each of these cases there was a slight oligopnœa, which certainly suggests more than a coincidence. Considering that the three cases above mentioned, namely, those which had a second dose of morphine, were also oligopnœic, it seems to me to be a perfectly justifiable conclusion that the morphine has more than a coincidental connection with the condition. This view is also supported by the time element, to be referred to shortly. If the above four cases where eutocine was administered be omitted too, there remain 20 cases which showed oligopnœa when the dosage was carried out according to my present procedure. The percentage, therefore, under these conditions becomes 10 per cent. Even in these, as I have already hinted, the oligopnœa was never alarming.

The average time during which the 27 cases under consideration were being treated was 6 hours

45 minutes. The three cases where morphine was given a second time were long cases. Omitting these latter and the four where eutocine was substituted, the average time of treatment for the remaining 20 cases was 4½ hours, *i.e.* 2¼ hours less than the average for the 27 cases. This emphasises the statement above that the morphine is undoubtedly the main factor in the causation of oligopnœa; for in the longer cases there has been a more ample opportunity for the elimination of the morphine, and it is just in these longer cases (where the morphine elimination has proceeded further) that the incidence of oligopnœa is less. However, it is scarcely possible to dispense with the morphine, because, in the first place, it gives just that anodyne effect which scopolamine almost lacks, and so allows an early period of hypalgesia during which the amnesic effect can be easily attained; and secondly, it has the effect of diminishing the tendency to restlessness which otherwise would probably be more common and more pronounced.

A few observers have tried the effect of scopolamine alone, not giving even the initial dose of morphine, but the desired semi-narcotic effect does not appear to be attainable without the combination. In view, therefore, of this fact and what also seems to be quite clear now—that the morphine is mainly responsible for the oligopnœa—

the conclusion appears to be established: give morphine only in the initial dose, and reduce the quantity of it to the lowest limit by which the desired amnesia and hypalgesia can be obtained.

CHAPTER VII

The Results Obtained

IT will now be as well to give a brief account of the results to be got by following the technique and exercising the care outlined above. Of the 200 cases already referred to, 138 were primiparæ and 62 were multiparæ, so that 69 per cent. were primiparæ. The ages of the primiparæ ranged from 17 to 49 years. Two were of the former age, while seven were under the age of 20 years. Twelve patients were over 40 years of age—the oldest of these being 49 years and another 45 years. These two were primiparæ. Five of the twelve were primiparæ: of the remaining seven, three were bearing their ninth child, two their seventh, two their fifth. Five of the cases were breech presentations; two were transverse presentations; two were brow (one of these was the second of twin brothers and remained an occipito-posterior); the remaining cases were vertex presentations, in only three of which the occiput failed to rotate forwards, and so remained complete occipito-posteriors. I may here remark

that I have several times rotated an occipito-posterior presentation with one blade of the forceps, used as a vectis. In three of the mothers there were mitral lesions; three had marked albuminuria. One of these latter was in my own practice, the two others were sent to me by other medical men. As one of these was a very interesting case in other respects, a brief account of it will not be out of place. The mother was the primipara aged 49 years. Œdema was very pronounced and general, and on arrival the patient was kept in bed and a light but generous diet allowed. Soon after the onset of labour I saw her at 3 a.m., and gave her the first injection of scopolamine gr. $\frac{1}{100}$ and morphine gr. $\frac{1}{4}$. The os uteri was then the size of a shilling, and at 6.30 a.m. was half dilated. At 8 a.m. it was fully dilated. At 9.30 a.m. a living female child was born, the cord was twice round the neck (the presentation was left occipito-anterior), and there were no signs whatever of oligopnœa. The perineum was œdematous and ruptured on the first serious pressure of the head, the tear eventually only stopping short at the rectal mucous membrane. It was sutured, and healed by first intention. In the course of the six hours' treatment the patient had four injections, the three following the initial dose being scopolamine gr. $\frac{1}{100}$ then gr. $\frac{1}{120}$ then gr. $\frac{1}{100}$. The dosage was made relatively large on account of the

albuminuria, the total in the six hours being gr. $\frac{1}{26}$. The child weighed over 8 lb., and is now, at the age of 12 months, perfectly well. There was marked œdema in the other two cases; each had a living child; one is now 14 months old, the other 2 years.

Since beginning to use this method of treatment I have had no maternal death in over 200 cases. Among the infants four were still-born, this being an infant mortality of 2 per cent. as against the usual average of $2\frac{1}{2}$ per cent. to $2\frac{1}{2}$ per cent. in general midwifery practice. Even if it still be argued that the drugs played some part in this mortality, the percentage is not as high as the general average. To meet this contention, however, it will be better to classify the cases, when it will be seen how little basis such a contention has. The deaths were as follows:

1. A premature detachment of the placenta. Cardiac action and respiration could not be re-established.
2. A breech presentation which was originally transverse and was turned. The head and both arms were extended, and delay in delivery ensued.
3. A difficult forceps extraction with cerebral or medullary hæmorrhage.
4. A second case of premature detachment of the placenta.

Premature detachment of the placenta is generally regarded as a rare contingency: the diagnosis of the second case was confirmed by another doctor who happened to be present. There was not the least pulsation in the cord, in either case, immediately on expulsion, and the placenta followed at once. I am inclined to think this condition is commoner than it is generally supposed to be, and may account for not a few still-born infants.

