

HEALTH BULLETIN No. 27

Report of an Enquiry into the Causes of Maternal Mortality in Calcutta

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CONTENTS

	PAGE
INTRODUCTION	i
Part I	
Chapter—	
I. <i>Scope of the enquiry.</i> —Area. Vital statistics available. Definition of “maternal death” used in the enquiry	1
<i>Method of work.</i> —Selection of maternal deaths from total registered female deaths between 10 and 50 years. Sources of possible omission of cases. Staff for investigation of deaths and their method of work.	
<i>The maternal mortality rate.</i>	
<i>Allocation of cases to causes of death.</i> —Classification of maternal deaths according to International List of Diseases of Child bearing. Additional heading for “Anæmia”. Disparity between ascertained and registered causes of death. Causes of deaths; summary of findings.	
II. <i>Preventibility.</i> —The primary avoidable factor. Standard used in other enquiries and modifications adopted	14
III. <i>Factors influencing mortality.</i> —The birth curve in Calcutta. Season and climate, community and province of origin. Age, gravidity. Duration of pregnancy. Home conditions	19
Cleanliness of house. Water supply. Ventilation. Drainage. Overcrowding. Economic status. Diet.	
Place of delivery, treatment and death. Attendant at delivery.	
IV. <i>The Maternity Services in Calcutta</i>	33
V. <i>Recommendations</i>	39
Part II.	
<i>Detailed analysis of maternal deaths by causes.</i> —	
I. Maternal deaths from childbearing causes	43
II. Maternal deaths from associated diseases	87
<i>References</i>	93
<i>Appendices</i> —A, B, C, (tables)	95
D. A statistical study of the seasonal incidence of maternal mortality by S. Swaroop, M.A.	110
E. Eclampsia and humidity by S. Swaroop, M.A.	115

Introduction.

Maternal mortality, either directly or indirectly due to childbearing causes, is known to contribute largely to the toll of female life in India, but exact information on the subject is very meagre. Such returns as are available from the Health Departments of different provinces show figures for maternal mortality rates which vary greatly from province to province. They are based, in some cases, on returns from limited areas only, and the figures are valueless on account of inaccuracy of registration of births and deaths and unreliability of stated causes of death. They give no idea of the true state of affairs.

An indirect light on the importance of childbearing in contributing to maternal mortality is provided by comparing mortality rates for males and females in the reproductive period of life (Appendix A, Table I). The figures for British India in the Report of the Public Health Commissioner for the year 1936 show that during the age period 15 to 40 years the female death rate was consistently higher than the male death rate, and the greatest difference between the rates occurred in the age period 20 to 30 years. Some provinces and some municipalities show very startling differences in these death rates, *e.g.*, in Calcutta in 1936 the death rate for males in the age period 20 to 30 years was 23·5 and for females it was 47·2. It is not unreasonable to suppose that childbearing is a major factor, which contributes either directly or indirectly or both, to the different rates in the two sexes. The other important factor is tuberculosis, and the two interact with one another.

Early marriage is often blamed for the high female death rate and there is evidence for its adverse effect on maternal mortality, but the results are not immediately obvious ; it is not so often in her first or even in her second pregnancy or labour that the very young mother dies, but later when worn out by too early childbearing and child-rearing and often by too rapidly repeated pregnancies, she succumbs as a multipara, to anæmia, sepsis, hæmorrhage or perhaps most frequently of all, to tuberculosis, when she is between 20 and 30 years of age. This is the time when the evil effects of very early marriage can be demonstrated.

An extensive survey was conducted by Major-General Sir John Megaw in 1933. He investigated certain public health aspects of village life and estimated that the maternal mortality rate in India as a whole was not less than 24·5 per 1,000 births.

More definite information is available in regard to causes of maternal deaths in hospital cases. Dr. Margaret Balfour in 1925-26 conducted an enquiry under the auspices of the Indian Research Fund Association. She collected particulars relating to 11,343 deliveries in hospitals in different parts of the country. Amongst these deliveries there were 244 maternal deaths. A few years later the Council of the Association of Medical Women in India, recognising how much valuable information on the subject of maternal morbidity and mortality was obtainable from the records in women's hospitals, began, in the year 1933, to collect annual returns from a number of hospitals staffed by members of the Association. These hospitals were scattered widely over the country and provided samples of conditions existing in many of the provinces and States. Since 1935 these returns have been submitted in a

uniform manner which has made it possible to tabulate them and classify the maternal deaths according to the International List of causes. In the course of 4 years 1935 to 1938 information relating to 125,428 deliveries and details regarding 3,032 maternal deaths have become available (Appendix A, Table 3). The frequency distribution of deaths by causes in a hospital series of cases is by no means an exact reflection of conditions in the whole population, but with certain minor modifications a fairly true picture is believed to be obtained. These hospital returns have shown that, while puerperal sepsis is the most frequent cause of maternal death, as is the case in other countries, *anaemia* comes second in importance, and indeed is so often a contributing cause that it may be considered an equally important factor in contributing to maternal mortality in this country. Remarkable variations in the frequency of anæmia, eclampsia and osteomalacia in hospitals in different parts of the country suggest important avenues of future research.

Two maternal mortality surveys have been carried out in Madras Presidency. The Madras Public Health Department in 1927-28 collected figures in four of the largest municipalities of the Province excluding Madras and showed a maternal mortality rate of 18.5 per 1,000 total births. Later, in 1930-31, Dr. A. L. Mudaliyar carried out a detailed investigation of 436 maternal deaths which occurred during a 12 month period in Madras city. He found a maternal mortality rate for that city of 16.6 per 1,000 total births.

Another survey was made in Assam in 1932 by Dr. Margaret Balfour who collected information relating to maternal mortality amongst coolie women working in 31 tea gardens. The maternal mortality rate in connection with 9,733 deliveries over a 3-year period was found to be as high as 42 per 1,000. Anæmia was stated to be the cause of death in 50 per cent. of cases. Subsequent investigation by Dr. L. E. Napier, of the forms of anæmia amongst tea garden coolies in Assam, suggests that both iron deficiency and megalocytic anæmia are prevalent.

Information regarding maternal deaths in rural areas in India is almost non-existent. In 3 rural health units under the direction of the Rockefeller Foundation during the period of the Calcutta Enquiry, 31 maternal deaths were reported in association with 5,807 births. This gives a maternal mortality rate of 5 per 1,000 total births. These figures are very small and until further information is available no conclusions can be drawn, but it is probable that rural maternal mortality rates (except in areas where such conditions as osteomalacia or anæmia are very common), will be found to be lower than urban rates.

The need for more accurate knowledge based on whole population studies caused the Maternal Mortality Advisory Committee of the Indian Research Fund Association in 1935, to recommend that a grant be provided for the first of a series of enquiries into the causes of maternal mortality. The enquiry was conducted in the All-India Institute of Hygiene and Public Health in Calcutta for the period of a year in 1936-37 and the information collected has provided the material for this report. A series of 887 maternal deaths was investigated which gives a maternal mortality rate for Calcutta of 24 per 1,000 registered live births. This figure must, however, be accepted with reserve for reasons that are discussed in the text.

The report which follows was written in the first place as a record of facts which were ascertained by the courtesy of superintendents of institutions and private practitioners and from information given by relatives and attendants of the women who had died. It was, however, considered by

the members of the sub-committee of the Maternal Mortality Advisory Committee, to which the report was submitted, that it would serve a more useful purpose if it contained a critical survey of the existing maternity services in Calcutta and recommendations based on the findings of the enquiry. These sections have therefore been added later. I wish to express my thanks to Dr. C. L. Houlton, Dr. J. M. Orkney and Dr. K. C. K. E. Raja, members of the sub-committee to which the report was submitted, for their very helpful criticisms and suggestions.

This enquiry was financed by the Indian Research Fund Association but was only possible with the help of the Public Health Department in Calcutta and the co-operation of many other individuals in public and private capacities and this assistance is gratefully acknowledged. We owe much to Dr. L. M. Biswas, Health Officer, Calcutta Corporation, for assistance, without which the work could not have been attempted with only two research assistants, and to the Sub-Registrars of the Calcutta Corporation on whom certain extra duties devolved. We also thank the superintendents of hospitals, maternity homes and welfare centres for so kindly putting their records at our disposal, and those private practitioners who spent a considerable time in giving us the information that we required.

I am very much indebted to Dr. K. C. K. E. Raja, not only for arranging for the mechanical analysis of the findings in the Vital Statistics Department of the All-India Institute of Hygiene and Public Health, but for generous help given on many occasions and particularly for his expert advice on statistical points. I also thank Mr. S. Swaroop for so kindly writing the statistical notes on the seasonal incidence of certain complications of pregnancy.

I am very grateful to Dr. Houlton, C.M.O., W.M.S., who lent the services of two temporary (now permanent) officers of the Women's Medical Service as research assistants; also to Dr. Lal, Acting Director of the Institute of Hygiene for his help, and to General Mills, Surgeon-General with the Government of Bengal, for supplying information relating to existing hospital facilities in Calcutta.

Lastly, I want to thank my assistants, Dr. Massick, Dr. Pandit and Dr. Shaw, who were entirely responsible for the actual work of following up cases and collecting information, and to say how much I appreciated the persistence, patience and tact with which they pursued a difficult and often depressing task; also Mr. A. P. Das Gupta, for his very reliable work in the matter of tabulation and calculations required for this report.

M. I. NEAL EDWARDS.

An Enquiry into the Causes of Maternal Mortality in Calcutta

Part I

CHAPTER I.

SCOPE OF THE ENQUIRY.

The object of this enquiry was to enquire into the number and investigate the causes of maternal deaths in Calcutta. The period during which follow-up of deaths took place was June 15th, 1936 to June 14th, 1937.

Area

The area chosen was that which is under the control of the Health Officer of the Calcutta Corporation. This area includes Calcutta proper and certain "Added Areas"; it does not include Howrah or Garden Reach. The area is divided into 31 wards, is 27 sq. miles in extent and has a population of approximately 1,160,000. The ratio of males to females is 2.1 to 1. The death rate of males in 1935 was 23 per 1,000 and of females 39 per 1,000. (Annual Report of the Health Officer, Calcutta Corporation for 1935).

The only information which was forthcoming from the annual reports of the Health Officer regarding the number and causes of maternal deaths in Calcutta appeared under the heading "Diseases of Childbed". The figures shown under this head in the three latest reports issued were as follows :—

Diseases of childbed.—(Reports of the H. O., Calcutta Corporations 1933, 1934 and 1935, Table VII).

	1933.	1934.	1935.
Puerperal septicaemia (acute)	69	56	98
Puerperal diarrhoea (sutika)	59	130	125
Childbirth	103	116	99
	<hr/>	<hr/>	<hr/>
	231	302	322

It was evident that this was an incomplete picture of deaths from child-bearing causes and it seemed likely that the actual number of such deaths must be considerably greater than these figures suggest.

Definition

The definition of "maternal death" which has been adopted for the purpose of this enquiry was that used in the enquiry into maternal mortality made by the Department of Health for Scotland a few years ago and is expressed as follows :—

"Maternal deaths which occurred during pregnancy or within four weeks after the termination of pregnancy, or later if illness originated during pregnancy, childbirth or the puerperium".

Method of collection of Maternal Deaths

Registration of deaths in Calcutta is carried out in the following manner : Sub-registrars, officers of the Calcutta Corporation, are stationed at all public

burning ghats and burial grounds and are required to submit daily to the health department, a registration card duly completed in the case of each dead person whose body is brought for disposal. These registration cards provide information regarding the name, age, sex, community and place of death, the name and address of the householder, the cause of death and the name of doctor (if any) certifying death. If no medical certificate is forthcoming the sub-registrar himself, who in some cases is a medical man, makes enquiries of the relatives and makes a provisional diagnosis of the cause of death. Later a sanitary officer makes further enquiries into the matter.

The registration cards in use provide no information regarding any relationship there may have been with pregnancy and childbirth; therefore a complete investigation of maternal deaths would have had to include follow-up of all deaths of women in the childbearing period of life. As this would have involved more work than could possibly be undertaken by the workers provided, some method of preliminary selection of female deaths with a definite or likely association with childbearing had to be devised.

Cards were prepared identical with those in regular use by the sub-registrars but with the addition of the name of the enquiry and the following questions :—

Was she pregnant at the time of death ?

Did she die during labour or abortion ?

Did she die within 3 months after labour or abortion ?

The Health Officer was kind enough to issue orders that these duplicate cards should be filled up for all female deaths between 10 and 50 years and, that these cards should be returned with the ordinary registration cards.

We arranged to collect the duplicate cards daily from the Health Office and thereby obtained notice of deaths within 1-3 days of their occurrence so that investigation was possible with very little further delay.

Arrangements to receive the duplicate cards were made about three months before the enquiry actually started and cards were coming in regularly when the investigation of deaths began on June 15th. In order to make sure that duplicates were being sent to us in each case and from each burial ground and burning ghat, we obtained permission to check our cards with the cards submitted to the Health Office, and this checking was carried on throughout the enquiry. When omissions were found, which happened occasionally, copies were made of the original registration card but the special information relating to childbearing was in these cases not forthcoming. The sub-registrars sometimes found difficulty in obtaining the information we required from the relatives at the burial grounds and burning ghats and the questions on the cards were sometimes unanswered or doubtful. When this happened the card was considered from the following points of view : if the death had occurred in the childbearing period of life and was said to have been due to a cause which was at all likely to be associated with childbearing, e.g., anæmia, heart failure, tetanus, the death was followed up for further details. If however the death was in a very young or old woman or was certified as due to e.g., carcinoma of cervix, pulmonary tuberculosis, smallpox, that is to say if it was most unlikely to be *directly* due to childbearing,

the case was not followed up further. We realised that in this way a few cases, particularly some due to diseases *associated with* childbearing, would be lost, but workers were insufficient to avoid this source of error.

All definite maternal deaths and others likely to have been associated with childbearing which occurred during the period June 15th, 1936 to June 14th, 1937 were selected in the above manner and followed up in detail.

The total "definite" and "likely" maternal deaths was 1,181, and of these 887 were found to be maternal deaths according to the definition adopted in the enquiry. These 887 cases were investigated in detail and the findings have provided the material for this report.

Sources of Error in Collection of Cases

It is impossible to say how accurately our findings represent the true maternal mortality in Calcutta during the year of the enquiry. The following are possible sources of error :—

1. *Failure to register deaths.*—This may happen if disposal of the body takes place outside municipal limits or in private burial grounds (of which a certain number exist in Calcutta).
2. *Failure to receive duplicate registration cards in all cases.*—This was guarded against as far as possible by checking the cards we received with the original cards submitted to the health department.
3. *Incorrect information obtained by sub-registrars regarding association with pregnancy or child-birth.*—If the registered cause of death suggested the likelihood of any association being present, the case was followed up. But a few cases have probably been lost in this way.
4. *Failure on the part of sub-registrars to obtain information relating to pregnancy and childbirth.*—The registered cause of death was the only guide in these cases (see above).
5. *Inability to trace cases of death in which the association with childbearing was definite or doubtful.*—If the case could not be traced owing to a wrong address or to the relatives having left Calcutta and there was said to have been definite association with childbearing, the case was included as a maternal death and classified according to the registered cause or "unknown". If the association was only doubtful the case was omitted. There were very few cases of this type and it is not an important source of error.

The omissions from amongst registered deaths which may have arisen in the ways suggested above are probably few. We believe that amongst these the number of cases directly due to childbearing which have been missed is very small, but there undoubtedly are some cases in which death was associated with childbearing but not directly due to it, which have unfortunately not been included. We have no means, however, of estimating the error which has been introduced by *failure to register* deaths.

Imported Cases

A number of women come to Calcutta from rural districts and distant places for confinement and a proportion of these come on account

of some complication of pregnancy or childbirth. Amongst the 887 deaths followed up there were 203 imported cases. These deaths should not strictly speaking be included amongst Calcutta deaths, but it is not altogether accurate to exclude them for the reason that many of these women stayed with relations in Calcutta, or their confinements took place in one of the large hospitals, and in either of these cases the birth would have been registered in Calcutta. The number of imported cases in which this occurred is unknown and impossible to estimate. This point is chiefly important in connection with the maternal mortality rate, but unfortunately the latter figure, owing to defective registration of births, cannot in any case be correctly ascertained.

The importance of the imported cases from the point of view of this enquiry lies in the fact that in these cases home visits were generally not possible or the information collected was incomplete because the relatives had left Calcutta.

Imported cases have been analysed together with Calcutta cases in this report but they have also been classified separately as regards causes of death. (Table 7).

Method of Investigation of deaths

All maternal deaths were followed up within a few days of receiving the duplicate registration cards. Visits to the home were made for the collection of information regarding past history, living conditions, health in pregnancy, the place of delivery and names of attendants. The doctor, midwife or dai who had attended the case was visited, or if the death had occurred in a hospital or maternity home, the particulars were collected from the institution concerned. Superintendents of hospitals and maternity homes had previously been requested to supply the required information in the case of maternal deaths which might occur during the period of the enquiry.

Two women doctors were appointed by the Indian Research Fund Association for the work of following up the deaths. It was necessary that these workers should possess a sound knowledge of obstetrics in order that the facts might be collected intelligently and so provide the desired information regarding the direct and indirect causes of death. They also needed in no small measure the capacity for making successful contact in the homes with the relatives of the women who had lately died and with their medical attendants. The work demanded considerable patience and persistence, from the initial difficulty of finding the homes, the addresses of which were often inadequate, to the final appointment with the doctor who had attended or the tracing of the case sheet amongst hospital records. The workers whom we were fortunate in obtaining are to be congratulated on the successful way in which they carried through the work.