It may be interesting to record the second case of transverse presentation. It occurred in a multipara (second child) with a flattened pelvis. Slight pains had occurred for two hours when I saw her, and the os uteri was then three-fourths dilated. The first injection was given, and chloroform at once administered. By combined internal and external version the fœtus was turned to a vertex presentation and the membranes were ruptured. Chloroform was stopped and the injections afterwards proceeded with as usual. Eight were given in 15½ hours. The uterine contractions continued vigorously the whole time, but at the end of 14¾ hours the head had not fully engaged in the pelvic brim, and the high forceps operation was decided upon. Very little chloroform was given, and the child extracted with difficulty. It was very vigorous, and no signs of oligopnœa were to be seen. I have given this case because I think it illustrates very well my contention that so far

from scopolamine-morphine being harmful to the child, it has a distinct influence, when properly used, in preventing pain and shock that would quite possibly be harmful.

It will thus be seen that the end results are at least as good as those of general obstetric practice. The percentages already given do not take count of the fact that a number of the cases were sent to me by medical men who frankly said they anticipated difficulty. It may be remarked here that this method of treatment is particularly valuable in those cases where there is, say, a slightly flattened pelvis, the child is larger than normal, more than an average time is needed for moulding of the head, and there is thus every prospect of a long labour. There seems to be no reason whatever why a case should not be allowed to go on for 48 hours or more provided the fœtal heart-sounds remain good. Unless the labour is a long one there appears to be no need for anxiety about these; and in any long labour, apart from this treatment, they would be auscultated from time to time: there is no more necessity in the one case than in the other.

As in any obstetric work, abnormal cases will receive the appropriate attention they demand. One remark may be made at this point. If Cæsarian section should not, from any cause, be discovered to be indicated until labour has

begun, or if the decision for its necessity is come to later in the course of labour, I believe the risks would be less under the scopolamine-morphine treatment than in a case being conducted without. Every one is familiar with the disastrous results of a compulsory emergency Cæsarian section. One of the grave dangers is the shock consequent upon futile attempts at delivery, and as the shock is reduced at least to a very small minimum by scopolamine-morphine this particular risk is diminished.

I should like to add that the fear of this treatment affecting the later health or development of the children appears to be, not only groundless, but absurd. I have followed the history of nearly every child, and know of two only that have since died, one of acute broncho-pneumonia at the age of 5 months, the other of acute bronchitis at the age of 11 months. Both died during the severe winter of 1916–17. As far as I am aware, there has been no other subsequent death or even serious illness.

Not a few of the supposed contra-indications have of necessity been dealt with in earlier chapters, and since the results to be obtained with scopolamine-morphine speak for themselves there is no need to enter upon any further discussion of purely theoretical contra-indications.

CHAPTER VIII

The Charts

THE general scheme of the specimen charts which are given was drawn up after a careful survey of the available literature before undertaking any cases. And since it was impracticable (when beginning this work) to see any cases conducted, they contain an epitomised record of the whole of the work on which this monograph is so largely based. Every observation recorded on every chart was made and entered at the time stated—a chart is an exact clinical record. By adopting this practice there has been no opportunity for the slightest error. In addition to the actual observations and tests recorded, the memory test in particular was very often made between the stated times. But there frequently appeared to be no further object in setting down a result that was identical with the one immediately before and after. So that every chart contains at least a minimum of observations necessary for a full comprehension of the case. In general, the charts show that as long as the progress of the

labour is normal, the pulse remains good, the amnesia is quite satisfactory, and restlessness is not troublesome, there is no need for anxiety on the score of the mother, while a watch on the fœtal heart-sounds in long labours satisfies the needs of the child.

The complete series of charts represents a period of two and a half years' work. They very clearly indicate how individual this work must be for the best success. They show more forcibly than argument can how the dosage (both in the amounts and in the intervals) is altogether dependent upon the condition of the patient's amnesic state, and that this must be ascertained by actual testing. Each one further states the total time from the first injection to the end of the second stage, the total amount of scopolamine used in each case, and the total number of injections.

A word may be said about the method of entering the results in the various columns. It may be taken that the pulse-rate sufficiently indicates its character unless a note is added in the last column. So, too, with the pains—they may be read as normal unless a special note is added. In the columns "Flushing," "Pupils," "Thirst," "Sleep," "Memory Test," I have adopted the plan of recording the *presence* of the first four symptoms by a + sign; in some early cases a − sign is found to indicate the absence of it, but this is unnecessary; and

where there is no sign the indication is that the symptom was absent. The only exception is under "Pupils." I have found that in practically every case towards the end there was *some* dilatation, and in many this was even more evident at the end of the sleep immediately following the completion of labour.

Under the column "Memory Test," as soon as the amnesia was found to be definitely established, it was signified by a + sign. In a few cases it will be noticed that the sign ∔ occurs. This is meant to indicate that in the particular test referred to the patient had some faint recollection, and after a very obvious mental effort hesitatingly, and more in the nature of a tentative suggestion, remembered the object shown her. In almost every case this was afterwards forgotten, because another dose of scopolamine was immediately given. In such cases, had the dose been delayed, even a short time, there would probably have been a very clear recollection with the establishment of a definite "memory island." This again only serves to emphasise the close attention needed, and the imperative necessity for frequent testing, and not trusting to a routine dosage at certain fixed intervals of time.