Visiting a family in which a death of a mother has recently occurred is, from the point of view of scientific investigation, no easy matter. There may be a feeling of resentment against doctors or hospitals and in any case it is understandable that the members of the bereaved family feel that they have nothing to gain from discussion of the details of the history and the circumstances of the death. The feelings of the attendants also may be such that discussion of the case is unwelcome. These points are mentioned but only to emphasise how remarkably little opposition, either from relations or attendants at delivery, was met with in the large majority of cases when the

objects of the enquiry were made clear. (There were however a few isolated cases in which information was refused and certain others in which it was thought that facts were withheld).

A weekly meeting between the investigators and the officer in charge of the enquiry was held for the purpose of reaching a conclusion regarding the cause of death and the avoidable factors present in all cases for which schedules had been completed within the previous week. In this way each case was discussed while the circumstances were fresh in the minds of the investigators and further details could be elicited or further enquiries made, if considered necessary.

In some cases all the information which could be collected was not sufficient to make a diagnosis possible but in the large majority a conclusion could be agreed upon which seemed to be justified by the data at our disposal.

Maternal Mortality Rate

The accurate estimation of the maternal mortality rate in Calcutta is not possible on account of defective birth registration and the fact that our series of maternal deaths unfortunately cannot be claimed to be complete. The possible sources of omission of cases in the collection of maternal deaths have already been discussed.

The Calcutta Municipal Act of 1923, Section 451, requires registration of births within 8 days. The number of births which escape registration is however very large, and probably varies considerably from ward to ward. In Ward 8, intensive home visiting in connection with the Maternity and Child Welfare Centre attached to the All-India Institute of Hygiene and Public Health has revealed that the percentage of error between registered and ascertained births in this particular area was 37 per cent. in 1934, 22 per cent. in 1935 and 19 per cent. in 1936. The increasing accuracy in registration is undoubtedly due to the efforts of the health visitors in urging registration and to the fact that births still unregistered after some weeks are reported to the District Health Officer who takes steps to investigate them. It is obviously impossible with the help of these few figures to make any correction for the whole of Calcutta.

The total number of registered live births which occurred during the period of the enquiry, from June 15th, 1936 to June 14th, 1937, was 28,714 and in addition 2,889 stillbirths were registered. The registration of stillbirths is believed to be even less accurate than that of live births. It seems better therefore to express the rate per live births. The figures at our disposal *viz.*, 28,714 live births and 701 maternal deaths due directly to childbearing causes gives a maternal mortality rate of 24·41 per 1,000 registered live births. If imported cases are excluded the rate becomes 17·90 per 1,000 live births but as was explained earlier (page 4) the births in connection with some of the imported cases of maternal death were registered in Calcutta. The exact number of these births could not be estimated and excluded from the total registered births of the city. The rate of 17·9 must therefore be considered an under-estimate. The true maternal mortality rate in Calcutta remains unknown.

Allocating Cases to Cause of Death

In classifying the cases according to the cause of death the *International List of Causes of Death (1929 revision)*, has been followed as closely as possible.

It has been found necessary however to make an additional heading for "anæmia". The relationship between the severe anæmias and pregnancy in India is probably an even more intimate one than exists between cardiac disease and pregnancy, and whether death from heart failure in pregnancy complicated by cardiac disease should or should not be classed to childbearing is a matter of opinion. It has seemed most accurate therefore to class the anæmia deaths with deaths *due directly* to childbearing and not with diseases *associated* with childbearing.

The rules laid down in the *Manual of Joint Causes of Death* which was designed to insure uniformity in ascribing primary causes of death, have been followed as far as possible but certain cases in which several contributing factors were present, for example, anæmia, toxæmia and operative shock, or information regarding their relative importance has been meagre, the classification has been very difficult and it is recognised that in certain cases different workers might have reached two equally reasonable conclusions from the same data.

Disparity between Ascertained and Registered Cause of Death

The probable cause of death as ascertained after enquiry did not correspond in about a quarter of the cases with the cause of death as registered. Many Calcutta deaths are not certified by a medical practitioner. In many others the doctor who certifies is called very late in the course of the fatal illness. It was therefore to be expected that our investigation would in many instances provide information which would lead to a different diagnosis of the cause of death from that which appeared on the registration card. But the main reason for the discrepancies between ascertained and registered causes arose from the use in some cases of primary and in others of secondary causes of death on the registration cards. For example "heart failure" unqualified, was frequently met with and covered such deaths as were found to be due to hæmorrhage, anæmia, operative shock, embolism and others. Again, the term "sutika" was in common use for deaths from varying causes including puerperal sepsis with diarrhœa, anæmia with intestinal symptoms, and abdominal tuberculosis in the puerperium. Accurate classification of causes of death is not possible under the present method of certification and registration in Calcutta.

It was found that in the series of 887 maternal deaths there were 656 or 74 per cent. of the total in which the registered and ascertained cause corresponded while in 231 or 26 per cent. a different conclusion as to the cause of death was reached after investigation.

Causes of Maternal Death

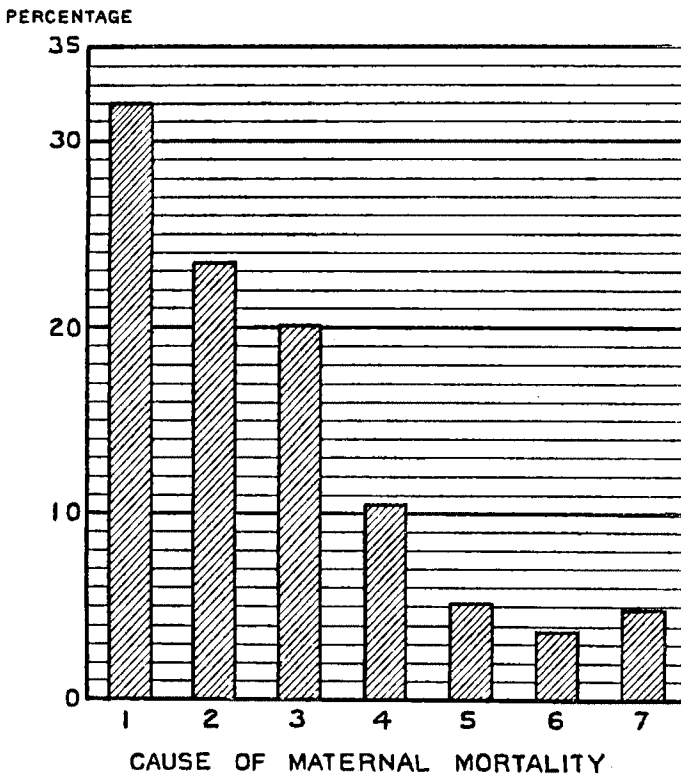
The 887 maternal deaths investigated have been divided into two classes :—

	Cases.
Class I.—Deaths due directly to childbearing	701
Class II.—Deaths due to an independent disease concurrent with pregnancy or childbirth	186

The cases in Class I have been divided into groups according to the headings of the International List of Causes of Death (1929 revision) with the addition of a separate heading for anæmia.

In the whole series there were 203 imported cases of which 187 were in Class I and 16 in Class II.

No. 1
MATERNAL DEATHS FROM CERTAIN CAUSES
AS PERCENTAGES OF TOTAL DEATHS
DUE DIRECTLY TO CHILDBEARING



- 1 Puerperal sepsis.
- 2 Anaemia.
- 3 Toxaemias of pregnancy.
- 4 Haemorrhage.
- 5 Abortion.
- 6 Accidents of labour and operative shock.
- 7 Others.

The following table shows the distribution of deaths by cause as ascertained after investigation in Calcutta cases, imported cases and in the combined series. The distribution of deaths due directly to childbearing is shown graphically on the opposite page.

TABLE I.

Maternal deaths.—Distribution by cause (International List, 1929 revision)

Int. List No.	Deaths due directly to childbearing.	Calcutta cases.		Imported cases.		Total.	
			%		%		%
140	Abortion (septic)	25	4.86	8	4.28	33	4.71
141	Abortion (non-septic)	2	0.39	2	1.07	4	0.57
142	Ectopic gestation	4	0.78	2	1.07	6	0.86
143	Other accidents of pregnancy . . . .	..	..	7	3.74	7	1.00
144	Hæmorrhage	65	12.65	9	4.81	74	10.56
145	Puerperal sepsis	172	33.46	52	27.81	224	31.95
146	Albuminuria and convulsions	75	14.59	51	27.27	126	17.97
147	Other toxæmias of pregnancy	11	2.14	4	2.14	15	2.14
148	Thrombosis and embolism	11	2.14	..	..	11	1.57
149	Accidents of labour and operative shock	15	2.92	11	5.88	26	3.71
150	Other and unspecified puerperal conditions	10	1.95	..	..	10	1.43
—	Anæmia	124	24.12	41	21.93	165	23.53
		514	100.00	187	100.00	701	100.00
	Deaths due to associated diseases	170		16		186	
	Total maternal deaths	684		203		887	

Puerperal sepsis

In countries where registration of maternal deaths is carried out and where special maternal mortality surveys have been made, puerperal sepsis has been consistently found to be the most important cause of maternal death. Not only has it been found to occur most frequently but the ratio of sepsis deaths to total maternal deaths shows a marked similarity in surveys in this and certain other countries. (Appendix A, Table 2).

Returns of the Registrar-General in England for the period 1925-30 showed 40 per cent. deaths due to puerperal sepsis (including post-abortive sepsis). In Scotland for the same period the figure was 30 per cent. but there were minor differences in classification in the two countries which partly accounted for the lower figure. In the registration areas of the U. S. A.* sepsis has been stated to be responsible for 40 per cent. maternal deaths.

*Woodbury—Maternal Mortality and Morbidity by Munro Kerr.

Special maternal mortality surveys in which puerperal and post abortive sepsis are classified separately have shown the following figures for puerperal sepsis (excluding post-abortive sepsis).

	Per cent.
England and Wales—	
(Report of the Departmental Committee on Maternal Mortality and Morbidity, 1932)	37·1
Scotland (1931-33)—	
(Report of Maternal Mortality and Morbidity in Scotland, 1935)	35·4
New York City (1930-32)—	
(Report of Maternal Mortality in New York City)	32·6

There are very few figures relating to India which can be used for comparison. In Madras where a survey was carried out for a period of a year, Dr. A. L. Mudaliyar found 26·4 per cent. deaths due to sepsis in a series of 426 maternal deaths including deaths from diseases associated with pregnancy and puerperium. If the latter are excluded so that the series can be compared with others, 34 per cent. of deaths directly due to childbearing were caused by sepsis in Madras.

The returns from certain women's hospitals in India* for the years 1935-38 showed sepsis responsible for 31·02 per cent. of deaths due to childbearing causes in hospital cases (Appendix A, Table 3). These deaths occurred in a selected population and are therefore not strictly comparable with those in the other surveys mentioned above but the proportion is very similar. Finally, this year's survey in Calcutta has revealed a similar proportion of sepsis deaths, 31·95 per cent. of deaths due directly to childbearing.

The small amount of evidence which is so far forthcoming in India, and all this evidence relates to urban conditions, goes to show that while the mortality rate in India is several times as high as in Western countries, the proportion of deaths from sepsis is not more than a third of the total and this in spite of the fact that a far larger number of deliveries in this country are attended by untrained women, who make no use of modern methods of asepsis and antisepsis.

The deaths from puerperal sepsis are discussed in detail in the second part of the report (page 49). Some of the findings will be summarised here.

Ill-health in pregnancy appeared to be an important aetiological factor in many cases of sepsis deaths. Anæmia was reported in a large proportion and in some the sepsis was merely the terminal event in the course of a severe pregnancy anæmia. Oedema without marked anæmia was reported in others, its cause often being obscure, and still others gave a history of dysentery or diarrhoea often of long standing. The proportion of deaths from sepsis in previously healthy women who had spontaneous deliveries was small and suggests that autogenous and droplet infection is uncommon.

Rather more than half the total number of deaths from sepsis took place after spontaneous delivery at home. A considerable number of these occurred amongst the lowest stratum of the population and ill-health and malnutrition, overcrowded and dirty homes, untrained attendants and often complete

*Journal of the Association of Medical Women in India, August 1936 and 1937.

lack of medical care during pregnancy (and sometimes also after the sepsis developed), were factors contributing to the fatal result. *Dais* and relatives delivered most of these women while a few were midwives' cases.

Only 20 per cent. of the women who died of sepsis after spontaneous delivery at home were admitted to hospitals for treatment. Facilities for the segregation and nursing of puerperal fever cases are inadequate in Calcutta and this was undoubtedly the main reason for this small proportion. Other reasons, besides ignorance and prejudice against hospitals, are peculiar to the puerperal woman; the confinement is over and the relatives often do not recognise the serious nature of the illness; there is the infant to provide for and facilities for this are not always available in an institution which would admit the mother. A doctor may be consulted who does not examine the woman but depends on the dai's description of the pelvic condition and may thus fail to recognise the true nature of the fever or to treat it adequately. There appeared to be too great a tendency to depend on expensive injections, often far beyond the means of the patient to buy, and some of them of very doubtful value in the treatment of uterine sepsis, instead of the recognition of the importance of good nursing under hygienic conditions.

The provision of adequate facilities for the hospital treatment of puerperal sepsis in Calcutta and the education of the public to make use of them, is a very urgent problem. The fact that in a year, at least 100 women die of puerperal sepsis in their homes after delivery by *dais* in Calcutta, means that many times this number must suffer from the disease and recover, while many of these *dais* are at the same time attending other confinements.

When one considers these conditions it is perhaps remarkable that there is not more fatal sepsis. The explanation probably lies in the fact that many women living under very unhygienic conditions possess a high immunity to infection, and further, that disproportion is not common in Calcutta and when labour is easy and spontaneous there is little internal interference on the part of *dais* and not much local trauma. Amongst the deaths from sepsis in institutions, abnormal labour and operative interference played an important part and the course of the illness in the puerperium suggested that the causative organism may have been of a different type.

Anæmia

The inclusion of the anæmia deaths amongst "childbearing" and not "associated" causes needs further explanation. In the first place, whenever anæmia was clearly associated with other conditions such as kala-azar, epidemic dropsy, malaria, tuberculosis, the death has been assigned to the "associated" group under the appropriate heading. Similarly all cases of anæmia in which other complications of childbirth were present have been assigned to their respective groups. Thus the sepsis, toxæmia, hæmorrhage and accidents of labour groups contain certain cases in which anæmia was probably the more important cause of death, the other condition being secondary or terminal. The anæmia cases which remained after exclusion of the above, have had to be classed with the limited information at our disposal, as due to anæmia *per se*. Although amongst them there must be many in which more thorough investigation would have revealed underlying diseases which were directly or indirectly responsible for its causation, the histories suggested that pregnancy itself was the precipitating factor in the development of the anæmia from which the patient died. In the present state of our knowledge regarding the aetiology of the severe anæmias met with in pregnancy it is

therefore necessary to give them a class by themselves and for reasons which have been explained it has been decided to class the anæmia deaths with deaths due *directly* to childbearing. Even when the aetiology and pathology of these conditions are more completely understood, a heading "Severe Anæmia" will still be required for the purpose of registration of maternal deaths in tropical countries. The more exact diagnosis in such cases will only be possible on a pathological basis and with few exceptions will only be forthcoming in cases investigated in institutions.

A condition of heart failure develops in the later stages of severe anæmia in pregnancy, and clinically, deaths from anæmia have many points in common with deaths from heart failure in cardiac disease. Labour is often premature and generally easy. Postpartum hæmorrhage is not very common but there is often delay in expulsion of the placenta. Collapse and death may occur before, during or after delivery; the most dangerous time, if labour is survived, is during the first three days after delivery. If the first week after labour is survived and there are no complications such as sepsis, gradual recovery seems usual particularly if treatment is being given. Without treatment death is most likely to occur either within a few days of delivery or after an interval of 1-3 months. These remarks are based on this series of severe pregnancy anæmias without differentiation into macrocytic and other forms.

There is very little reference to anæmia as a cause of maternal death in reports of maternal mortality surveys in other countries but that it may cause death, although rarely, is shown in the Report on Maternal Morbidity and Mortality in Scotland (2). During a period of nearly 3½ years in a series of 2,465 maternal deaths, there were 19 deaths in Scotland which were said to be due to "severe anæmia". The description and blood picture in these cases resembled that of macrocytic anæmia commonly found in pregnancy in India. The cases occurred for the most part in women living under very poor conditions, and some gave a history of a recurring anæmia in earlier pregnancies. Death occurred before delivery in 3 of the 19 cases; several of the births were premature and the duration of post-confinement life was short. The blood pictures showed red blood counts reduced more in proportion to the hæmoglobin and the colour index was above one.

Although reports of the blood picture in pregnancy in western countries have shown a wide incidence of a mild degree of microcytic hypochromic conditions little mention has been made of the occurrence of macrocytic forms. It would however appear from this Scottish series of deaths that pregnancy under certain conditions of living may be accompanied by the same type of anæmia as is so frequently met with in India, and that it may occasionally be so severe as to cause maternal death.

In an investigation into the causes of maternal mortality in Madras city (7), Dr. A. L. Mudaliar assigned 50 deaths in a series of 426, to anæmia of pregnancy and emphasised the importance, in Madras, of two main types of anæmia, a macrocytic form and an anæmia secondary to hookworm infection.

A report on maternal mortality returns from certain women's hospitals in India (8) showed 17.56 per cent. deaths from anæmia in 1935-38 (Appendix A, Table 3).