Mention ought to be made of a few of the very short cases. These have always been multiparæ. In the cases where a very rapid labour is antici-

pated, such as in cases with a history of previous short labours, I have found it no contra-indication to use scopolamine-morphine. In such cases I have sometimes given the smallest amount of chloroform very slowly for about six minutes early in labour, and it is surprising how the drugs will then act on an already partially anæsthetised cerebrum and quickly attain a permanent hold. But this is by no means always necessary, especially so in women of a more phlegmatic temperament. This experience is distinctly opposed to the statements of some writers that the drugs should not be administered in short labours; one writer asserting that a dose should not be given within four to six hours of the termination of labour. This not only shows a very limited experience and an overweening regard for theory, but the effect of the last dose would have totally passed off long before, and the most painful stage of all would thus be unprovided for. A glance at some of the charts will show how groundless are such fears. In one recent case, at 11 a.m. I gave morphine gr. $\frac{1}{6}$ and scopolamine gr. $\frac{1}{100}$; at 10.50 a.m. scopolamine gr. $\frac{1}{100}$ was repeated; at 12.10 p.m. an absolutely normal infant was born with no trace of oligopnœa.

It is not necessary to say more about the charts, as they will now be self-explanatory.

CHAPTER IX

Probable Effect on the Birth-Rate

IF these were normal times there would very likely be no urgent need to say anything on this subject. But while it may be of small academic interest, the present conditions invest it with an importance which can scarcely be over-estimated. The report of the National Birth-Rate Commission, covering some 450 pages, shows that the educated sections of the community are fully alive to the gravity of the situation. The *Lancet* of 4th September 1915 contained an article on "Infant Mortality and the Birth-Rate" in which occurs the passage:

"Recent statistical returns of the births and deaths of infants in this country are disquieting; regarded individually they are bad enough, but taken collectively they are distinctly alarming. The continued fall in the birth-rate, which has now reached the lowest level heretofore recorded, may have many explanations, but the factor of the deliberate limitation of families, whether from provident or selfish motives, can no longer be

ignored. The dissemination of knowledge with respect to the use of contraceptives has undoubtedly contributed to this result, not only among the upper and middle classes, but even among the poorest, with whom such practices were quite exceptional a decade ago."

It is to be feared the knowledge of contraceptives does not get even near the root of the problem. What really matters is—On what grounds are based the desires to limit families ? And besides, it is no more immoral for the poor to have and use this knowledge than the upper and middle classes. Indeed if there is any justification to be pleaded at all, it is to be found among the poor. Unfortunately they happen to form the bulk of the population of a country. No doubt a large number do resort to such uses from purely selfish motives ; many adopt the attitude that they will *not* have more children than they can adequately provide for and educate. These and some other classes will, in all likelihood, never be reached by argument or appeal ; and further, they are outside the range of obstetric art. There is, however, one class, the numerical importance of which is either not appreciated, or which has been overlooked from ignorance of the facts. The class has already been alluded to—the women who have such a dread of the pain associated with parturition. And it must be admitted that the artificial condi-

tions imposed by civilisation and the hurried stress of modern life do not tend to mitigate the pains of labour. The cranial capacity in infants at birth is tending towards a gradual increase, and there is not a relatively increasing pelvic capacity in women.

And although the nature of obstetric work conducted under scopolamine-morphine in a private nursing home is perhaps peculiarly conducive to confidences, yet some are reticent and definite inquiries cannot always be made. Still, I have learnt from casual remarks, which made inquiries easier, that no less than a dozen of the first 200 cases had decided to embark upon that particular pregnancy after (but only after) learning it was possible to obtain the scopolamine-morphine treatment in England. This represents, on the 200 cases, an increased birth-rate of 6 per cent.; so that, if large numbers of parents could be reached, the possibilities in the matter of a substantial increase in the birth-rate are very real. I may incidentally draw attention to the fact that this 6 per cent. increase three times covers the infant mortality at birth in this series of cases. While I do not in any respect suggest that this treatment should be allowed to create a popular *demand* for it, I think that a dispassionate judgment must allow the dangers are negligible if properly used, while the benefits from a national point of view are entitled to consideration and respect.

It would appear, therefore, that obstetric art has here the means of striking directly at the root of one, at any rate, of the causes of the declining birth-rate. There is a growing tendency among the upper and middle classes to have their labours conducted in private nursing homes. This is possibly partly due, at the present moment, to the necessities of the abnormal times, but the custom will probably grow even after the war, and indeed many practitioners have told me they would welcome the custom, as midwifery often seriously interferes with other work. If suitable provision could be made for, and so the inducement held out to, the poorer classes, we should have travelled some way towards repairing the gap now being torn in the nation's manhood. Perhaps it is not too utopian to hope that it may soon be possible to provide nursing homes and hospitals where rich and poor may be encouraged to embark on the responsibilities of maternity and paternity from the assurance of easier labours — hospitals in charge of those who are willing to make the sacrifices which this work undoubtedly imposes.

NOTE ON THE VALUE OF "SCOP-OMNOPON" (OMNOPON-SCOPOLAMINE)

I HAVE lately conducted a number of labours in which, instead of the ordinary morphine and hyoscine, I have used the combination Scop-Omnopon, supplemented by such additional doses of hyoscine as were found to be needed. The full designation of this combination by the chemists preparing it is "Scop-Omnopon 'Roche' (Omnopon-Scopolamine)"—the omnopon being stated to be the preparation known on the Continent and in the U.S.A. as pantopon. Professor Sahli was interested in attempting to produce a derivative of opium which should combine the special advantages of opium and morphine without certain disadvantages incidental to each; and after a number of investigations succeeded in producing pantopon. Omnopon is prepared according to these suggestions of Professor Sahli. It contains the total alkaloids of opium in the water-soluble form of their hydrochlorides, but free from their inert and injurious extractive matter. Being soluble in a form suitable for hypodermic injection,

omnopon has the manifest advantage that it acts more quickly than does opium by the ordinary oral method of administration. The combination scop-omnopon is, therefore, an interesting one, and deserving of a careful investigation and consideration.

Before instituting a close analysis of the cases it will be well to make this prefatory remark: that in the specimen charts which are given it will be noticed that the injections are given under the headings " M." and " Hy.," *i.e.* morphine and hyoscine. But in a few of the later ones these headings are " Om." and " Hy.," so that the cases where the omnopon-scopolamine was used are thus distinguished from the others. Scop-omnopon is put up in ampoules of 1 c.c. of solution, and the solution is in two strengths: (*a*) containing $\frac{2}{3}$ gr. omnopon and $\frac{1}{150}$ gr. scopolamine; (*b*) containing $\frac{1}{3}$ gr. omnopon and $\frac{1}{300}$ gr. scopolamine. The former is ordinarily intended to be enough for two doses.

The first general observation I would make about scop-omnopon is that hypalgesia (and even analgesia) is more readily obtained, but that amnesia is much more variable of attainment in the time element and more uncertain in its completeness. The obvious query is whether this is due to some inherent property of the drugs or due to some other factor. I think omnopon is a

potent hypalgesic and analgesic, but I do not think this is by any means the final word. For it will be observed that the recommended single dose of omnopon (gr. $\frac{1}{3}$) is combined with only gr. $\frac{1}{300}$ of scopolamine. Now to get the proportion of hypalgesia and amnesia at which the obstetrician is aiming is entirely a matter of adjustment of the doses of scopolamine and omnopon (or morphine, as the case may be) which are being used. The amount of scopolamine combined with omnopon gr. $\frac{1}{3}$ will be universally accounted too small, as most observers will agree that gr. $\frac{1}{300}$ is not large enough as an *initial* dose. However, it is a very simple matter to increase this and still leave the dose of omnopon as it stands in the ampoules. Thus the addition of scopolamine gr. $\frac{1}{300}$ gives us an initial dose of gr. $\frac{1}{150}$, and the addition of gr. $\frac{1}{200}$ gives an initial dose of gr. $\frac{1}{120}$, and so on. Then, too, the makers are courteous enough to entertain a suggestion such as preparing ampoules containing omnopon gr. $\frac{1}{3}$ and scopolamine gr. $\frac{1}{150}$. While on the subject of dosage I may say that some of my most ideally successful cases have been those where I have used omnopon gr. $\frac{1}{4}$ to $\frac{1}{3}$ with the scopolamine increased as above to gr. $\frac{1}{150}$ to $\frac{1}{120}$, followed by scopolamine alone in doses based upon the amnesic condition of the patient.

There is one indisputable feature to be noticed relative to the use of omnopon, and it is that

patients are quieter under its influence. I am not referring now to those cases that must be definitely regarded as cases of "restlessness," for I am quite convinced these cases denote a decided tendency to overdosage with scopolamine or a pronounced idiosyncrasy to this drug. But in the ordinary case one must fairly concede this point. Nor is this because the initial dose of scopolamine in the scop-omnopon is much smaller than the usual one in scopolamine-morphine, for I have almost always used an addition of scopolamine in the first dose. Omnopon would appear to have a more definitely sedative action, since my practice has been not to use a relative insufficiency of scopolamine.

At first I was disposed to think, despite the somewhat greater sedative action of omnopon, that a little longer time was needed to gain the desired effect, but this has not since been confirmed. The first few cases chanced to be like those not infrequently encountered in ordinary scopolamine-morphine practice, where the average time needed for obtaining amnesia was exceeded. The average time for the induction of amnesia with omnopon and an increased dose of scopolamine does not differ appreciably from other cases. In two of the cases the memory test was complete in an hour.

It remains to say something about the vexed question of oligopnœa, and its relative incidence with scop-omnopon as compared with scopola-

mine-morphine. Here again the remark that has already been made applies, namely, that so much depends on the grade of oligopnœa induced and the importance attached to these varying grades by different observers. The mere mention of oligopnœa is enough, in the minds of some, to demonstrate conclusively the futility of all further discussion. But this is an exaggerated fear. What I have repeatedly spoken of as a slight oligopnœa—where the condition of the infant is merely a drowsiness and a resentfulness of interference, if I may so describe it—is certainly not dangerous. Having premised this much, it is to be admitted that the incidence of slight oligopnœa is somewhat higher in infants where the cases have been treated with scop-omnopon than in those treated with scopolamine-morphine. At the same time there has not proved to be any risk whatever; and believing, as I do, that a slight oligopnœa is even beneficial to an infant by being the means of reducing the shock and pain inseparable from the moulding of the head, I can only say such a grade of oligopnœa need excite no uneasiness.

In an interesting discussion on this subject which I had with Dr. Sanderson of the Simpson Memorial Hospital, Edinburgh, he told me he was inclined to think there was what may be termed a "time-zone" in the action of scop-

omnopon, and infants born within the limits of this time-zone were more liable to be slightly oligopnœic. He suggested about two hours as this "time-zone," and children born about two hours after an injection of scop-omnopon were liable to oligopnœa. It is an interesting proposition, as it would exclude the use of this combination in those cases where there was reason to think the labour would terminate about two hours after its use. Very rapid multiparous cases would not be excluded, nor would prolonged ones (from any cause) where there was no intention of repeating the omnopon. Without endorsing so rigid an opinion in its entirety, I must say that scop-omnopon has a big field of usefulness, especially in cases where the onset of labour is more than ordinarily severe and where also the duration is likely to be long. For in these cases the hypalgesia is attained more effectively and a rapid attainment of amnesia is not so imperative. If, however, the amount of scopolamine be supplemented by the addition of a further small dose there is no reason why the amnesia should be delayed.