The question as to which types of anæmia are responsible for the very large proportion of maternal deaths from this cause in Calcutta cannot be answered by the findings of this enquiry. Detailed investigation of cases of anæmia in different parts of the country will doubtless reveal very different distribution of types and the measures which will be required to reduce mortality from this cause will depend on discovering first the forms which are most prevalent in a particular area and then treating the underlying causes, whether these be economic, dietetic, or resulting from underlying diseases such as chronic malaria, dysentery, kala-azar, and others. Clinical differentiation of the anæmias is a matter of such difficulty, if not impossibility, that pathological aids to diagnosis will be an essential part of schemes for appropriate methods for relief.

Such evidence as we have collected in the course of this enquiry suggests that in Calcutta severe anæmias of both the macrocytic and microcytic type, and also mixed forms, are extremely common and that while many cases are associated with poverty and malnutrition, others occur amongst the well-to-do in families that seem healthy and well-nourished.

The association between a history of dysentery or diarrhœa and a severe pregnancy anæmia in the Calcutta series of cases was noticeable and the suggestion is put forward that the development of anæmia in these cases may often be the result not only of the intestinal infection but of the diet which is commonly prescribed in these cases, and often taken for long periods afterwards. Case histories suggest that when an attack of diarrhœa or dysentery occurs in pregnancy the woman calls a doctor who prescribes a very low diet (in which barley water often plays a large part) and gives some medicine; he often does not see the case again. The woman gets a little better, but in the nature of these conditions the symptoms do not entirely clear up, her appetite is poor, and she often continues to take for long periods the low diet which she was originally advised, thinking that she will thereby improve. Instead of this a vicious circle develops and she gets into a state of malnutrition which can only be described as semi-starvation, in which, with the increasing demands of the growing foetus it is not surprising that she becomes very weak and markedly anæmic. Stomatitis as a result of the defective diet often develops and appetite and digestive powers become still worse. The last thing which such a woman or her relatives seem to realise is that she needs good nourishing food, and instead of getting this, she is still more strictly dieted until her exhausted hæmopoietic system gives up the unequal struggle between the demands of the foetus on the one hand and her state of partial starvation on the other and the complete picture of a severe pregnancy anæmia develops. Such a woman may become quite incapable of surviving the added strain of labour. "Barley water anæmia" both in woman and infants may almost be described as a 'clinical entity' in Calcutta and some of the results of this much abused "dietetic treatment" appear in this series of maternal deaths.

We have no evidence of how large a part hookworm infection plays in the causation of pregnancy anæmias in Calcutta. In the series of deaths from anæmia *per se* a report on the faeces was obtained in only 9 cases, in 2 of which *ankylostoma duodenale* was found.

The detailed discussion of the series of anæmia deaths will be found on page 82. Our findings demonstrate clearly that only by early and unremitting antenatal care and the provision of beds in institutions for the admission and treatment of anæmia during pregnancy will the toll of life from this cause be prevented.

Eclampsia

Eclampsia caused the deaths of 102 women in Calcutta during the year of the enquiry. The proportion of Hindus was higher than that of Hindu to other births registered during the period. Primigravidae predominated and no less than half the deaths from eclampsia occurred in women under 20 years of age. It was found that the women who died from eclampsia were relatively more from the middle class than the poor. Their diets were better, and fewer of them worked during pregnancy. It is the young newly married woman in her first pregnancy, taking little exercise, living on a good diet, who seems more liable to develop toxæmia of pregnancy.

The most striking thing about this series of cases is the almost total lack of antenatal supervision which these women received and the failure on the part of the patients, doctors and relations alike to realise the serious nature of the warning symptoms which were present in a large proportion of cases and, in many, were of long standing. Oedema of the feet, in a primigravida especially, must become recognised as demanding treatment, if possible institutional treatment, and for this antenatal beds become a necessity. Regular examinations of the urine, the blood pressure and also the weight during pregnancy, are recognised methods of detection of early toxæmia and this series of deaths from eclampsia indicates that, had antenatal care of this nature been given, a very large proportion of these deaths might have been avoided. In 41 per cent. of the Calcutta eclampsia cases there was warning *oedema* for approximately a month before eclampsia occurred and in many cases it was of still longer standing. In a further 31 per cent. of cases, symptoms such as oedema, headaches or vomiting had been present for two weeks at least, and in some of the remaining cases the time was not stated. In 13·8 per cent. of cases we obtained no record of any warning symptoms. These may have been cases which might correctly be described as fulminating, but even in these it is possible that symptoms were present although not reported and that the onset of eclampsia would have been avoided by adequate antenatal care, including urine and blood pressure examinations and the giving of advice regarding diet, exercise and the prevention of constipation.

In contrast to the apathy which was shown with regard to the *warning symptoms* in pregnancy is the energy with which hospital treatment was advised and obtained in such a large proportion of cases when eclampsia developed. Many were taken straight to hospital when fits started, others called in a doctor who generally administered morphia and sent the patient to hospital. It is noteworthy that of the deaths of eclampsia cases undelivered, only one died at home, and of those who died after delivery there were only 7 who were not given institutional treatment. A higher proportion of eclampsia cases get admission into hospital than those suffering from any other gross abnormality of pregnancy in Calcutta. Eclampsia may be considered to be the least prevented but the most energetically treated of the major complications of pregnancy.

A more detailed discussion of the deaths from toxæmias of pregnancy will be found on page 66.

Hæmorrhage.

Hæmorrhage, including cases of placenta prævia, accidental hæmorrhage, and postpartum hæmorrhage caused 10 per cent. of all deaths due to child-bearing. Many of these deaths were undoubtedly preventible. The group includes some of the worst cases of mismanagement, delay in getting skilled

assistance and failure to treat the blood loss, that were met with during the course of the enquiry. Warning hæmorrhages were present in half the cases of death from placenta prævia, but in no case were *adequate* steps taken to ensure safe delivery.

Amongst the deaths from postpartum hæmorrhage the number delivered by trained attendants was rather high which raises the question as to whether such attendants are inclined to try to hurry the third stage of labour. This is a point on which further enquiry needs to be made, but suggestive evidence was the gross overcrowding in some of the institutions during the "rush" months of the year and the fact that some midwives took a larger number of cases per month than they could be expected to deal with properly.

Abortion

There were 33 deaths due to septic abortion (including 3 cases of tetanus) and 4 deaths due to hæmorrhage associated with abortion. Evidence of interference with the course of pregnancy was definite in a few cases only, but was suspected in several others. Histories in this group were inconsistent and difficult to obtain. All the women who died of septic abortion were either admitted to institutions or were seen by doctors at home and it is therefore highly probable that there were other deaths from abortion which we failed to discover during the year of enquiry.

Accidents of labour

Deaths due to accidents of labour, *i.e.*, due to the shock of labour itself, apart from hæmorrhage, made up a small proportion of maternal deaths in our series, and one is led to the conclusion that neglected cases of obstructed labour are rare in Calcutta. Disproportion due to osteomalacic pelvic deformities is hardly ever met with in Calcutta except amongst the Marwari community where it is fairly common. The reason for the incidence of osteomalacia amongst Marwari women needs further investigation.

Tuberculosis

Tuberculosis was of outstanding importance in the "associated" group and caused 41 per cent. of all maternal deaths due to intercurrent diseases. The problem of tuberculosis and pregnancy in Calcutta is discussed in the second part of this report. (Page 87).

CHAPTER II.

PREVENTIBILITY.

Maternal mortality surveys in other countries have been much concerned with the estimation of the proportion of avoidable maternal deaths and attempts have been made to ascertain the factors at fault with the object of determining the lines along which efforts to reduce the mortality might be expected to be effective.

The Departmental Committee on Maternal Mortality and Morbidity appointed by the Ministry of Health for England and Wales in 1928 drew up a series of standards of established practice according to which each case was judged and any point at which departure from these standards occurred was described as the primary avoidable factor.

The standards adopted were as follows :—

1. *The patients should "book" and make arrangements for confinement, should report any obvious deviation from the normal, and should carry out the instructions of the doctor or midwife.*

2. *The patient should receive such antenatal care from her doctor, midwife, hospital or clinic as should lead to the detection of albuminuria, malpresentation or marked disproportion between the foetal head and the mother's pelvis. The examiner should obtain details of previous difficult labours and of serious illnesses.*

3. *The confinement should not be undertaken in an entirely unsuitable environment.*

4. *Such antiseptic and aseptic precautions as are generally recognised to be necessary should be taken.*

5. *A doctor or midwife should be available, and should bring to the case a fair average degree of skill, knowledge and attention.*

6. *Such hospital, consultant and transport services as are essential should be available, and the doctor should take advantages of them as and when necessary.*

7. *A second doctor, acting as anaesthetist, should be obtained in severe cases.*

8. *The hospital should provide suitable facilities and their officers show evidence of special skill.*

The findings of the Departmental Committee were summarised under the headings of (1) lack or failure of antenatal care, (2) error of skill or lack of judgement, (3) lack of facilities, (4) negligence of the patient or her relatives and (5) no departure from established practice.

The Committee found that 46% of maternal deaths relevant to that part of their enquiry showed an avoidable factor.

A similar enquiry into the causes of maternal mortality was instituted by the Ministry of Health for Scotland in 1929 and the conclusion of the Committee was that 58·7% of the deaths investigated were avoidable.

A report of maternal deaths which occurred during the period 1930-32 in New York showed that 65·8% of deaths attributed to childbearing causes were avoidable according to accepted standards of practice.

In a report on maternal mortality in Madras City in 1930, Dr. A. L. Mudaliar found that of 436 maternal deaths investigated by him, a primary avoidable factor was present in 53·44%. Unfortunately it was not stated to what extent there was modification of the standards used in other countries in assessing avoidability in the Madras series.

An attempt has been made in the course of this enquiry in Calcutta to apply the standards drawn up by the Departmental Committee but there is considerable doubt whether the time has come when such an attempt is really justified. The difficulties of adopting a standard for antenatal care when so little antenatal care is given; of deciding whether facilities in a particular case were adequate when accommodation for maternity cases is so limited; of assessing lack of skill or error of judgment when accurate information is so difficult to come by and written records are so few; of assessing negligence on the part of the patient or her relatives in the face of so much ignorance and superstition, makes the task an almost impossible one. On the other hand to adopt a considerably lower standard is very undesirable.

The standards of the Departmental Committee have therefore been applied with a few modifications which are shown below, but in view of the difficulties of the task these findings are put forward with considerable hesitation and must be accepted with reserve.

Modifications in the standards which have been found to be necessary are as follows :—

1. *Booking before confinement and antenatal care.*—The standard of antenatal care which has been considered sufficient has been somewhat lower both as regards quantity and quality than would be accepted in more advanced countries. It has been considered 'adequate' according to the particular needs presented by each case.

2. *Antiseptic and aseptic precautions.*—Antiseptic precautions have been considered sufficient and have been presumed to have been observed if the attendants were trained and the surroundings clean and no transgression of the ordinary rules of conduct of labour was discovered. The use of sterile gowns masks and aseptic towels has not been considered necessary in order that this standard might be satisfied.

3. The standard of *suitable facilities* was that available in the hospitals ordinarily admitting maternity cases in Calcutta and has not been taken to include ready means of blood transfusion for hæmorrhage, facilities for which are very limited at the present time in Calcutta.

Finally it must be made clear that only when a point of departure from the standards had a *probable causal relationship with the death* has it been considered an avoidable factor. For example, if a woman died of sepsis after a spontaneous delivery and all standards appeared to have been satisfied except that she had received no antenatal care, this fact would not have been considered to have a casual relationship to the death if *she was in good health at the beginning of labour*. If on the other hand *she was in bad health at the beginning of labour* e.g. extremely anæmic or suffering from toxæmia of pregnancy when labour began, the lack of antenatal care would have been considered a factor with a probable casual relationship to the death.

The standards of preventibility could only be applied to a certain number of the maternal deaths investigated. Deaths due to associated diseases were irrelevant to this part of the enquiry as avoidable factors could not be assessed. Amongst deaths due *directly* to childbearing imported cases had to be excluded

for lack of sufficient information. Cases of ectopic gestation and abortion were irrelevant and those cases in which death occurred before delivery have also been excluded on account of difficulty in applying the standards in many of these.*

The total cases remaining, to which the standards were applied were 430 deaths. It was found that only in 16 of these or 3·7% were all the modified standards described above satisfied, and that in the remaining 414 or 96·3% of relevant cases there was a primary avoidable factor present.

TABLE 2.

Deaths due directly to childbearing—Preventibility.

1. Cases showing one or more avoidable factors	414	} 430
2. Cases in which no departure from established practice having a causal relationship to the death was found	16	
3. Cases not relevant to this part of the enquiry (viz. abortion, ectopic gestation and undelivered cases)	84	
4. Cases in which information was insufficient (imported cases)	187	
	701	

The causes of death in the 16 cases in which no avoidable factor was found were as follows :—

Sepsis	8 cases.
Anæmia	2 cases.
Hæmorrhage	2 cases.
Eclampsia	1 case.
Other toxæmias	1 case.
Shock	1 case (? anæsthetic death.)
Embolism	1 case.

The main reason for a large proportion of avoidable deaths was lack or failure of antenatal care which was the first point of departure from established practice in a very large number of cases. Untrained attendants and unsuitable surroundings seemed to have been responsible for many of the sepsis deaths. Failure to make use of hospital facilities was another factor of great importance, but the hospitals of Calcutta would not have been able to admit by any means all of those women who died at home as a result of lack of special facilities and proper nursing.

It has not been found possible to classify maternal deaths according to the *primary* factor at fault as has been done in other enquiries and to state the proportion of cases in which lack or failure of antenatal care, lack of skill or error of judgment, lack of facilities or negligence of the patient or her relative was the point of departure from established practice. The difficulty arose because there were so many cases in which more than one avoidable factor was

*The same procedure was followed in the report of the Departmental Enquiry on Maternal Mortality and Morbidity, England & Wales.

present. The following cases illustrate this :—

1. A Hindu 2-para aged 30, was delivered by relatives in an extremely dirty room in which 7 persons lived. She developed puerperal fever and died 6 weeks later. She was seen by a doctor on 3 occasions in all and a ' bottle of medicine ' was prescribed. She had no other treatment as far as could be ascertained. The doctor stated that he had advised that the woman be removed to hospital. The relations made no efforts to get her admitted.
2. A Mohammedan 3-para aged 22, suffered from swelling all over the body for 3 months and ulceration of the mouth for 1 month before delivery. She was very anæmic. Her diet during the latter part of pregnancy consisted mainly of barley water and sago, but no record of any medical treatment could be obtained. She had a spontaneous delivery at home with a trained midwife in attendance. Fever began on the 2nd day after confinement and the doctor who was supervising the midwife visited her and ordered a " P. A. C. powder ". As far as could be discovered she had no other treatment whatever. She was still oedematous when the midwife ceased her visits. On the 10th day she became worse. No doctor was called. She died on the 19th day.

Although it has been found impossible to classify deaths according to the primary avoidable factor in each case on account of the complex situation present, the part played by some of the factors will be considered in their relationship to the different causes of death in the second part of this report.

Antenatal Examination

In view of its close connection with the subject of preventibility the question of the number of cases which had any antenatal examination will be discussed here instead of later in connection with the other factors affecting maternal mortality.

In assessing the presence of an avoidable factor due to the lack or failure of antenatal care and with a causal relationship to the death, a standard has been adopted in accordance with the demands of the particular case. For example, suppose that a woman who died from eclampsia had suffered from oedema in pregnancy and had been found to have albuminuria but was only given a bottle of medicine and no further examination or treatment. Or again, that a woman who died from anæmia at the time of delivery had taken a little iron mixture for a few days during pregnancy. In neither of these cases would the antenatal care which had been given be considered adequate in view of the conditions present. As a result of applying this test, the number of cases in the whole series without a primary avoidable factor was, as has been stated, very small indeed.

But in order that some idea may be given of the number of women who had *any kind of antenatal examination whatever* a summary has been made of the 430 relevant cases in which the lowest possible standard of what constitutes antenatal examination has been adopted. In the table given below ' antenatal examination ' means that at least *once* in pregnancy the woman had an examination from a doctor or trained midwife which included the testing of the urine. The cases ' seen ' by a doctor are those who had medical treatment of some kind.

during the antenatal period, but the urine was not examined. It is realised that in putting forward these figures it is possible that, only if the woman herself had been questioned, could accurate information have been obtained, but the fact of examination of the urine has seemed to be a point on which the relatives are generally informed and questions on this point were particularly carefully asked during the home visit.

It was found when these standards were adopted that amongst the 430 relevant cases only 15·6% had an 'antenatal examination', 19% were only 'seen' and in 65·4% no record of any antenatal examination or treatment could be obtained. (Table 3).

TABLE 3.