There is one feature in connection with the cases where scop-omnopon is used. The usual dose of omnopon is gr. $\frac{1}{3}$, and we may allow morphine gr. $\frac{1}{4}$ to be a usual dose where this is used. The effect of omnopon gr. $\frac{1}{3}$ is certainly more prolonged than morphine gr. $\frac{1}{4}$ or $\frac{1}{6}$, so that if

any one still had an objection to more than the initial dose, *i.e.* if it were decided beforehand that only the one dose would be given to any particular case, then a more lasting effect would be gained by scop-omnopon.

With regard to the question of standardisation of dose, the remarks made in the text apply equally to scop-omnopon.

It will be seen there are not a few interesting points to be elucidated still; these can only be furnished by a more extended investigation, with careful charting of the results. The opportunity for permanently recording such results will probably be taken in the near future.

May 21, 1915.—Mrs. V. Age 30. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
May 20, '15. 8.30 p.m.	¼	1/100	64	10 mins.						Membranes ruptured early morning. Pains began at 7 p.m. L.O.A.
9.15 ,,			62	10 ,,	+		+	+	Not quite +	
11.0 ,,		1/100	68	10 ,,	+		+	+	+	Memory Test + by 9.45.
11.50 ,,			72	8 ,,	+	+	+	+	+	
May 21. 12.30 a.m.			66	8 ,,	+	+	+	+	+	Os three-quarters dilated.
1.30 ,,		1/200	62	8 ,,	+	+	+	+	+	Slightly restless during pains.
2.30 ,,			66	5 ,,	+	+	+	+	+	
3.30 ,,			66	5 ,,	+	+	+	+	+	

3.45 a.m.—Boy born. Slight oligopnœa, but did not interfere. Perineum slightly ruptured, sutured.
Total treatment, 7¼ hours. Total scopol., gr. 1/40. Three injections.

June 25, 1915.—Mrs. C. Age 28. Multipara (fourth).

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
4.0 a.m.	¼	1/100	80	12 mins.						Os size of 2s. L.O.A.
5.0 ,,			94	10 ,,	Slight			Drowsy	Not quite +	
5.30 ,,			76	6 ,,	+	+	+	+	+	
6.0 ,,		1/100	86	5 ,,	+	+	+	+	+	Os size of 5s.
7.0 ,,			72	5 ,,	+	+	+	+	+	Os almost dilated.
9.30 ,,		1/200	70	5 ,,	+	+	+	+	+	
10.30 ,,			70	5 ,,	+	+	+	+	+	

10.35 a.m.—Girl born. No oligopnœa. Total treatment, 6½ hours. Total scopol., gr. 1/40. Three injections.

October 24, 1915.—Mrs. M. Age 35. Multipara (fourth). Last child aged 9 years.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
Oct. 23.										
10.45 p.m.	½	1/100	66	3 mins.						Marked albuminuria. Os size of 2s. L.O.A.
Oct. 24.										
3.30 a.m.		1/200	78	3 ,,	Slight		+	+	—	Os size of 4s.
4.10 ,,			82	3 ,,	,,		+	+	+	
6.0 ,,			78	3 ,,	,,		+	+	+	
7.0 ,,		1/200	70	3 ,,	+		+	+	+	
9.15 ,,		1/200	78	3 ,,	+		+	+	+	
11.0 ,,			94	3 ,,	+		+	+	+	Os fully dilated. Ruptured the membranes.
12.0 ,,			90	3 ,,	+		+	+	+	

12.30 p.m.—Girl born. No oligopnœa. ½ c.c. pituitrin. Total treatment, 15¾ hours. Total scopol., gr. 1/10. Four injections.

November 24, 1915.—Mrs. R. Age 21. Primipara.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
11.30 a.m.	½	1/100	80	7 mins.						Os size of 5s. L.O.A.
1.15 p.m.			68	5 ,,				+		
1.30 ,,		1/100	68	5 ,,	Slight		+	+	+	Little nausea, sickness.
3.30 ,,			70	5 ,,	+		+	+	+	
4.30 ,,		1/200	66	5 ,,	+		+	+	+	
5.15 ,,			66	5 ,,	+		+	+	+	Remarked about sunset.
6.30 ,,		1/200	72	5 ,,	+		+	+	+	
7.20 ,,	½ Eutocine		72	5 ,,	+		+	+	+	
8.30 ,,			70	5 ,,	+		+	+	+	Head on perineum.

9.15 p.m.—Girl born. Slight oligopnœa. Total treatment, 10 hours. Total scopol., gr. 1/3. Five injections.

March 31, 1916.—Mrs. A. Age 29. Multipara (second).

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
1.15 p.m.	¼	1/100	98	10 mins.						Os size of 2s. 6d. L.O.A.
2.15 ,,			88	10 ,,	Slight			Drowsy	Clouded	
2.45 ,,		1/100	88	10 ,,	+			+	+	Os size of 5s.
3.15 ,,			90	8 ,,	+	+		+	+	
4.0 ,,			90	3 ,,	+	+		+	+	Os fully dilated.
4.15 ,,		1/200	90	3 ,,	+	+		+	+	
4.30 ,,			90	3 ,,	+	+		+	+	

4.35 p.m.—Boy born. No oligopnœa. Total treatment, 3½ hours. Total scopol., gr. 1/43. Three injections.