Deaths due directly to childbearing—Antenatal Examination

Only 'seen' in pregnancy	82	19·0%
No examination or care	281	65·4%
Antenatal 'examination' at least once	67	15·6%
	430	100·0
Irrelevant cases (abortions ectopics, undelivered cases)	84	
Insufficient information (imported cases)	187	
	701	

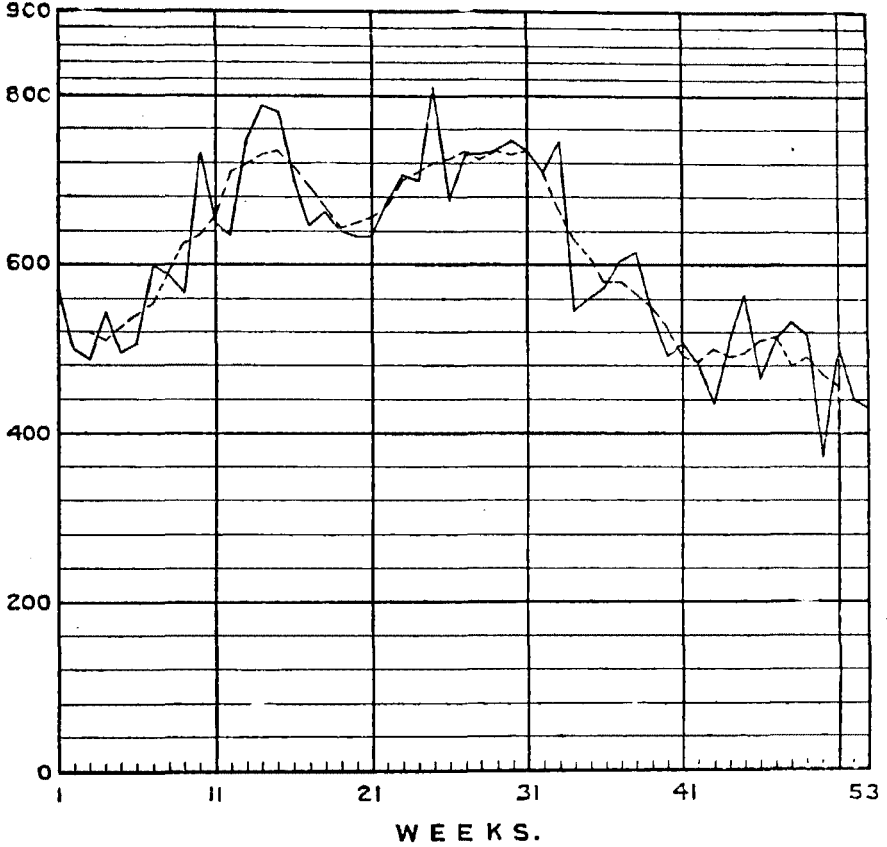
These 67 cases which had an antenatal examination included some who were given a considerable amount of antenatal care, but the majority had only an occasional examination by a doctor or at a clinic.

The influence of the lack or failure of antenatal care is discussed more fully later in connection with individual causes of death.

No. 2

GRAPH SHOWING THE TOTAL WEEKLY BIRTHS REGISTERED DURING THE PERIOD OF THE ENQUIRY, JUNE 20TH, 1936-JUNE 19TH, 1937.

TOTAL WEEKLY BIRTHS.

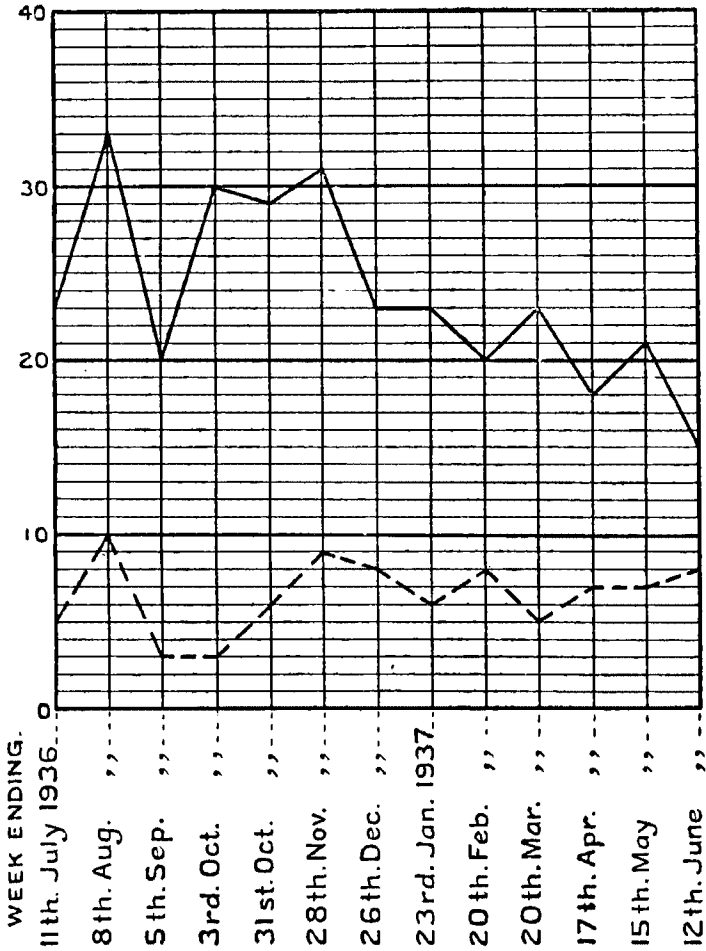


WEEKLY BIRTHS ———
SMOOTHED CURVE - - -

No. 3

GRAPH SHOWING THE MATERNAL MORTALITY RATE PER 1,000 LIVE BIRTHS BY 4 WEEKLY PERIODS

Rate per 1,000 live births.



Deaths due directly to childbearing..... ———
 Deaths due to associated diseases..... - - - -

CHAPTER III

FACTORS AFFECTING MORTALITY

Such suggestions as can be made regarding the effect of various factors on maternal mortality are based entirely on this series of maternal deaths, for the only figures available for comparable purposes were the total registered births by communities for the year of the enquiry and reports of the Health Officer, Calcutta Corporation. Complete lack of comparable information regarding housing conditions in general in Calcutta, place of delivery, attendant at delivery, whether trained or untrained, and number of deliveries of primiparae and multiparae, has limited to a very great extent the value of the findings of this enquiry. There seems to be no reason why information relating to place of delivery and attendant should not be collected at the birth registration stations, and it is suggested that action in regard to this is necessary in view of the high maternal and infantile mortality in Calcutta, and as an important auxiliary measure in view of the newly-passed Bengal Nurses and Midwives' Registration Act.

Season and climate

Births in Calcutta show a marked seasonal variation (Graph 2). During the year of the enquiry nearly three-fifths of the total registered births occurred during the six months August to January. The week to week variation in registered births was found to be significant. The figures suggest that in Calcutta there is a period of greater fertility between November and April, i.e., in the cold weather and spring.

The weekly maternal mortality rate per 1,000 registered live births also suggested some seasonal influence but this was found to be not significant. (Graph 3).

The maternal mortality rate which was 24 per 1,000 registered live births during the year of the enquiry reached its highest figure of 33 per 1,000 in the 4-weekly period, July 12th to August 8th, and was 30 per 1,000 between November 1st and November 28th. The lowest rate occurred between May 16th and June 12th. (Appendix B, Table 1).

The increase in the number of deliveries which takes place between August and January puts a heavy strain on the limited accommodation in maternity institutions. This results in overcrowding, overworking of staff and discharge of patients too soon after delivery. In the homes the work of midwives may also suffer from the fact that too many cases have been booked and so less time and attention is given to each. The question whether there is any relationship between these conditions and the higher maternal mortality rate during the same period would repay closer study.

The significance of the seasonal variations in death from puerperal sepsis, anæmia and eclampsia and the subject of the effect of humidity on eclampsia are discussed by Mr. Swaroop in Appendices D & E.

Community

The distribution of maternal deaths by community is shown in Table 4 and is compared with the distribution of registered births during the period of the enquiry and also during the two years 1934-35 (Health Officer's reports for 1934 and 1935). It is however quite possible that accuracy in registration of births varies in the different communities and that therefore the figures used for comparison do not give even a relatively accurate idea of the community

distribution of the population at risk. In ward 8 in the course of home visiting in connection with Welfare Centre work it was found that registration in that particular area is more defective amongst the Mohammedan community but the same may not be true for other parts of Calcutta.

TABLE 4
Maternal Deaths—Distribution by Community

Cause	Hindu	Moham- medan	Indian Christian	Anglo- Indian and others	Total.
Deaths due directly to child- bearing	533 76·03%	146 20·83%	11 1·57%	11 1·57%	701
Deaths due to associated dis- eases.	124 66·67%	57 30·64%	5 2·69%	.. ..	186
Total maternal deaths	657 74·07%	203 22·89%	16 1·80%	11 1·24%	887
Registered births during the period of the enquiry.*	20,568 71·63%	6,654 23·17%	1492 5·20		28714
Percentage distribution of regis- tered births in Calcutta for 1934-35.†	76·02	18·89	1·62	3·47	

The figures at our disposal show a community ratio of Hindus to Mohammedans of 4 to 1 in total registered births for 1934-35, 3·1 to 1 in registered births during the period of the enquiry and 3·2 to 1 in total maternal deaths. It appears therefore that the distribution of maternal deaths by community bears a close relationship to the populations at risk as far as can be shown from the figures available.

When deaths due directly to childbearing and those due to associated diseases are compared it is found that in the former group the community ratio of Hindus to Mohammedans was 3·6 to 1, and in the latter it was 2·17 to 1. The larger proportion of Mohammedans who died of tuberculosis was mainly responsible for the markedly different ratio in the associated diseases group.

Table 5 shows the distribution by main cause of death and community. Sepsis was the most important cause of death in all communities except the Indian Christian in which anæmia stood first. Anæmia and eclampsia followed sepsis in importance in Hindus, but anæmia and tuberculosis took second and third place in Mohammedans. A rather higher proportion of Hindus than Mohammedans died of septic abortion and other accidents of childbirth. Anæmia and associated diseases (apart from tuberculosis) showed a similar community distribution. *The outstanding differences in the two main communities were the larger proportion of Hindus who died of eclampsia and albuminuria and the larger proportion of Mohammedans who died of tuberculosis.*

*Communication from the Health Officer.

†Report of the Health Officer, Calcutta Corporation for 1934-35.

TABLE 5

Maternal deaths—Distribution by Cause and Community

Cause	Hindu		Moham- medan		Indian Christian		Anglo- Indian and Others		Total
	Per cent		Per cent		Per cent		Per cent		
<i>Deaths directly due to childbearing.</i>									
Abortion (septic) . . .	27	4.11	4	1.97	1	6.25	1	0.09	33
Puerperal hæmorrhage . .	60	9.13	13	6.40	...	...	1	9.09	74
Puerperal sepsis . . .	157	23.90	60	29.56	2	12.50	5	45.46	224
Puerperal albuminuria and convulsions . . .	106	16.13	18	8.87	1	6.25	1	9.09	126
Other accidents of childbirth . . .	24	3.65	2	0.99	...	...	...	...	26
Anæmia . . .	123	18.72	36	17.73	5	31.25	1	9.09	165
Other causes . . .	36	5.48	13	6.40	2	12.50	2	18.18	53
<i>Deaths due to Associated diseases.</i>									
Tuberculosis . . .	39	5.94	36	17.73	2	12.50	...	...	77
Other causes . . .	85	12.94	21	10.35	3	18.75	...	...	109
Total	657	100.00	203	100.00	16	100.00	11	100.00	887
		74.07%		22.89%		1.80%		1.24%	100.00

Province of Origin

Information regarding the province to which the woman belonged was collected when possible, but was not forthcoming in most of the imported cases.

It was found that 66% of the total maternal deaths occurred in Bengalis, but the number was actually higher than this for many of the cases classed as 'unknown' certainly came from Bengal. The United Provinces contributed 8.79% of the total mortality and Bihar and Orissa 2.48%. Other provinces contributed smaller numbers.

The distribution of causes of death in Bengalis shows no important variations from that of maternal deaths as a whole and the numbers of deaths from individual causes reported from women belonging to other provinces are too small for comment.

Distribution by ward in Calcutta

The number of the ward in which a death was registered was forthcoming from the registration cards but some of the hospitals act as registration stations and then these hospital deaths are registered as occurring in the district in which the hospital is situated; therefore the figures give no idea of the actual mortality in different parts of Calcutta. It would have been possible as a result of the follow-up work to refer back the hospital deaths to the wards

in which the homes were situated, but in the absence of any information regarding the population at risk in the different wards little useful information would have been forthcoming and this has therefore not been done.

Age of the Mother

The distribution of maternal deaths by age periods is shown in graph No. 3 and the actual figures by age and cause will be found in Appendix Fig. 4.

There were 8 deaths in very young women (under 15 years) and 1 death over the age of 45. The largest number of deaths occurred in the age period 20-24 years. Figures for the age distribution of deliveries are not available so that rates at different age periods cannot be shown.

The percentage age distribution of causes of maternal deaths due directly to childbearing is shown in Table 6. For all causes of maternal death 47·79% occurred in women aged 20-29, 26·11% in women over 30 years and 21·68% in the youngest group, under 20 years. It is interesting to compare these figures with those given in the report on Maternal Mortality in Scotland (2) for the percentage age distribution of causes of maternal death in 1931-33, in which it was found that there were 49·29% deaths in the age period 25-35, 29·70% over 35 years, and 21·10% deaths in the youngest group, under 25 years. It will be seen that these distributions show a marked similarity except that the Scottish figures are for age periods 5 years later than those shown in the Indian series.

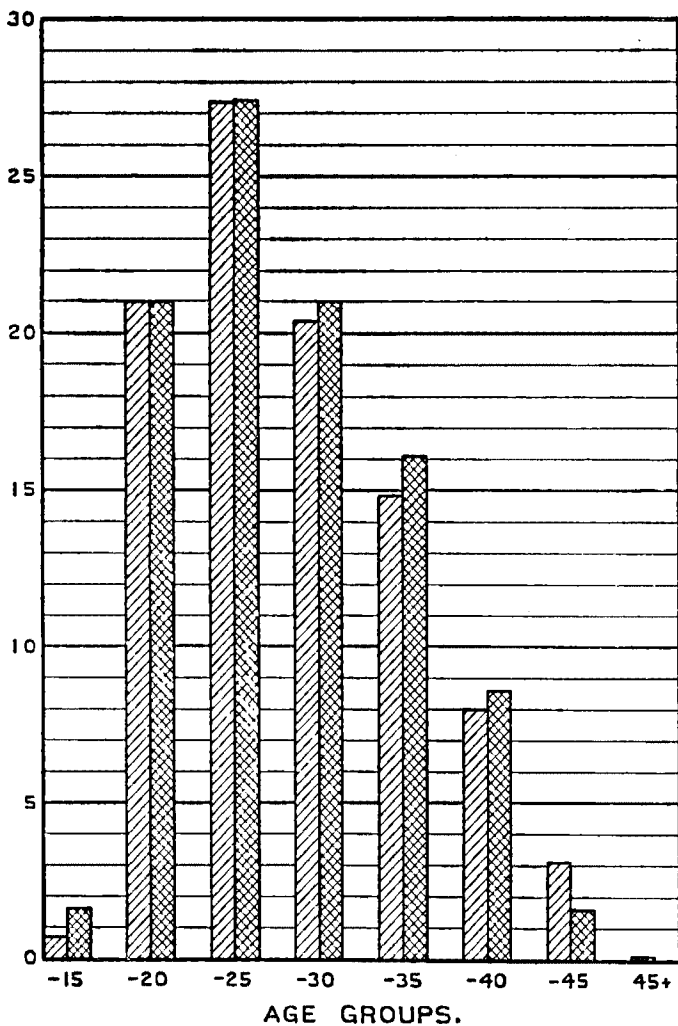
TABLE 6
Percentage Age Distribution of Causes of Death



Causes	-20	20-29	30+	Unstated	All ages
Abortion (septic)	9·09	57·58	30·30	3·03	100
Abortion (non-septic)	25·00	25·00	50·00	..	100
Ectopic gestation	..	33·33	50·00	16·67	100
Other accidents of pregnancy	..	42·86	28·57	28·57	100
Puerperal hæmorrhage	17·57	37·84	43·24	1·35	100
Puerperal sepsis	16·07	51·34	28·13	4·46	100
Puerperal albuminuria and convulsions	48·41	39·68	9·52	2·38	100
Other toxæmias of pregnancy	46·66	26·67	26·67	..	100
Thrombosis and embolism	27·27	63·64	9·09	..	100
Other accidents of childbirth	15·39	38·46	38·46	7·69	100
Other and unspecified conditions of puerperal state	30·00	40·00	30·00	..	100
Anæmia	12·73	55·76	24·85	6·66	100
All Causes	21·68	47·79	26·11	4·42	100

No. 4

**CHART SHOWING THE MATERNAL MORTALITY
DUE TO CHILDBEARING & ASSOCIATED DISEASES
AT DIFFERENT AGES EXPRESSED AS PERCENTAGE
OF THE TOTAL MATERNAL DEATHS**

PERCENTAGE.



Deaths due directly to childbearing.... 
Deaths due to associated diseases.... 

N.B. Rates at different age periods cannot be shown as information relating to populations at risk at respective age periods is unknown.

Table 7 shows the number of deaths for each cause expressed as a percentage of the total deaths in that age group. The principal causes of death over 20 years were sepsis and anæmia, but under 20 years eclampsia and albuminuria were outstanding. Ectopic gestation, hæmorrhage and accidents of labour were less important causes contributing to deaths in the young as compared with the old. Post-abortive sepsis and anæmia show a higher proportion of deaths in women in the middle period of reproductive life.

TABLE 7

Percentage distribution of maternal deaths by cause at different age periods

Causes	—20	—30	30+	Unstated	Total
Abortion (septic)	1.97	5.67	5.46	3.23	4.71
Abortion (non-septic)	0.66	0.30	1.09	..	0.57
Ectopic gestation . . . .	..	0.60	1.64	3.23	0.86
Other accidents of pregnancy	..	0.90	1.09	6.45	1.00
Puerperal hæmorrhage	8.55	8.36	17.49	3.23	10.56
Puerperal sepsis	23.68	34.33	34.43	32.26	31.95
Puerperal albuminuria and convulsions	40.13	14.93	6.56	9.68	17.97
Other toxæmias of pregnancy	4.61	1.19	2.19	..	2.14
Thrombosis and embolism	1.97	2.09	0.55	..	1.57
Other accidents of childbirth	2.63	2.98	5.46	6.45	3.71
Other and unspecified conditions of puerperal state	1.97	1.19	1.64	..	1.43
Anæmia	13.82	27.46	22.40	35.47	23.53
All Causes	100.00	100.00	100.00	100.00	100.00

Gravidity

In considering the influence of gravidity on maternal mortality we are again hampered by the total absence of information regarding the gravidity distribution of the population at risk.

In the total series of maternal deaths there were 262 primigravidae, of whom 207 died of causes directly due to childbearing and 55 of associated diseases.

The proportion of primigravidae in the two classes of deaths and in the whole series was 29.5% in each case, and the proportion of deaths in succeeding pregnancies was closely similar in both classes (Appendix B, Table 3). The very slightly higher proportion of deaths in connection with the second pregnancy in deaths from associated diseases was mainly due to a large number of tuberculosis deaths in 2-parae (Fig. 5).

When individual causes of deaths are considered marked differences are found in primigravidae and multiparæ (Table 8). Thus in *primigravidae*, eclampsia and albuminuria were responsible for 39% of deaths, puerperal sepsis for 24%, anæmia for 13% and hæmorrhage for 10%. In *multiparæ* on the other hand, puerperal sepsis was the most important cause and accounted for 35%, anæmia for 27%, hæmorrhage for 10% and eclampsia and albuminuria for only 9% of deaths.

These figures show the outstanding importance in Calcutta of the toxæmias which contributed considerably more even than sepsis to the mortality in primigravidae. In this respect the Calcutta findings differ from those of maternal mortality enquiries in other countries including that of Dr. Mudaliar in Madras (7) in which sepsis was the commonest cause of death in both primigravidae and multiparæ. Anæmia was of greater importance as a cause of death in multiparæ; a large number of deaths from this cause occurred in 2-and 3-paræ. (Appendix B, Table 4).

The proportion of deaths from hæmorrhage in primigravidae was as high as in multiparæ in this series. Hæmorrhage increased in importance in multiparæ having had more than 5 previous pregnancies.

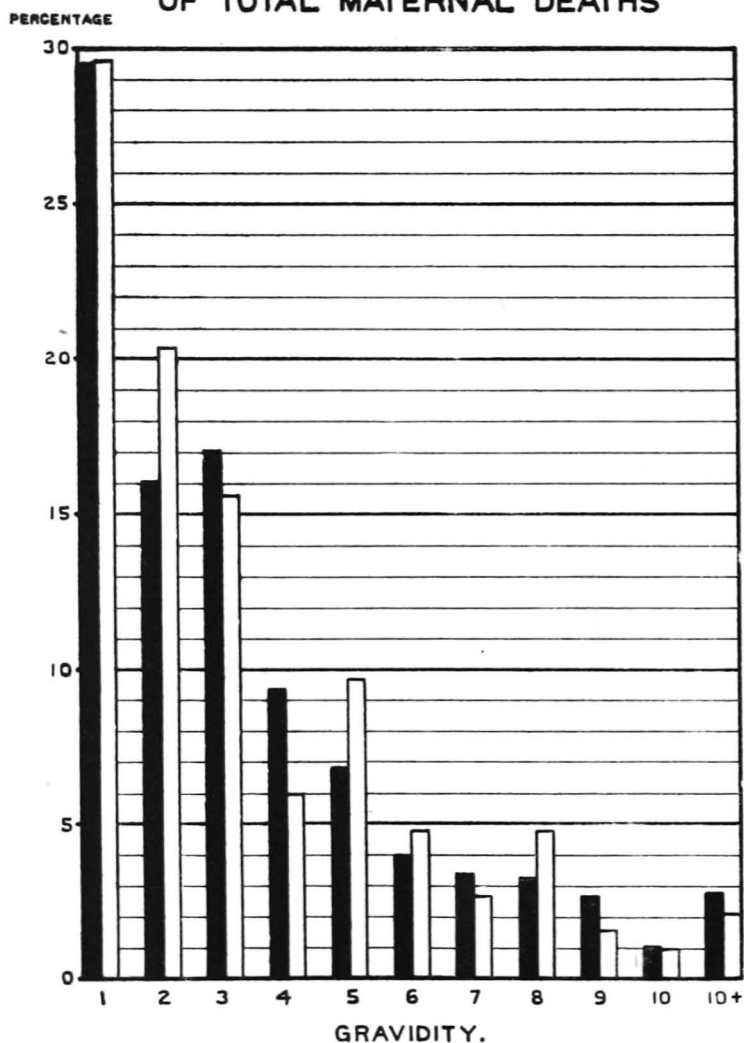
Septic and non-septic abortion and accidents of labour contributed considerably more to the deaths of multiparæ while accidents of pregnancy and thrombosis and embolism were found in somewhat higher proportion amongst women pregnant for the first time.

TABLE 8

Gravidity—Percentage distribution according to cause of death

Causes	<i>Primigravidae</i>	<i>Multigravidae</i>	<i>Unknown</i>	Total
Abortion (septic) . . .	2.90	5.54	4.00	4.71
Abortion (non-septic) . . .	..	0.85	..	0.57
Ectopic gestation . . .	0.48	0.85	4.00	0.86
Other accidents of pregnancy . . .	0.97	0.85	4.00	1.00
Puerperal hæmorrhage . . .	10.14	10.66	12.00	10.56
Puerperal sepsis . . .	24.15	35.29	32.00	31.95
Puerperal albuminuria and convulsions.	39.13	8.96	12.00	17.97
Other toxæmias of pregnancy . . .	2.42	2.13	..	2.14
Thrombosis and embolism . . .	2.42	1.28	..	1.57
Other accidents of childbirth . . .	1.93	4.69	..	3.71
Other and unspecified conditions of puerperal state	1.93	1.28	..	1.43
Anæmia	13.53	27.51	32.00	23.53
All Causes.	100.00	100.00	100.00	100.00

No. 5
**FREQUENCY DISTRIBUTION OF
 MATERNAL DEATHS BY GRAVIDITY
 EXPRESSED AS A PERCENTAGE
 OF TOTAL MATERNAL DEATHS**



Deaths due directly to childbearing...
 Deaths due to associated diseases...

N. B. Rates for each pregnancy cannot be shown as information relating to populations at risk is lacking.

Home Conditions

In those cases of maternal death in which home visits were possible, information was collected regarding the housing conditions. The number of rooms and the persons occupying them were noted and an estimate made with regard to overcrowding. The family income was asked so that the income per head could be calculated. The cleanliness and ventilation of the house and the water supply and drainage were also observed. The findings relate only to Calcutta cases (684 maternal deaths), as the homes of imported cases could not be visited.

The standards adopted by the investigators were as far as possible the same and have been described by one of them in the following words :—

“ A house was considered ‘ clean ’ when there was no garbage or food-stuff or dirty rags lying about, when the house was clean outside and inside and there were no cobwebs hanging from roof and walls.

A room was considered ‘ not overcrowded ’ when there was space to accommodate the furniture and to allow the occupants to sleep and the cooking was done on a verandah or in another room. A small room (about 12 × 15 ft.) with one bed, one small almirah, a couple of boxes and a few vessels would not be considered overcrowded if occupied by a family of three, provided the kitchen was separate.

Ventilation was considered ‘ good ’ if there was one good-sized window or two small windows in the room.

Drainage was considered ‘ good ’ when there were proper drains in good repair, no stagnant water seen standing in the courtyard and the bathing place was cemented ”.

We have no figures with which the findings regarding home conditions of women who died can be compared, because figures for the whole female population, and female population at risk, are entirely lacking. The remarks which follow relate therefore only to the *home conditions of women who died* and these conditions cannot necessarily be correlated with the incidence of the diseases concerned.

The following table shows that of 684 maternal deaths 378 or 55·26 per cent occurred in families living in one room, 175 or 25·58 per cent in two rooms, and only 110 or 16·08 per cent in more than two rooms.

TABLE 9

Rooms per family.

	1 room	2 rooms	More than 2 rooms	Unknown	Total
Maternal deaths due to child-bearing	274	138	77	15	514
Associated diseases	104	37	33	6	170
Total maternal deaths	378	175	110	21	684
	55·26%	25·58%	16·08%	3·07%	100·00%

Appendix B, Table 7, shows the percentage distribution of cleanliness, overcrowding, good and bad ventilation and drainage by main causes of death.

The house was described as 'clean' in 22 per cent of all maternal deaths, 'fair' in 45 per cent and 'dirty' in 31 per cent un stated 2 per cent. In the sepsis group the proportion of clean houses was very similar to that of the whole series, but there were considerably more houses described as 'dirty', 40 per cent. as compared with 31 per cent. In the eclampsia and albuminuria group there were more 'fair' houses and fewer that were 'dirty'.

There was said to be overcrowding in the homes of 49 per cent of all women who died. The proportion was higher in the anæmia group, (60 per cent) and in the sepsis group (56 per cent), and lower in the eclampsia group (37 per cent). Considering the low standard adopted overcrowding was very marked in this series of maternal deaths.

Ventilation was described as good in 34 per cent of all maternal deaths and bad in 65 per cent. The proportions were similar in the sepsis and anæmia groups but in the eclampsia group there were rather more well-ventilated homes.

Drainage was good in 41 per cent of houses and bad in 57 per cent in the whole series, and the proportions in the different groups were similar.

Appendix B, Table 8, shows the position of the water supply in relation to the house, and the figures indicate that water was somewhat less readily available in the sepsis group than in the whole series but that the eclampsia group included a larger number of homes with water laid on inside the house.

These findings may be summarised by saying that while *nearly half the total number of women who died were living under conditions which were in one or more respects unsatisfactory, the living conditions of the sepsis and anæmia cases were rather worse than the average and those of eclampsia cases rather better than the average for all maternal deaths.*

Income per head

The income of the family was asked in the course of investigation but it must be emphasised that the information obtained gives only a very rough idea of the economic status. The income per head has been calculated by dividing the total income by the number in family (adults and children). The figures show that more than half the maternal deaths occurred in women belonging to families with an income per head of less than Rs. 10 per month. It is not known whether a majority of the population at risk belonged to this class. The figures for the main causes of death suggested that there was greater poverty amongst cases in the anæmia and sepsis groups, and that the eclampsia and albuminuria group contained a larger number of those of higher economic status.

Purdah

The standard of 'purdah' adopted in this enquiry included not only the 'strict purdah' observed by Mohammedans, but also the confinement to the house which is customary amongst a large number of Hindus in Calcutta. In many parts of the city it is an unusual thing to see the women who live in the locality walking in the streets and except on rare occasions the majority of them remain indoors. Such restrictions involve in many cases confinement to a single room, or perhaps a single room and verandah for long periods, with very limited sunlight and fresh air and almost complete lack of exercise, except what is involved in the carrying out of household tasks.

It was found that 80 per cent of women who died observed these restrictions, and that the proportion was as high as 88 per cent. in the eclampsia and albuminuria group. It is noteworthy that 84 per cent. of women in the latter group were Hindus.

INFLUENCE OF DIET IN PREGNANCY.

An attempt was made in all cases in which home visits were possible, to find out from the relations the customary diet and the amount of milk taken daily in pregnancy by the women who died. Each case was classed to one of the following nine types of diet :

R_1 =Rice and vegetarian . R_2 =Rice and occasionally meat and/or fish. R_3 =Rice and fish or meat both regularly.
 W_1 =Wheat, "atta" and vegetarian. W_2 =Wheat and occasionally fish and/or meat. W_3 =Wheat and fish or meat both regularly.
 M_1 =Mixed (R_1+W_1) . M_2 =Mixed (R_2+W_2) . M_3 =Mixed (R_3+W_3).

It must be remembered however that many of these women were not in good health during pregnancy or during part of pregnancy and the modifications which their diets underwent as a result often involved an increase of milk and a decrease of the other constituents. The figures for milk therefore cannot, in an unknown proportion of cases be considered to have been additions or constant additions to the diet. Further it has been our experience in collecting particulars of diet in pregnancy when the women themselves could be questioned, that quantities of milk said to have been taken regularly are usually over-statements of fact rather than the reverse ; it is therefore still more likely that the reports of relatives made after death regarding quantities of milk taken in pregnancy were frequently exaggerated. In some cases also the relations who were questioned admitted to very vague ideas about the quantities of milk taken, especially if the woman, as frequently happened, had come to her parent's house for delivery only towards the end of pregnancy. In the absence of any other source of information the relations' statements regarding diet and milk have had to be accepted.

Further, without any quantitative information regarding the food actually taken during pregnancy, it is felt that the facts as shown may have been so obscured by other factors influencing mortality especially poverty and ill-health that the findings may be actually misleading rather than otherwise. Keeping these reservations in mind the tables will be discussed.

TABLE 10
Diet—Main causes of maternal death
(Percentage distribution)

	R_1 .	R_2 .	R_3 .	W_1 .	W_2 .	W_3 .	M_1 .	M_2 .	M_3 .	Un-stated.
<i>Deaths due directly to child-bearing.</i>										
Puerperal sepsis	4.07	22.09	0.58	4.07	2.91	1.16	15.12	43.61	5.81	0.58
Puerperal albuminuria and convulsions	1.33	13.33	1.33	2.67	8.00	..	12.00	50.67	10.67	..
Anæmia	1.61	25.82	0.81	3.22	3.22	0.81	22.58	32.26	8.06	1.61
Other Causes	0.70	15.38	4.19	5.59	2.10	..	14.69	34.97	18.18	4.19
Total child-bearing	2.14	19.84	1.75	4.09	3.50	0.58	16.34	39.49	10.5	
<i>Associated deaths</i>	4.12	25.87	1.18	10.00	1.18	..	12.94	34.71	7.65	2.35
Total	2.63	21.34	1.61	5.56	2.92	0.44	15.50	38.30	9.80	1.90

We have no figures for the diet of the whole population of Calcutta or for the population at risk, so that the distribution in total maternal deaths provides

the only available standard for comparison. Table 10 shows that the diet taken by the largest proportion was rice and wheat and fish and/or meat occasionally (M_2), this was found in 38 per cent. This is the diet of many Bengali Mahommedans (who take both fish and meat) and of such Hindus as take wheat in addition to rice and add fish (but generally not meat). The second commonest type of diet (found in 21 per cent. of total deaths) was rice and fish and/or meat occasionally (R_2). This is the usual diet of a large proportion of Bengali Hindus.

Total deaths due to child-bearing showed a distribution as regards diet which was closely similar to that of total maternal deaths. In deaths due to associated diseases there was a somewhat higher proportion of cases in which a wheat and vegetarian diet was taken (W_1) and a rather smaller proportion of mixed diets (M_1, M_2, M_3).

The distribution of diets in deaths from sepsis and anæmia does not show marked variation from maternal deaths as a whole. In the eclampsia and albuminuria group, however, there was a marked difference in the proportions. A significantly higher proportion of the total deaths from eclampsia took place amongst those who took a relatively high protein diet, animal or vegetable or both. If a high protein diet was characteristic of the majority of pregnant women in Calcutta then the high proportion would not justify us in attributing a higher incidence of eclampsia mortality to a higher protein diet. High protein diet is however usually associated with better economic conditions and although we have no figures for different levels of economic status amongst the pregnant women in general it may probably be assumed that the proportion of women of high economic status is relatively small.

In the distribution of maternal deaths by community it was found that 84 per cent. of those who died of eclampsia and albuminuria were Hindus. It would therefore seem that a Hindu diet containing a proportion of wheat and some animal protein is that most often associated with death from the toxæmias in Calcutta. It must however be remembered that it may have been some other factor associated with better economic status which was important in causing death from eclampsia. Further the incidence of other illness in pregnancy in women who died of eclampsia was low and a larger intake as well as food of better quality may have been a contributing factor.

The diet figures for the other causes of death have not been shown. Hæmorrhage showed nothing suggestive and the figures for the other causes are too small for comment to be possible. Diet in tuberculosis cases is mentioned again in considering deaths from this cause in the second part of this report.

TABLE 11
Milk—Main causes of maternal deaths
(Percentage distribution)

	0	-½ pau.	-1 pau.	-2 pau.	+2 pau.	Unstated.
<i>Deaths due directly to child bearing.</i>						
Puerperal sepsis	25.00	29.65	23.25	13.96	4.07	4.07
Puerperal albuminuria and convulsions	21.34	24.00	25.33	17.33	12.00	..
Anæmia	22.58	16.93	25.81	18.55	8.87	7.26
Other causes	16.78	20.98	32.87	17.48	6.29	5.59
Total child-bearing	21.59	23.35	26.85	16.54	7.00	4.67
<i>Associated deaths</i>	18.24	22.94	30.59	17.06	5.88	5.29
Total maternal deaths	20.76	23.25	27.78	16.67	6.72	4.82

'No milk' was taken regularly during pregnancy by 20 per cent. of women who died (Table 11). The figures for childbearing deaths and for associated deaths were similar, 21 per cent. and 18 per cent. respectively.

In the eclampsia and albuminuria group there was a higher proportion (12 per cent. as compared with 6 per cent. in total deaths) who took more than 2 pau of milk daily in pregnancy. This fits in with the higher economic status of many of those women who died of eclampsia and albuminuria and the more generous diets which a large number of them undoubtedly received. An increased intake of milk together with less ordinary food, in the treatment of the toxæmia may also have been a factor, but probably a very unimportant one in view of the small number who received adequate dietetic treatment.

Place of delivery, treatment and death

It has unfortunately not been possible to obtain accurate information regarding the number of deliveries which took place in institutions and the number which took place at home in Calcutta. But the births registered as occurring in institutions was less than half the total registered births during 1934-35 (Reports of the Health Officer). The actual figures given in the reports are not helpful because returns of some of the large maternity hospitals were not stated and because registration of births is so defective. In considering the figures (Table 12) for distribution of deaths by place of delivery it must be kept in mind that deliveries which take place in hospitals include a large proportion of abnormal and emergency cases.