July 28, 1916.—Mrs. N. Age 24. Primipara.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
July 27.										
10.15 p.m.	¼	1/100	98	7 mins.						Os size of 1s. L.O.A.
11.50 ,,		1/200	90	7 ,,	+		+	Drowsy		
July 28.										
12.50 a.m.		1/300	90	3 ,,	+		+	+	+	
2.15 ,,	1/13	1/200	84	3 ,,	+			+	++	Os nearly half dilated.
3.30 ,,		1/200	86	3 ,,				+	++	
5.0 ,,		1/150	92	3 ,,		+		+	++	
6.30 ,,		1/150	88	3 ,,	+	+		+	++	Os fully dilated.
8.0 ,,		1/100	78	2 ,,	+	+		+	++	
9.0 ,,		1/100	78	2 ,,	+	+		+	++	Little restless; gave small whiffs of chloroform.

10.30 a.m.—Boy born. No oligopnœa. Two perineal sutures. Total treatment, 12¼ hours. Total scopol., gr. 1/21. Nine injections.

September 23, 1916.—Mrs. H. Age 30. Primipara.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
7.50 a.m.	¼	1/100	84	3 mins.						Os half dilated. L.O.A.
9.35 ,,		1/100	100		+			+	+	
11.20 ,,		1/100	94	2 ,,	+		+	+	++	
1.15 p.m.		1/100	94	2 ,,	+		+	+	++	Os dilated.
2.15 ,,		1/100	92	2 ,,	+		+	+	++	
4.0 ,,		1/100	96	2 ,,	+		+	+	++	

6.10 p.m.—Boy born. No oligopnœa. Total treatment, 10¾ hours. Total scopol., gr. 1/25. Six injections.

October 24, 1916.—Mrs. F. Age 49. Primipara.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
3.20 a.m.	¼	1/100	98	5 mins.						Albuminuria. Œdema. Os size of 1s. L.O.A.
5.20 ,,		1/100	86	3 ,,	+					
6.30 ,,			80	2 ,,	+		+	+	++	Os half dilated.
7.30 ,,		1/120	80	2 ,,	+		+	+	+	
8.30 ,,			78	2 ,,	+			+	+	Os fully dilated.
8.50 ,,		1/100	74	2 ,,	+			+	+	
9.0 ,,			72	2 ,,	+			+	+	

9.30 a.m.—Girl born. No oligopnœa. Cord twice round neck. Total treatment, 6 hours. Total scopol., gr. 1/25. Four injections. This case is commented upon in the text. Larger doses were given because of the albuminuria.

November 17, 1916.—Mrs. T. Age 26. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
1.35 a.m.	½	1/100	80	5 mins.						Os size of 2s. L.O.A.
3.30 ,,		1/100	80	5 ,,	Slight		+			
5.45 ,,		1/200	80	5 ,,	+		+	+	++	
6.25 ,,		1/200	76	5 ,,	+		+	+	++	
7.35 ,,		1/200	80	3 ,,	+		+	+	++	Membranes ruptured.
9.20 ,,		1/200	70	3 ,,	+		+	+	++	
10.30 ,,		1/150	76	3 ,,	+		+	+	++	Os fully dilated.
12.15 p.m.		1/150	74	3 ,,	+		+	+	++	
2.0 ,,		1/200	72	3 ,,	+		+	+	++	

2.30 p.m.—Girl born. No oligopnœa. Total treatment, 13 hours. Total scopol., gr. 1/17. Nine injections.

February 1, 1917.—Mrs. H. Age 26. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
3.45 a.m.	½	1/100	94	5 mins.						Os size of 2s. L.O.A.
6.0 ,,		1/100	78	5 ,,	Slight			+		
8.15 ,,		1/150	78	5 ,,	+			+	++	Os size of 5s.
9.0 ,,			78	3 ,,	+	+		+	++	
9.30 ,,		1/200	72	3 ,,	+	+		+	++	Os almost fully dilated.
10.0 ,,			70	3 ,,	+	+		+	++	
10.55 ,,		1/200	70	2 ,,	+	+		+	++	Head on perineum.
11.30 ,,			70	2 ,,	+	+		+	++	

11.45 a.m.—Boy born. No oligopnœa. Total treatment, 8 hours. Total scopol., gr. 1/17. Five injections.
Note in this chart, what so many of them show, a steady slowing of the pulse-rate, clearly showing the increasing shielding from the effects of the pain.

February 13, 1917.—Mrs. D. Age not known in this case. Multipara (second).

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes : Progress of Labour.
7.20 a.m.	½	1/100	100	2 mins.						Os fully dilated. L.O.A.
8.10 ,,			90	2 ,,	Slight			+	+	Membranes ruptured.
8.40 ,,		1/200	86	2 ,,	+			+	+	
9.20 ,,		1/200	86	2 ,,	+			+	+	Head on perineum.

9.50 a.m.—Boy born. Slight oligopnœa. Total treatment, 2½ hours. Total scopol., gr. 1/60. Three injections.