TABLE 12
Place of delivery

Place of delivery.	Maternal deaths directly due to childbearing.		Maternal deaths due to associated diseases.		Total.	
		%		%		%
In hospitals	268	38.23	42	22.58	310	34.95
In maternity homes	22	3.14	10	5.38	32	3.61
At home	295	42.08	98	52.69	393	44.31
Unknown	3	0.43	1	0.54	4	0.45
Irrelevant cases (undelivered)	113	16.12	35	18.81	148	16.68
Total	701	100.00	186	100.00	887	100.00

Institutional treatment

In addition to those cases in which delivery took place in institutions there were others, e.g., who died undelivered, or were admitted postnatally, who received institutional treatment. The total number of women in the series who were admitted to hospitals or maternity homes at some stage of their illness was 525 or 59.19 per cent. of all maternal deaths (Table 13).

TABLE 13
Maternal death and institutional treatment

Place of treatment.	Deaths due directly to childbearing.	Deaths due to associated diseases.	Total.
<i>Delivered in hospital</i>	268 } 60.63%	42 } 32.26%	485 54.68%
<i>Treated ante-or postnatally in hospital.</i>	157 }	18 }	
<i>Delivered in maternity homes</i>	22 } 4.28%	10 } 5.37%	40 4.51%
<i>Treated ante-or postnatally in maternity homes.</i>	8 }	.. }	
<i>No institutional treatment</i>	246 35.09%	116 62.36%	362 40.81%
Total ₁	701 100.00%	186 100.00%	887 100.00%

Place of death

There were a few cases in which institutional treatment was given but the patient died later at home, either after discharge from hospital or after leaving at her own risk. The following table shows the place where death occurred in the whole series.

TABLE 14
Place of death

Place.	Deaths due directly to childbearing.	Deaths due to associated diseases.	Total.
In hospitals	412 58.77%	54 29.03%	466 52.54%
In maternity homes	25 3.57%	5 2.69%	30 3.37%
At home	264 37.66%	127 68.28%	391 44.08%
Total	701 100.00%	186 100.00%	887 100.00%

In the absence of comparative data very little can be said regarding the significance of any of the figures given above relating to place of delivery, treatment or death. But certain facts stand out in relation to the different causes of death and will be mentioned here although they are discussed in more detail in the second part of this report.

Puerperal sepsis.

There were 224 deaths attributed to puerperal sepsis of which 76 or 33.93 per cent. were delivered in hospitals, 5 or 2.23 per cent. in maternity homes and 142 or 63.39 per cent. in their own homes (1 died undelivered). A considerable number of hospital cases were abnormal and were admitted as emergencies after examination outside, and infection had most probably been introduced before admission, but in 41 out of 81 cases delivered in institutions no record of examination outside before admission could be obtained. It is however probable that the actual number not examined was smaller than this. This subject is discussed more fully under the subdivisions of the sepsis groups.

There were 142 sepsis deaths in which delivery took place at home. Only 29 or 20 per cent. of these were admitted to hospital for treatment of the sepsis. This is a very small proportion and indicates that a lack of hospital facilities or failure to take advantage of existing facilities are factors contributing to the sepsis mortality. It was impossible to discover in what proportion of cases the doctor had failed to advise admission; the relations or the patient herself were unwilling for hospital treatment; or no hospital facilities were available; many of the histories obtained were inconsistent. But the investigators gathered the impression that in puerperal sepsis admission to hospital was not often advised, perhaps because the doctors know of the limited accommodation for such cases in most of the hospitals. On the other hand the puerperal woman is a difficult subject for hospital admission. The delivery is over and the relations are not inclined to think seriously of the fever; there is the problem of the infant, and arrangements have to be made for its care, either in the hospital or at home.

The fact must be faced that the success of treatment in puerperal sepsis depends primarily on good nursing under hygienic conditions. Serum and other injections of various kinds which have had a temporary vogue are now discredited in the treatment of acute forms of the disease and the use of the sulphonamides, particularly in India where the bacteriology of puerperal sepsis has been little investigated, does not take the place of all that the hospital should be able to supply in the way of nursing and hygienic surroundings. Institutional facilities for the treatment of puerperal sepsis (including accommodation and nursing care for the infant) will have to be extended if the maternal mortality from this cause is to be reduced in Calcutta and at the same time the medical profession and the public must be educated to appreciate the necessity of taking advantage of such facilities. This can be done best through the teaching institutions each of which should have special septic blocks with beds set aside for the admission of such cases.

Anæmia

There were 26 anæmia cases in which death took place before delivery. Only 16 of these were admitted to hospital for treatment. The others died at home. Of the 139 cases delivered in this group, 68 were delivered in hospitals or maternity homes and 69 at home (unknown 2). In the case of those delivered at home sudden collapse at the time of delivery was in many cases the first indication recognised of the woman's dangerous condition. A few of those delivered at home were admitted to institutions later for treatment, but this was in many cases at such an advanced stage of the disease that nothing could be done. The insidious onset of anæmia and the fact that the woman herself has often suffered from similar symptoms in a previous pregnancy and has survived, make it all the more difficult for patients and their relations to realise that it may be only by intensive treatment in a well-equipped hospital that the woman's life can be saved. Antenatal beds are far too few in Calcutta and in the face of the mortality from this cause each maternity hospital should have an antenatal ward where anæmia cases can be given the special nursing and good diet they require and intensive treatment for the particular form of anæmia from which they are suffering. Severe anæmia in pregnancy, if labour is imminent, should be treated with the same energy as a surgical emergency.

Eclampsia and Albuminuria

There were 126 deaths in this group (102 of which were due to eclampsia) and 110 or 87·30 per cent. received institutional treatment. This is a high

proportion. The medical profession and the public in Calcutta realise the importance of admission to hospital when fits occur; it was lack of antenatal care and failure to get hospital treatment when the warning symptoms occurred that were responsible for many of these deaths.

Hæmorrhage

There were 74 deaths from hæmorrhage of which 27 took place at home. The remaining received some hospital treatment but all the cases of antepartum hæmorrhage and 24 per cent. of the cases of postpartum hæmorrhage were admitted only *after* bleeding had begun and many of these women were exsanguinated on admission. In 35 per cent. of deaths from postpartum hæmorrhage delivery took place in hospital. There was only one record of blood transfusion being given to a woman who died from hæmorrhage.

The Attendant at Delivery

In the class of deaths due directly to childbearing the attendant was trained in 49·36 per cent. of cases, and untrained (dais and relatives) in 34·10 per cent. (irrelevant cases 16·54 per cent.). In the class of deaths due to diseases associated with childbearing the attendant was trained in only 37·10 per cent. cases. (Table 15). These figures refer to the attendant who actually delivered the case and not to others who may have examined the patient previously or were called in later.

In the absence of information regarding the number of deliveries in the city attended by untrained and trained attendants it is not possible to draw any conclusions from these figures, as a whole. The subject is discussed further under the different causes of death.

TABLE 15
Attendant at Delivery

Attendant.	Deaths due directly to childbearing.		Deaths due to associated diseases.		Total.
Trained—					
Midwives	41	5·85%	11	5·91%	52
Private Doctors	15	2·14%	6	3·23%	21
Hospitals	268	38·23%	42	22·58%	310
Maternity Homes	22	3·14%	10	5·38%	32
Untrained—					
Relatives	44	6·28%	16	8·60%	60
Dais	195	27·82%	65	34·95%	260
Irrelevant cases (undelivered, threatened abortions)	113	16·12%	35	18·81%	148
Unknown	3	0·42%	1	0·54%	4
	701		186		887

Absence of any trained attendant

There were 97 (10%) maternal deaths in the whole series, 64 in the 'child-bearing' and 33 in the 'associated diseases' class, in which as far as could be ascertained, no doctor or trained attendant saw the woman either at the time of delivery or before death, and no institutional treatment was given. This is a very serious reflection on the Calcutta maternity services.

CHAPTER IV.

THE MATERNITY SERVICES IN CALCUTTA

There is a lack of co-ordination of existing facilities for maternal care in Calcutta and it has been difficult to collect complete information on the subject. The hospitals, the municipal public health department and certain voluntary organisations contribute in various ways.

Institutional Midwifery.

The hospital accommodation available is shown in Table 16. The total number of hospital beds for maternity cases was 342. The Corporation of Calcutta provides accommodation in four maternity homes with a total of 125 beds. In addition there are several maternity homes maintained by voluntary organisations, the largest of which is the Shishumangal Pratisthan of the Ram Krishna Mission with 20 beds. In the absence of registration and supervision of private maternity homes the number of beds available in these is a matter of conjecture. It is probable that the total number of available maternity beds in Calcutta during the year of the enquiry was a little more than 500.

TABLE 16
Institutional Midwifery, Calcutta, 1935

Name of Institution.	Antenatal clinic.	No. of Obstetric Beds.				No. of Midwives.		Total deliveries.
		Antenatal.	Maternity.	Others available.	Total.	Trained.	Pupil.	
<i>Hospitals.</i>								
Eden	Yes .	No separate ward.	36	26	62	10	54	2,294
Dufferin	Yes .	Ditto .	30	..	30	4	14	884
Chittaranjan Seva Sadan.	No .	Ditto .	54	..	54	21	46	1,946
Chittaranjan	No .	Ditto .	15	6	21	7	26	408
Campbell	Yes .	Ditto .	22	..	22	2	..	667
Carmichael Medical College.	No .	Ditto .	46	28	74	3	..	1,552
Marwari Hospital	No .	Ditto .	13	8	21	4	..	183
Sambhu Nath Pandit Calcutta Medical School Hospital.	No .	Ditto .	12	6	18	6	..	178
	Yes .	Ditto .	30	10	40	4	6	236
<i>Corporation Maternity Homes.</i>								
1. Baldeodas	No .	No	35	No	35	5	9	2,591
2. Kidderpore	No .	No	24	No	24	4	..	931
3. Chetla	No .	No	40	No	40	3	..	657
4. Manicktola	No .	No	20	6 (septic).	26	3	..	298
Ramkrishna Mission Shishumangal Pratisthan.	Yes .	2	13	5	20	3	12	448
		2	390	95	487	79	167	13,273

On the assumption that 1 bed for 100 births is a reasonable provision this might appear sufficient for this city which has approximately 30,000 registered births per annum, but there was ample evidence that the available accommodation is far from adequate for the needs of the people. The reasons for this appear to be as follows :—

- (1) The actual number of deliveries is considerably higher than is indicated by the total number of registered births, on account of defective registration of both live and stillbirths. The defect in registration may be as high as 20 per cent.
- (2) Nearly three-fifths of the total births registered occur between the months of August and January; the accommodation required during this season is therefore greater than at other times.
- (3) The very large number of families occupying only one room and living under very overcrowded and unhygienic conditions makes it highly desirable, and this is being increasingly recognised, that deliveries in these families should not take place at home.
- (4) The incidence of complications of pregnancy such as anæmia and the toxæmias of pregnancy, tuberculosis and dysentery is very high and such cases require prolonged institutional treatment during and after the antenatal period.

It is impossible to estimate the degree to which the above factors operate owing to the lack of precise information regarding any one of them. It is therefore not possible to estimate the number of beds which should be provided, but there is no question that the present *demand* exceeds the supply and as a higher standard of maternal care develops, this demand will undoubtedly increase, for the *need* very far exceeds the supply.

The growing popularity of institutional delivery is obvious from the figures for admission to maternity homes of the Corporation. During 1936, 5,552 confinements were conducted in the four Corporation Homes in Calcutta. One of these homes, with 35 beds dealt with 2,550 deliveries in the year, which gives an average length of stay per patient of only 6 days. This indicates either overcrowding or far too early discharge of the patient after delivery.

The question as to what extent the growing demand for institutional delivery should be met by providing more maternity homes for normal cases, or whether a well-organised and supervised domiciliary service would not meet better the needs of those whose homes are suitable for confinement, is not an easy one to answer. It may be that the experience in Bombay where more than 70 per cent. of deliveries take place in institutions may throw some light on the matter. The fact remains that if only the numbers at present admitted to hospitals and maternity homes are to be adequately cared for, the accommodation must be increased.

The limitations, defects and even danger of small inefficient institutions, whether hospitals or maternity homes, must also be recognised. When such institutions are overcrowded, or staffed inadequately, or are without proper arrangements for segregation of septic cases, they may be a source of danger especially to women in a poor state of health with lowered resistance to infection. Regulations for the supervision and control of such institutions admitting maternity cases are therefore required.

Antenatal care of women delivered in institutions

There is very little systematic antenatal care carried on in connection with institutional midwifery in Calcutta. Only three of the hospitals admitting maternity cases hold regular antenatal clinics and one of them, as far as is known, have any system of follow-up in the homes, in the case of failure to attend regularly or to follow advice. Booking of cases for confinement is by no means general.

Beds for antenatal cases are far from sufficient. No hospital reported separate antenatal wards although antenatal cases are said to be admitted to the obstetric or other wards. This state of affairs is most unsatisfactory, particularly in view of the large number of cases with complications of pregnancy demanding treatment in Calcutta.

There is no systematic antenatal clinic work carried on in connection with the Corporation Maternity Homes although patients are treated before delivery if they attend the dispensaries attached to the homes. There is no system of booking in use. The antenatal care carried on in connection with the Ram Krishna Maternity Home is, however, of sound quality and includes both clinic work and home visiting.

One reaches the conclusion, therefore, that the large proportion of institutional midwifery in Calcutta consists of admission of cases seen for the first time during labour.

Domiciliary Midwifery

The Health Department of the Corporation of Calcutta provides 7 maternity units for domiciliary midwifery, each unit consisting of several midwives supervised by a woman assistant surgeon or a nurse in charge. No trained health visitors are employed. The total number of cases delivered by 22 midwives attached to these units during the year 1936 was 6,688, an average of over 25 cases per midwife per month. This is more than one midwife should undertake and must result in insufficient attention to individual cases. Visits to waiting cases were stated to be 8,093 which shows that most cases receive only one visit during pregnancy and, as there are no regular clinics, antenatal care is markedly defective.

In addition to the midwives working in connection with the maternity units there is a small number of midwives attached to the Indian Red Cross, and other welfare centres. These midwives are supervised by health visitors in charge of the centres. Further, there are a considerable number of midwives practising privately. The number of these is unknown as the Nurses' and Midwives' Registration Act is not yet in force.

It is not possible with the information at our disposal to calculate with any degree of accuracy the probable number of deliveries in Calcutta per annum at which a trained attendant is present. The following estimate is therefore purely tentative :—

Hospital deliveries	10,000
Maternity Homes	6,000
Delivered by Corporation midwives in patients' homes	6,700
Delivered by other trained midwives and private doctors in patients' homes	2,000
	<hr/>
	24,700
	<hr/>

The city has approximately 30,000 registered births per annum and it would therefore appear that only about 5,000 deliveries are conducted by dais and untrained attendants. But it is known that many births are not registered, possibly as many as 20 per cent. of all deliveries, and that this failure to register occurs mainly amongst that part of the population which employs dais for delivery. It is probable that the total number of deliveries by dais is more than double the above figure and that 10,000 to 15,000 represents an estimate nearer to the truth.

Antenatal care in domiciliary midwifery

Antenatal care in connection with domiciliary midwifery in Calcutta is very limited. A few cases delivered at home get antenatal care from the hospital clinics, but this is generally of a casual nature as there is no follow-up in the event of failure to attend regularly or follow advice.

Antenatal care in connection with welfare centres is carried on in certain areas by the Indian Red Cross Society and the Maternity and Child Welfare Section of the All-India Institute of Hygiene and Public Health. This antenatal care is systematic and is given by trained workers; it includes home visiting and medical consultations in the welfare centres. This service is confined to small limited areas in the city and in 1937 affected only about 1,300 women per annum, 50 per cent. of whom attended the medical consultation clinics at the centres in addition to being visited at home. As it is strongly recommended that this method of work should be extended to cover the whole of Calcutta a brief description is given :—

It is the object of this antenatal service to get 100 per cent. of the pregnant women in the area under care. Cases of pregnancy are either discovered in the course of home visiting (all registered births in the area are followed up) by the health visitor attached to the welfare centre, or come of their own accord to the antenatal clinic. All such cases have antenatal cards made for them and receive regular monthly visits until delivery, after which the mother is visited at the same time as the infant. Pregnant women found during visiting are encouraged to attend doctor's clinics at the centre and a considerable proportion of them do so. Advice is given by the health visitor in the home and in the clinic as to a suitable place for delivery, the choice of attendant and preparations for confinement. Disorders of pregnancy and diseases which are detected, are either treated at the centre or the patient is referred to a suitable hospital or to a private doctor. The welfare centre usually undertakes the treatment of minor disorders of pregnancy and of vitamin, iron and calcium deficiency conditions; anti-syphilitic treatment is also given. Extra nourishment in the form of milk and cod liver oil is provided in necessitous cases. Advice as to diet and habits plays a large part in this antenatal work. Cases which require treatment which the welfare centre cannot provide, are referred to other institutions and special efforts are made to make use of available facilities for treatment. Some of these welfare centres provide a domiciliary midwifery service and thus ensure continuity of care. Workers with special training in the prevention of disease and convinced of the value of constructive health work are essential if work of this kind is to be successful.

The number of women in Calcutta at present who get systematic antenatal care of the kind outlined above is, however, limited to a few hundreds who come under the welfare centres and a certain number of others under the care of private practitioner.

Postnatal Care

(1) *Institutional facilities for treatment of puerperal fever.*—The fact that during the year of the enquiry 119 women died from puerperal fever in their homes suggests very strongly that beds in institutions for the treatment of such cases are markedly inadequate. The case incidence is probably at least 10 times the number of deaths,* and as there were 224 deaths attributed to puerperal sepsis, ten times this number would require 130 beds set aside for this purpose on the basis of a three weeks stay per patient. The actual accommodation said to be available is shown in Table 17.

TABLE 17

Existing provision for Institutional Treatment of Puerperal Sepsis in Calcutta.

Hospital.	Separate Block.	Separate Ward.	Total beds available (excluding private).	Are cases of puerperal sepsis admitted ?
Medical College Hospital	Yes	Yes + cabins.	13	Admitted.
Dufferin Hospital . . .	No	Yes + cabins.	12	Admitted.
Campbell Hospital . . .	No	No	4	Admitted.
Chittaranjan Hospital . .	No	No	..	One segregation room. Outside cases not admitted.
Chittaranjan Seva Sadan Hospital	No	2 wards + cabins.	27	Admitted.
Carmichael Hospital . . .	No	Yes	12	Admitted 'if condition serious'.
Marwari Hospital	No	Yes	4	Admitted.
Sambhu Nath Pandit Hospital	No	No	..	Admitted; cases segregated on verandah of maternity ward.
Calcutta Medical School Hospital	No	No	5	Admitted.
Total beds available			77	

It will be noticed that many of these beds are not properly segregated and it is likely that a considerable proportion of them are reserved for infected or potentially infected cases which are delivered in the hospital. It was certainly demonstrated many times during the enquiry that the institutional treatment of puerperal sepsis was very difficult to obtain. Properly segregated blocks for the treatment of puerperal sepsis should be arranged in connection with several more of the hospitals and efforts made to encourage the admission, isolation and proper treatment of cases of sepsis delivered at home. The recent advances in chemotherapy of the puerperal infections do not do away with the need for institutional treatment.

* This figure is based on incidence of puerperal sepsis to deaths from sepsis in certain women's hospitals (A. M. W. I returns).

(2) *Postnatal Clinics.*—Special clinics for systematic postnatal care do not exist, as far as is known in connection with any of the hospitals in Calcutta. Some of the welfare centres do routine postnatal examinations and give advice at the infant clinics. The only postnatal care which is available for the majority of women is in the hospital outpatient or gynaecological department.

This aspect of maternal care may therefore be said to be almost entirely undeveloped except in so far as patients in the hands of private doctors may be concerned.

RECOMMENDATIONS SUGGESTED BY THE FINDINGS OF THE ENQUIRY

(1) *Vital Statistics*.—Registration of births is very defective in Calcutta, more especially in some areas and amongst certain sections of the population. The possession of accurate information regarding the total number of births, live and still, is a basic requirement in drawing up adequate schemes for maternal care and it is therefore urged that steps be taken to enforce the Calcutta Midwives Act, 1923, Section 451 (which requires registration of births within 8 days), if necessary by means of judicious prosecutions for contravention of the law.

Information with regard to the age and parity of the mother, the place of delivery and the attendant at delivery, are additional facts which could be collected at the time of registration of births and if available would provide most valuable information for the further elucidation of facts relating to child-birth in the city. The possession of such information would greatly facilitate the registration and control of private midwifery practice, private maternity homes and the work of the untrained dai, and is a most desirable supporting measure for the Bengal Nurses and Midwives Act, 1934.

In the interest of greater accuracy in the registration of deaths, it is suggested that the primary and secondary causes of deaths should be stated on the death certificate and that the annual reports of deaths by cause should be prepared according to the International List of causes of death with an additional heading for anæmia in the child-birth group.

(2) *Organisation*.—In the interest of better co-operation between the existing services, and of developing plans for future extension and improvements, it is suggested that a co-ordinating body should be formed of representatives of (1) hospitals admitting maternity cases, (2) the department of the municipal public health service concerned with maternal care, (3) the voluntary organisations which are carrying on maternity work in Calcutta, (4) the anti-tuberculosis service and other allied services. It should be the function of such a body to obtain in the first place complete information regarding existing facilities, and then armed with accurate knowledge of the total number of deliveries per annum in the city, to consider means of increasing the efficiency of the existing services and making plans for their future development.

The recommendations which follow make no pretence to completeness. They are outstanding points noted during the course of this enquiry and arising out of its findings and they are such as might be taken into consideration by a co-ordinating body, such as that suggested above, in the course of its deliberations.

(a) *Staff*.—Doctors and midwives employed by public health authorities and voluntary organisations for maternity work should have had special training in the preventive aspects of maternal care. The medical training of the sub-assistant surgeon is by no means an adequate preparation for work of this kind and the same is true of the course for training of midwives in many institutions. The fact that several hospitals which train medical students and midwives in Calcutta have neither antenatal nor postnatal clinics is sufficient evidence of the truth of this statement.

More use should be made of the health visitor in the existing maternity services, both for follow-up work in the homes and for the supervision of

midwifery. The trained health visitor is the backbone of the welfare centre system and at present, adequately staffed welfare centres are confined to the scheme of work of voluntary organisations in Calcutta.

The work of midwives should be adequately supervised and refresher courses should be arranged. The number of cases which the midwife takes in a month should not be greater than she can properly attend to in that time. The number will depend to some extent on the area in which she works, but it should not exceed 15 cases a month.

(b) *Antenatal Care*.—1. Systematic antenatal care should be provided in connection with all hospitals admitting maternity cases, maternity homes, welfare centres and domiciliary maternity schemes. This antenatal care should include consultation clinics held by a doctor and follow-up work in the homes.

2. The system of booking for confinement should be introduced in institutions admitting maternity cases and annual returns should be made for booked and emergency cases.

3. The extension of the intensive type of welfare centre work which includes systematic antenatal care (as at present carried on in small circumscribed areas in Calcutta by the welfare centres of the Indian Red Cross Society, and the Institute of Hygiene centre), so that all areas are covered, is recommended. The desirability of domiciliary midwifery being carried on in connection with such centres is emphasised. This makes for continuity of work and direct supervision of the midwives by health visitors becomes possible.

4. Milk and extra nourishment should be available for pregnant women in poor circumstances who are unable to obtain proper food and should be distributed as part of welfare centre antenatal care.

5. In view of the importance of the complications of pregnancy, especially anæmia, the toxæmias and tuberculosis, the need for a generous supply of beds for antenatal cases in institutions is of the greatest importance in Calcutta. It is necessary not only that the number at present available should be greatly increased, but that closer co-operation should exist between welfare centres, domiciliary schemes and the hospitals so that those cases found to require institutional treatment in pregnancy may have the means of obtaining it.

(c) *Intranatal Care*.—1. More beds for confinements both in hospital and maternity homes, especially for women of the Mohammedan community, who at present take relatively less advantage of the facilities offered, are greatly needed. In addition a sufficient number of beds must be provided for those whose homes are entirely unsuitable for confinement.

2. Regulations for the control and supervision of maternity homes should be introduced. The prevention of overcrowding, the provision of an adequate and trained staff and the proper segregation of infected or potentially infected cases are the outstanding requirements.

3. More provision is necessary for beds for cases of puerperal sepsis delivered at home. Such beds should be in a separate block if possible, or at least in a separate ward, and arrangements for the care of the infant while the mother is in hospital should be made.

4. When a case of puerperal sepsis occurs in the practice of a midwife she should not be allowed to attend normal confinements as long as she is in attendance on the septic case.

(d) *Postnatal Care*.—Postnatal clinics (with arrangements for gynaecological treatment if necessary), should be held in maternity hospitals, maternity homes and welfare centres. Birth control advice should be available for those women for whom rapidly repeated pregnancy is undesirable on health grounds.

(e) *Special Considerations*.—1. *Anæmia*.—The diagnosis and early treatment of anæmia in pregnancy is such a vital one in Calcutta that special methods of tackling it, apart from ordinary antenatal care, are needed. It is suggested that (1) all antenatal clinics should have access to a central laboratory where examination of blood of anæmic women can be carried out; (2) that certain hospitals should provide special wards for the treatment of anæmia in pregnancy and (3) that the necessary treatment for milder cases as out-patients should be available free of charge to poor patients at welfare centres, hospitals and maternity homes. The lay public, the health worker, midwives and doctors should be taught to recognise the early symptoms and signs of anæmia and to know what steps are necessary in order to get adequate treatment in pregnancy.

2. *Tuberculosis*.—The problem of the tuberculous mother, when home conditions are unfavourable, is one that can only be properly dealt with by providing institutional accommodation for her and segregation for the infant. Until such time as facilities for this are available, the provision of extra nourishment during pregnancy and lactation, and the closest possible co-operation between the maternity services and the anti-tuberculosis service are required in order to reduce the ravages of this disease. This problem is undoubtedly the most complex of those relating to maternal mortality in Calcutta, and raises difficulties which seem almost impossible of solution.

PART II

CHAPTER I

Maternal deaths from Childbearing Causes**SEPTIC ABORTION—33 DEATHS**

Septic abortion was responsible for 4.71 per cent. deaths due directly to childbearing. It was particularly difficult to get accurate information in some of these cases and many of the histories were incomplete or inconsistent.

In six cases the abortion was stated to be spontaneous. There was strong evidence for non-therapeutical abortion in 4 cases but the number was probably larger than this.

The direct cause of death was tetanus in three cases. These were admitted to hospital for treatment after the condition had developed. In another erysipelas was present. In two others the abortion seemed to have been caused by an attack of malaria, or the treatment which was given for it, and sepsis developed afterwards. In the remaining, no information regarding the cause could be obtained.

There were 27 Hindus, 4 Mohammedans, 1 Anglo-Indian and 1 Indian Christian in this series. Two were widows.

There were 4 primigravidæ and of the remaining, 21 were 2-5-multiparæ. Almost half the deaths (46 per cent.) occurred in women pregnant 4-6 months, the remaining occurred in earlier pregnancy. This porportion of abortions in the second trimester of pregnancy suggests either that abortion when it does occur after the third month of pregnancy is more likely to be associated with fatal sepsis, or that a large number of these abortions were induced. Probably both factors played a part.

All these women were admitted to hospital or were seen by a doctor at some stage of their illness but in many cases very late. Twenty-two went to hospital, 2 to maternity homes and 9 were treated at home by private doctors. Evacuation of the uterus was carried out in 5 cases. Three of the hospital cases were given prontosil in treatment.

ABORTION (NON-SEPTIC)—4 DEATHS

Four women died from non-septic abortion; all were multiparæ. The cause of death was hæmorrhage in three cases and hæmorrhage and operative shock in one. Three women died in hospital; one after a very profuse bleeding and another after prolonged bleeding (3 months) outside. The third was a case of threatened abortion admitted to hospital 10 weeks pregnant; the uterus was evacuated and the patient was sterilised by ligature of the Fallopian tubes. She died a few hours after the operation.

The fourth case was treated by a doctor at home by palliative measures only and death occurred from hæmorrhage.

ECTOPIC GESTATION—6 DEATHS

There were 6 deaths (0.86 per cent. of the childbearing group) from extra-uterine pregnancy. All occurred between the ages of 30 and 45 years. One woman was pregnant for the first time. The pregnancies were of short duration except one which was said to be full-term.

All these women were taken to hospital but two died without operation and in one of the latter the diagnosis of internal hæmorrhage did not seem to have been made.

The first case was a patient admitted to hospital at 'full-term' with abdominal pain for a month. She was anæmic (Hb. 30 per cent.) and gave a history of kala-azar. Ten days after admission, internal hæmorrhage was suspected and laparotomy was performed. An abdominal pregnancy was found, the macerated fœtus was removed and the sac marsupialised. The patient died an hour after operation.

The other deaths occurred in early pregnancy. The second case was a woman who came from outside Calcutta and died within an hour of admission to hospital. The third and fourth cases were operated on, on the day of admission to hospital, but died within a few hours.

The fifth case was admitted to hospital in the 2nd month of pregnancy with signs of internal hæmorrhage and a pelvic mass. She was re-admitted in the 4th month with a recurrence of symptoms. Laparotomy was performed but the patient died 2 hours later.

The last case was not diagnosed as a ruptured ectopic gestation but the history was typical. A 4-gravida 2½ months pregnant developed sudden severe abdominal pain and slight vaginal bleeding. A doctor was called who realised that urgent admission to hospital was required. She was taken to hospital the same day but was refused admission on the grounds that the case was not suitable for that particular hospital. She went home and was taken to another hospital the following day where she was admitted in a condition of shock and died a few hours later. Better co-operation between the doctor and the two hospitals concerned would probably have prevented this death.

OTHER ACCIDENTS OF PREGNANCY—7 DEATHS

The causes of death in this group were vesicular mole, retroverted gravid uterus, trauma and in one case an unknown cause which was registered as "pregnancy and heart failure" but all efforts to obtain further details failed. All were imported cases and five came from long distances; all but one were admitted to hospital on reaching Calcutta.

There were 3 deaths from vesicular mole. These women were multiparæ and each one gave a history of irregular bleeding for a period of one to three months and was in very poor condition on admission to hospital. One was pulseless and died after 4 hours undelivered before any treatment except that for shock could be given. Another was treated for shock and expelled the mole spontaneously but died within 24 hours. The third was bleeding profusely on admission and the uterus was evacuated but the patient died 2 hours later. Earlier admission to hospital would probably have saved all these cases.

There were 2 cases of retroverted uterus in which death occurred from pyelo-nephritis and uræmia. Both were multiparæ. One had been repeatedly catheterised outside but the retroversion had not been corrected and she died from uræmia the day following admission. The other case gave a history of 5 months amenorrhæa, watery discharge for one month and complete retention of urine for six days. The greatly distended bladder was catheterised, 5 pints of urine were drawn off and a self-retaining catheter left in situ. The patient died four days later of pyelo-nephritis.

One death was thought to be due to traumatic rupture of the pregnant uterus. There was a history of a fall 4 days before admission to hospital. The abdomen was rigid and tender and there was offensive vaginal discharge. Laparotomy was performed and the foetus was found between the layers of the broad ligament. The patient died two days later from shock and sepsis. There was considerable doubt as to whether the condition could have been due to the fall and it seems possible that this was either a case of induced abortion with perforation of the uterus or possibly an infected ruptured ectopic gestation.

No information could be collected about the 7th case which was registered as death due to pregnancy and heart failure.

PUERPERAL HÆMORRHAGE—74 DEATHS

<i>Antepartum hæmorrhage—</i>	
Placenta Prævia	25
Accidental Hæmorrhage	7
	32
<i>Postpartum Hæmorrhage</i>	42
	—
TOTAL	74
	—

Puerperal hæmorrhage caused 74 or 10·56 per cent. deaths due directly to childbearing causes. It was the fourth cause of death in order of frequency for all cases in the series under review and it was the third in order of frequency for all multiparæ and for all women in the age group over 30 years.

The deaths considered in this group were caused, as far as could be ascertained, by hæmorrhage itself (in some cases operative shock was also a factor) and cases of hæmorrhage in which death occurred from later complications are not included. Ectopic gestation, ruptured uterus and abortion with hæmorrhage are discussed under their respective groups.

Considering hæmorrhage deaths as a whole we find that there were 21 primiparæ and 50 multiparæ (unstated 3) in this series.

Hæmorrhage caused 10·14 per cent. of deaths of all primiparæ and 10·66 per cent. of deaths of all multiparæ in the series of childbearing deaths.

There were 41 deaths from hæmorrhage in women under 30 years (5·85 per cent. of childbearing deaths in this age period) and 32 deaths in women over 30 years (4·56 per cent. deaths in the same age period), (unstated 1).

TABLE 18

Hæmorrhage—Attendant at delivery

	Rela- tives.	Dais.	Mid- wives.	Private doctors.	Mater- nity homes.	Hos- pitals.	Un- known.	Undeli- vered.	Total.
Placenta prævia . . . . .	...	...	...	2	2	5	1	15	25
Accidental hæmorrhage . . . . .	...	...	...	...	1	3	...	3	7
Postpartum hæmorrhage	2	16	5	4	2	13	...	...	42
Total	2	16	5	6	5	21	1	18	74
Percentage	2·70	21·62	6·76	8·10	6·76	28·38	1·35	24·33	100·00

Placenta Prævia—25 deaths

There were 17 deaths in which the diagnosis of placenta prævia was made on examination of the patient, but in the remaining no vaginal examination by a trained observer was reported to have been made and the diagnosis is therefore only a probable one, based on the occurrence of profuse antepartum bleeding and supported by such evidence as was forthcoming from the history and general condition of the patient. This is obviously insufficient and it is possible that premature separation of the placenta and not placenta prævia may have been responsible for some of these deaths. The degree of neglect which some of these cases of antepartum hæmorrhage suffered was one of the outstanding findings of this enquiry and is clearly indicated by the fact that in a quarter of the cases even the position of the placenta was not ascertained.

Liability to placenta prævia increases with age and the figures at our disposal confirm this. Gravidity appears to be of less ætiological significance.

Placenta Prævia deaths by age

Total.	—20	—25	—30	—35	—40	—45	Unknown.
25	1	4	7	5	5	1	2

Placenta Prævia deaths by gravidity

Total.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	10th+	Unknown.
25	2	2	4	3	5	2	2	2	...	...	...	1

Death occurred before delivery in 15 cases and soon after delivery in 9 (information not obtained in 1 case).

TABLE 19

Placenta Prævia—Place of death

	Died undelivered.	Died after delivery.	Total.
At home	8	2	10
In hospitals	7	5	12
In maternity homes . . . . .	..	2	2
Unstated . . . . .	..	..	1
	—	—	—
	15	9	25
	—	—	—

The occurrence of warning hæmorrhages was reported in 14 of the 25 cases (56 per cent.). Irregular vaginal bleeding for more than a month previous to death was reported in 5 cases. Two of these women had been treated for the bleeding, one by packing of the vagina by a doctor 2 months earlier (bleeding must therefore have been considerable) and the other one by admission to hospital for 6 days, 2 months before death. In 7 cases bleeding was said to have been present for some days before labour or death and in 2 others the duration of the warning hæmorrhage was not stated. In 11 cases there was no history of warning symptoms.