February 13, 1917.—Mrs. G. Age 28. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes : Progress of Labour.
Feb. 12.	M.	Hy.								
2.30 a.m.	½	1/100	76	5 mins.						Os size of 1s. L.O.A.
4.20 ,,		1/150	70	5 ,,	+			+		
7.20 ,,		1/100	70	5 ,,	+			+	+	Little sickness.
9.45 ,,		1/150	74	5 ,,	+			+	+	
11.50 ,,		1/200	72	3 ,,	+			+	+	
12.50 p.m.		1/150	70	3 ,,	+			+	+	Os size of 5s.
2.35 ,,		1/200	76	3 ,,	+			+	+	
5.0 ,,		1/150	68	3 ,,	+			+	+	Os fully dilated.
7.20 ,,		1/150	64	3 ,,	+			+	+	
8.55 ,,		1/200	64	3 ,,	+			+	+	Head on perineum.
9.55 ,,		1/200	64	3 ,,	+			+	+	
12.30 a.m.			66	3 ,,	+			+	+	

1.15 a.m. Boy born. No oligopnœa. Total treatment, 22¾ hours. Total scopol., gr. 1/12. Twelve injections. The husband of this patient, a doctor, helped me to conduct it the whole time, and enthusiastically agreed how little was the danger to the child.

March 18, 1917.—Mrs. B. Age 33. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
8.40 a.m.	½	1/100	86	5 mins.						Os slightly larger than 1s.
11.10 ,,		1/150	72	5 ,,	+		+	+	+	
12.50 p.m.		1/150	72	5 ,,	+		+	+	++	Os size of 5s.
1.55 ,,		1/200	74	5 ,,	+		+	+	++	
4.10 ,,		1/150	74	3 ,,	+		+	+	++	
6.0 ,,		1/150	80	3 ,,	+		+	+	++	Os fully dilated.
7.45 ,,		1/200	78	3 ,,	+		+	+	++	
9.0 ,,			78	3 ,,	+		+	+	+	

9.45 p.m.—Girl born. No oligopnœa. Total treatment, 13 hours. Total scopol., gr. 1/23. Seven injections.

May 5, 1917.—Mrs. H. Age 23. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
4.25 a.m.	½	1/150	72 irreg.	10 mins.						Os size of 1s. L.O.A.
7.0 ,,		1/150	66 reg.	8 ,,	+			+		
7.30 ,,			66 ,,	8 ,,	+			+	+	
9.0 ,,		1/300	66 ,,	5 ,,	+			+	+	
10.0 ,,			68 ,,	5 ,,	+			+	+	
11.0 ,,		1/300	68 ,,	5 ,,	+	+		+	+	Os nearly dilated.
12.45 p.m.		1/150	68 ,,	3 ,,	+	+		+	+	Os fully dilated.
1.40 ,,			70 ,,	3 ,,	+	+		+	+	

1.45 p.m.—Girl born. No oligopnœa. Total treatment, 9½ hours. Total scopol., gr. 1/33. Five injections.

May 23, 1917.—Mrs. P. Age 35. Multipara (fourth).

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
2.55 p.m.	$\frac{1}{6}$	$\frac{1}{100}$	70	10 mins.						Os size of 2s. 6d. L.O.A.
4.0 ,,			66	10 ,,	Slight			+		
6.30 ,,		$\frac{1}{100}$	60	7 ,,	+			+	+	Os three-quarters dilated. Membranes ruptured.
8.30 ,,		$\frac{1}{100}$	62	7 ,,	+			+	+	Os fully dilated.
10.0 ,,		$\frac{1}{300}$	64	5 ,,	+			+	+	
10.20 ,,			60	5 ,,	+			+	+	

10.25 p.m.—Boy born. No oligopnœa. Total treatment, 8 hours. Total scopol., gr. $\frac{1}{40}$. Four injections.

May 26, 1917.—Mrs. P. Age 29. Primipara.

Time.	Injections. M.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes : Progress of Labour.
May 25.										
4.45 p.m.	$\frac{1}{6}$	$\frac{1}{100}$	88	10 mins.						Os size of 1s. R.O.P.
7.0 ,,		$\frac{1}{150}$	74	10 ,,	+			+		
8.30 ,,		$\frac{1}{100}$	78	10 ,,	+			+	++	
10.35 ,,		$\frac{1}{100}$	72	10 ,,	+		+	+	+	
May 26.										
12.15 a.m.		$\frac{1}{100}$	72	10 ,,	+		+	+	+	Os size of 2s. 6d.
3.15 ,,		$\frac{1}{100}$	70	7 ,,	+		+	+	+	
4.45 ,,		$\frac{1}{100}$	76	7 ,,	+		+	+	±	
6.45 ,,	$\frac{1}{12}$	$\frac{1}{100}$	80	5 ,,	+		+	+	+	Pains violent : little restless.
8.40 ,,		$\frac{1}{200}$	78	5 ,,	+		+	+	+	Os three-quarters dilated.
9.30 ,,		$\frac{1}{150}$	74	5 ,,	+		+	+	+	
11.0 ,,		$\frac{1}{100}$	80	5 ,,	+		+	+	+	
12.45 p.m.		$\frac{1}{200}$	82	3 ,,	+		+	+	+	Os fully dilated.
2.40 ,,		$\frac{1}{200}$	80	3 ,,	+		+	+	+	Ruptured the membranes.
3.50 ,,			76	3 ,,	+		+	+	+	

4.30 p.m.—Boy born. Slight oligopnœa. Total treatment, $23\frac{3}{4}$ hours. Total scopol., gr. $\frac{1}{11}$. Thirteen injections.

July 22, 1917.—Mrs. G. E. Age 21. Primipara.

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
July 20.										
11.15 p.m.	½	1/100	100	3 mins.						Membranes ruptured twelve hours before. Os not quite size of 2s. L.O.P.
12.25 a.m.		1/100	78	3 ,,	Slight			Drowsy		
2.0 ,,		1/100	80	3 ,,	,,			+		
3.45 ,,		1/100	74	3 ,,	+			+	++	
5.20 ,,		1/100	80	3 ,,	+			+	+	
7.20 ,,		1/100	78	3 ,,	+			+	+	
9.10 ,,		1/100	70	3 ,,	+			+	+	Os size of 2s. 6d.
10.55 ,,		1/100	76	3 ,,	+			+	+	
12.45 p.m.		1/100	78	3 ,,	+			+	+	
2.15 ,,		1/200	80	3 ,,	+			+	+	
3.15 ,,		1/200	80	3 ,,	+			+	+	
4.20 ,,		1/200	80	3 ,,	+			+	+	
5.50 ,,		1/200	78	3 ,,	+			+	+	
7.30 ,,		1/200	78	3 ,,	+			+	+	Os half dilated.
9.0 ,,		1/100	80	3 ,,	+			+	+	
10.35 ,,		1/200	80	3 ,,	+			+	+	
12.30 a.m.		1/200	80	3 ,,	+			+	+	Os fully dilated.
2.0 ,,			78	3 ,,	+			+	+	

3.0 a.m.—Boy born. No oligopnœa. Total treatment, 28¾ hours. Total scopol., gr. 1/10. Seventeen injections. This case illustrates the advantages in a long, tedious and very painful first stage. Note, too, the regularity of the pains, which retained their full intensity the whole time.

August 9, 1917.—Mrs. R. Age 29. Multipara (fourth).

Time.	Injections. M.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
										Twins.
11.0 p.m.	$\frac{1}{6}$	$\frac{1}{150}$	90	5 mins.						Os size of 5s. L.O.A.
12.5 a.m.		$\frac{1}{150}$	74	5 ,,	Slight			Drowsy		Os almost dilated.
12.35 ,,			74	5 ,,	+			+	+	
1.17 ,,		$\frac{1}{300}$	72	5 ,,	+			+	++	
1.45 ,,			70	5 ,,	+			+	++	1 c.c. pituitrin.

1.50 am.—Boy born. Cord once round neck. $7\frac{1}{4}$ lb. 2.0 a.m.—Boy born. R.O.P. Brow presentation. $7\frac{1}{2}$ lb.
No oligopnœa. Completely separate placentæ.
Total treatment, 3 hours. Total scopol., gr. $\frac{1}{100}$. Three injections.

August 10, 1917.—Mrs. D. Age 40. Multipara (fifth).

Time.	Injections. Om.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
1.50 p.m.	$\frac{1}{3}$ gr.	$\frac{1}{150}$	70	15 mins.						Os size of 5s. L.O.A.
3.0 ,,		$\frac{1}{400}$	68	5 ,,	+			+	++	Os fully dilated. Head engaged.
3.20 ,,			68	5 ,,	+			+	+	

3.30 p.m.—Girl born. Slight oligopnœa. Total treatment, $1\frac{3}{4}$ hour. Total scopol., gr. $\frac{1}{100}$. Two injections.

August 11, 1917.—Mrs. C. Age 30. Multipara (fifth).

Time.	Injections. Om.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
4.45 a.m.	½	1/200	78	10 mins.						Os size of 2s. L.O.A.
6.15 ,,		1/200	70	6 ,,	+			+	+	
7.50 ,,		1/200	70	3 ,,	+			+	++	Os fully dilated.
8.30 ,,			72	3 ,,	+			+	++	Head on perineum.

8.45 a.m.—Girl born. No oligopnœa. Total treatment, 4 hours. Total scopol., gr. 1/75. Three injections.
This is the chart of the same patient to whom the chart dated June 25, 1915, belongs.

August 22, 1917.—Mrs. B. Age 29. Primipara.

Time.	Injections. Om.	Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
1.0 a.m.	½	1/200	80	5 mins.						Os size of 2s. L.O.A.
2.20 ,,		1/150	70	5 ,,	+					
3.30 ,,		1/150	66	5 ,,	+			+		Os half dilated.
5.0 ,,	½	1/150	62	5 ,,	+			+	++	
6.50 ,,		1/150	62	5 ,,	+			+	++	Os fully dilated.
8.30 ,,		1/200	62	5 ,,	+			+	++	

9.0. a.m.—Boy born. Slight oligopnœa. Total treatment, 8 hours. Total scopol., gr. 1/75. Six injections.
This chart illustrates a case where a longer time than the average was needed to obtain perfect amnesia. With "one dose" this case would have been a total failure. With "standardised" dosage it would probably have been at least one and a half time longer before any result was obtained.

August 30, 1917.—Mrs. H. Age 36. Primipara.

Time.	Injections. Om.	Injections. Hy.	Pulse.	Pains.	Flushing.	Pupils.	Thirst.	Sleep.	Memory Test.	Notes: Progress of Labour.
7.50 a.m.	$\frac{1}{4}$	$\frac{1}{400}$	60	7 mins.						Os size of 1s. Breech.
9.30 ,,			58	7 ,,	+			+	Clouded.	
10.0 ,,			56	5 ,,	+			+	+	
10.30 ,,		$\frac{1}{180}$	54	5 ,,	+			+	+	
11.15 ,,			54	3 ,,	+			+	+	Os fully dilated.
12.0 ,,			56	3 ,,	+			+	+	

12.40 p.m.—Girl born. Pressure on cord caused some cyanosis. Recovery with Schultze's artificial respiration. Total treatment, 5 hours. Total scopol., gr. $\frac{1}{82}$. Two injections.

This case, compared with the preceding one (August 22, 1917), clearly shows how superior is individualisation of the dosage to standardisation. This case had scopol. gr. $\frac{1}{82}$ in the total 5 hours; the earlier one had gr. $\frac{1}{40}$ in the same time.

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