Five women received antenatal care, including the two mentioned above, but the quality of it was markedly inadequate.

A doctor was called in all but one of the cases in which death occurred at home, but in several there was no record of the patient being examined internally by the doctor and 'only medicine' was said to have been given, while in one case at least the packing of the vagina seems to have been left entirely to the dai. In none of the cases in which packing was done at home was any mention made of an anæsthetic being given.

Some of the histories in these cases were difficult to obtain and it is possible that more was done for the patients than has been recorded, but from the information which was obtained the treatment of most of these cases seems to have been very inadequate indeed. Of the 14 cases admitted to hospitals and maternity homes, in 5, packing was the only treatment apart from measures to combat the shock. Internal version was performed in 5 and Cæsarean section in 1 case. The remaining 3 cases were only treated for shock. Saline injections, subcutaneous or intravenous were given to 10 of these cases but only one of these had a transfusion of blood (8 oz.).

The treatment of the 10 cases in which death occurred at home was reported as follows: three were packed by doctors and one by a dai; internal version was performed in one case by a doctor, in another the membranes were ruptured, in 3 the treatment was said to be by medicine only and in 1 no information about the treatment could be obtained.

There was far too much delay in getting these cases admitted to hospital. In one case the patient was said to have been packed once by a dai and twice by a doctor before being sent to hospital where internal version was performed.

There were only 2 infants born alive of the 25 mothers who died of placenta prævia.

Accidental Hæmorrhage—7 deaths

There were 7 deaths from antepartum hæmorrhage in which neither the history nor the signs suggested the presence of placenta prævia and these cases have been classed as accidental hæmorrhage due to premature separation of the placenta.

The women were all multiparæ, 2 were 11-paræ and all were in the later stages of the childbearing period of life between 25 and 40 years. The duration of pregnancy was full-term in 4 and premature in 3 cases.

There were no histories of warning hæmorrhage in these cases, the bleeding started suddenly and was accompanied by signs of shock. But œdema in pregnancy had been present in 5 cases and in 3 of these and in the remaining 2 without œdema, there was albuminuria, so that chronic renal disease or toxæmia of pregnancy may have been a predisposing factor in all. The blood pressure was high in only one, but as the records were taken in hospital after considerable bleeding had occurred this fact is hardly surprising. One woman with albuminuria and a history of œdema gave a history of a fall, after which bleeding began.

Only one woman in this series had received antenatal care and she had failed to follow the advice given.

Every case received institutional treatment, 6 in hospitals and 1 in a maternity home, but the condition of these patients was very serious on admission and death occurred in each case in less than 10 hours. Three women died undelivered and the remaining very shortly after delivery. Postpartum hæmorrhage was mentioned in connection with the four who were delivered.

The foetal mortality was 100 per cent.

The treatment given included saline injections in treatment of the shock in all cases but one. Artificial rupture of membranes was mentioned in 4 cases. No further operative treatment was attempted and no blood transfusions were given.

Postpartum Hæmorrhage—42 deaths

There were 42 deaths from postpartum hæmorrhage; 5 were imported cases. There were 18 primigravidaë and 21 multiparæ (gravidity unrecorded in 3) and 9 of the multiparæ were pregnant for the 7th to the 11th time. The proportion of primigravidaë in this series is surprisingly high. The duration of the pregnancy was described as full-term in 35 cases, ended prematurely in 5 and was unrecorded in 2.

The health in pregnancy of 20 of these women was described by the relatives as good; 16 were in poor health of whom 14 were said to have been anæmic. This point was unrecorded in 6.

Delivery of the infant took place at home in 27 cases but 10 of these were admitted to hospital later for difficulty in the third stage of labour; the remaining 15 were delivered in hospitals and maternity homes.

Delivery was spontaneous in 37 cases and in 5 the hæmorrhage followed operative delivery (Cæsarean section 2 cases, forceps 2 cases, and incision of rigid cervix 1 case). The operative deliveries with the exception of the last took place in hospitals. The last was a case of twins and uterine fibroids and although the diagnosis was made before labour began, delivery was allowed to take place at home. The cervix was said to be rigid and after 4 days labour, when the os was said to be still only $\frac{2}{5}$ dilated, chloroform was given and two lateral incisions were made in the cervix and the first infant, a breech, was extracted, followed by version of the second and extraction as a breech. The placenta was delivered manually. Profuse bleeding occurred after delivery and death followed 4 hours later. There was no report of saline infusion to combat the hæmorrhage and shock. There were no less than five causes which probably contributed to death from postpartum hæmorrhage in this case: twin pregnancy, prolonged labour, fibroid uterus, incisions in the cervix and accouchement forcé. That a case such as this was not admitted to hospital showed very grave error of judgment.

These deaths from postpartum hæmorrhage fall into two groups—those in which there was difficulty in the third stage on account of retained placenta, and those in which the hæmorrhage began after completion of the third stage. There was no death from secondary postpartum hæmorrhage, in every case the bleeding occurred during or very soon after the third stage of labour.

Severe hæmorrhage *before* delivery of the placenta took place in 27 cases. In 12 of these, death occurred with the placenta still retained. In 11 cases the placenta was removed manually and in 3 it was expressed, unknown, one.

Hæmorrhage *after* delivery of the placenta occurred in 13 cases, 5 of which were associated with operative delivery (Cæsarean section 2, forceps 2, incision of cervix 1) and 8 followed spontaneous delivery of the infant and placenta.

In 2 cases the time of the hæmorrhage was not stated.

There were 4 cases, 3 in hospital and 1 in a maternity home in which the labour was said to have been prolonged. One of these cases was terminated by forceps. In two cases which took place at home labour was said to have

been precipitate. Exact information regarding the duration of labour was not possible to obtain in most cases.

If the abnormal cases in this series are excluded, of the 37 spontaneous deliveries, 9 were delivered in hospitals, 2 in maternity homes, 2 by doctors at home and 5 by midwives, a total of 18 delivered by trained attendants as compared with 19 by unskilled attendants, dais and relatives.

In rather more than half the cases in this group the information which was obtained suggested that there was an avoidable factor at the time of labour; either the case was mismanaged, or there was delay or failure to call skilled assistance or to remove the case to hospital, or the blood loss was not treated by saline infusion and other means of combating the shock, or the woman was moved in a state of shock. In one case the relations of the woman refused to allow the male doctor who was present to remove the placenta and also refused to allow the patient to be taken to hospital. In most of the remaining cases the condition of the woman at the time of labour was so poor that lack of antenatal care had to be considered a predisposing factor in causing the death. There were however two cases of postpartum hæmorrhage in which no avoidable factor could be found.

PUERPERAL SEPSIS—224 DEATHS

Puerperal sepsis caused 224 deaths or 31·95 per cent. of deaths due directly to childbearing. This number does not include deaths from septic abortion or ectopic gestation which have been considered under their respective groups. It does include all other deaths from sepsis including those in which it was secondary to hæmorrhage, toxæmia of pregnancy, or associated with anæmia or other complications of pregnancy or labour. Sepsis has been given precedence over all other conditions in classifying deaths to their respective groups (with the exception of abortion and ectopic gestation noted above).

The diagnosis of puerperal sepsis has been reached, in a number of cases in this group, from histories given only by the relatives after death, for many women who died from sepsis, especially amongst those who died after spontaneous delivery at home, were examined by no trained observer. A history of fever which started early in the puerperium and was accompanied by abdominal pain and offensive vaginal discharge has often been the only information forthcoming. It is therefore only too probable that mistakes in diagnosis have been made. There may be cases which have been classed to anæmia and pulmonary tuberculosis which should have been included under sepsis but on the other hand, there may have been included in this group a few cases which should have been grouped under associated diseases.

Puerperal sepsis deaths have been analysed under three heads:—

- (A) *Sepsis following spontaneous delivery at home (including tetanus cases)*—126 deaths.
- (B) *Sepsis following spontaneous delivery in hospital*—39 deaths.
- (C) *Sepsis following abnormal labour*:—
 - (1) *Operative delivery and malpresentation*—36 deaths.
 - (2) *Hæmorrhage and manual removal of placenta*—23 deaths.

In the whole series of sepsis deaths the distribution by religion was Hindu 157 (70·09 per cent.), Mohammedan 60 (26·79 per cent.), Indian Christian 2 (0·89 per cent.), Anglo-Indian 4 (1·78 per cent.) and others 1 (0·45 per cent.).

cent.). There was a rather higher proportion of Mohammedans than in the distribution by religion of total registered deliveries in Calcutta in the same period.

The distribution by age groups (Table 20) showed nothing striking.

The proportions are similar to those found in the whole series of maternal deaths.

TABLE 20
Puerperal sepsis deaths by age groups.

	Total.	—20	—35	35+	Unknown.
A. <i>Spontaneous delivery at home</i> (including tetanus) percentage .	126	19 15·07	93 73·81	12 9·53	2 1·59
B. <i>Spontaneous delivery in hos- pitals</i> percentage .	39	6 15·38	26 66·67	2 5·12	5 12·83
C. <i>Abnormal delivery—</i>					
1. Operative delivery . percentage .	36	9 25·00	19 52·77	7 19·44	1 2·78
2. Hæmorrhage (includ- ing M. R. P.) . percentage .	23	2 8·70	13 56·51	6 26·09	2 8·70
Total . percentage .	224	36 16·07	151 67·41	27 12·05	10 4·46
Total childbearing deaths . percentage .	701	152 21·68	439 62·63	79 11·27	31 4·42

Distribution by gravidity (Table 21) showed that while a larger number of deaths occurred in the first than in any one succeeding delivery the numbers for second and third deliveries were almost as large. In group C, primiparæ predominated but in group A, 3-paræ accounted for the largest number of deaths.

TABLE 21
Puerperal sepsis deaths by gravidity

	Total.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	10th +	Unknown.
A. Spontaneous delivery at home (including tetanus)	126	21	23	36	15	9	5	4	2	3	2	2	4
percentage .	...	16.67	18.25	28.57	11.90	7.14	3.97	3.17	1.59	2.39	1.59	1.59	3.17
B. Spontaneous delivery in hospital	39	11	9	8	3	...	3	2	...	1	1	1	...
percentage .	...	28.21	23.08	20.51	7.69	...	7.69	5.13	...	2.56	2.56	2.56	...
C. Abnormal delivery—													
1. Operative delivery	30	15	6	2	3	1	2	2	...	4	...	...	1
percentage .	...	41.67	16.67	5.56	8.33	2.78	5.55	5.55	...	11.11	...	...	2.78
2. Haemorrhage (including M. R. P.).	23	3	4	1	2	1	1	1	2	3	1	1	3
percentage .	...	13.04	17.38	4.35	8.70	4.35	4.35	4.35	8.70	13.04	4.35	4.35	13.04
Total	224	50	42	47	23	11	11	9	4	11	4	4	8
percentage .	...	22.32	18.75	20.98	10.27	4.91	4.91	4.02	1.79	4.91	1.79	1.79	3.56
Total Childbearing	701	207	113	120	66	48	28	24	23	19	8	20	25
percentage .	...	29.53	16.12	17.12	9.42	6.85	3.99	3.42	3.28	2.71	1.14	2.85	3.57

TABLE 22

Puerperal sepsis—Attendant at delivery

	Relatives.	Dais.	Midwives.	Private doctors.	Maternity homes.	Hospitals.	Unknown.	Undelivered.	Total.
A. Spontaneous delivery at home (including tetanus)	13	96	11	...	...	...	6	...	126
B. Spontaneous delivery in hospitals	...	...	...	...	3	36	...	...	39
C. Abnormal delivery—									
1. Operative delivery and malpresentation	...	1	...	...	1	34	...	...	36
2. Hemorrhage (including M. R. P.)	...	11	3	1	1	6	...	1	23
Total	13	108	14	1	5	76	6	1	224
percentage	5.80	48.21	6.25	0.45	2.23	33.93	2.68	0.45	100.00
Total Childbearing	44	195	41	16	22	268	3	113	701
percentage	6.28	27.82	5.85	2.14	3.14	38.23	0.42	16.12	100.00

Study of the home conditions of women who died from sepsis was confined to Calcutta cases. Purdah was observed by 131 and was not observed by 41. The proportion of homes described as "clean" and "fair" was somewhat smaller in sepsis cases than in the total series of childbearing deaths and this is mainly due to the fact that in group A there were as many as 51 per cent. of homes which fell into the group described as "dirty". This was in contrast to the homes of those who died of sepsis after operative delivery (group B) and after spontaneous delivery in hospital (group C) which included a higher proportion of "clean" and "fair" homes than in the total childbearing deaths (Table 23).

TABLE 23
Puerperal sepsis deaths—Cleanliness of house (excluding imported cases)

	Total.	Clean.	Fair.	Dirty.	Unknown.
A. Spontaneous delivery at home (including tetanus)	112	14	39	58	1
percentage		12.50	34.82	51.79	0.89
B. Spontaneous delivery in hos- pital	31	12	14	4	1
percentage		38.71	45.16	12.90	3.23
C. Abnormal delivery—					
1. Operative delivery	17	4	8	5	..
percentage		23.53	47.06	29.41	..
2. Hæmorrhage (including M. R. P.)	12	2	8	1	1
percentage		16.67	66.67	8.33	8.33
Total	172	32	69	68	3
percentage		18.60	40.12	39.53	1.75
Total Childbearing	514	111	248	148	7
percentage		21.60	48.25	28.79	1.36

The total number of sepsis deaths showed a slightly higher proportion of "overcrowding" than in the whole series and this again was mainly due to cases in group A (Table 24).

TABLE 24
Puerperal sepsis deaths—Overcrowding (excluding imported cases)

	Total.	Yes.	No.	Unknown.
A. Spontaneous delivery at home (including tetanus)	112	74	38	..
percentage		66.07	33.93	..
B. Spontaneous delivery in hospital	31	11	20	..
percentage		35.48	64.52	..
C. Abnormal delivery—				
1. Operative delivery	17	9	8	..
percentage		52.94	47.06	..
2. Hæmorrhage (including M. R. P.)	12	5	7	..
percentage		41.67	58.33	..
Total	172	99	73	..
percentage		57.56	42.44	..
Total Childbearing	514	247	257	10
percentage		48.05	50.00	1.95

In 96 cases of maternal death from sepsis the family lived in one room, in 51 cases in two rooms, in 19 cases in more than two rooms, unstated in 6.

TABLE 25
Puerperal sepsis deaths—water supply (excluding imported)

	Total.	Tap in house.	Tap near.	Tap far.	None.	Unknown.
A. Spontaneous delivery at home (including tetanus)	112	30	58	23	1	..
percentage		26.79	51.78	20.54	0.89	..
B. Spontaneous delivery in hospital	31	20	9	2	..	..
percentage		64.52	29.03	6.45	..	..
C. Abnormal delivery—						
1. Operative delivery	17	9	6	2	..	..
percentage		52.94	35.29	11.76	..	..
2. Hæmorrhage (including M. R. P.)	12	7	2	3	..	..
percentage		58.33	16.67	25.00	..	..
Total	172	66	75	30	1	..
percentage		38.37	43.60	17.44	0.58	..
Total Childbearing	514	253	172	83	2	4
percentage		49.22	33.46	16.15	0.39	0.78

Information which was forthcoming with regard to the water supply (table 25) showed that in sepsis cases there was a larger number with taps 'near' as compared with 'in' the house; this again is largely due to cases in group A in which 73 per cent. of the homes of the women who died from sepsis at home had no tap inside the house. Bad ventilation and bad drainage also were more common in the sepsis group than in the whole series.

The distribution of diets as a whole showed little difference from the proportions in the whole series of deaths, but in separate groups it was found that there were a larger number of women both in group A and group C¹ who took a diet containing rice and wheat and/or meat occasionally and that in group B and C² the proportion of rice and fish and/or meat occasionally was higher than in the total series. Rather less milk was taken in pregnancy in the series of deaths due to sepsis than in the whole series. This question of diet and milk is closely bound up with the question of economic status.

TABLE 26
Puerperal sepsis deaths (excluding imported cases)
Diet.

	Total.	R ₁ .	R ₂ .	R ₃ .	W ₁ .	W ₂ .	W ₃ .	M ₁ .	M ₂ .	M ₃ .	Unknown.
A. Spontaneous delivery at home (including tetanus)	112	2	21	..	4	4	1	17	57	6	..
percentage .		1.79	18.75	..	3.57	3.57	0.89	15.18	50.89	5.36	..
B. Spontaneous delivery in hospital	31	2	9	1	3	1	..	6	6	3	..
percentage .		6.45	29.03	3.23	9.68	3.23	..	19.35	19.35	9.68	..
C. Abnormal delivery—											
1. Operative delivery .	17	1	4	..	..	..	1	3	8	..	..
percentage .		5.88	23.53	..	..	..	5.88	17.65	47.06	..	..
2. Hæmorrhage (including M. R. P.) .	12	2	5	..	..	..	..	1	2	1	1
percentage .		16.67	41.67	..	..	..	..	8.33	16.67	8.33	8.33
Total .	172	7	39	1	7	5	2	27	73	10	1
percentage .		4.07	22.67	0.58	4.07	2.91	1.16	15.70	42.44	5.81	0.58
Total Childbearing .	514	11	102	9	21	18	3	84	203	54	9
percentage .		2.14	19.84	1.75	4.09	3.50	0.58	16.34	39.49	10.51	1.76

TABLE 27

Puerperal sepsis deaths (excluding imported cases)
Health in pregnancy.

	Total.	Good.	Poor.	Bad.	Unknown.
A. Spontaneous delivery at home (including tetanus)	112	49	22	38	3
percentage		43.75	19.64	33.93	2.68
B. Spontaneous delivery in hospital	31	12	6	10	3
percentage		38.71	19.35	32.26	9.68
C. Abnormal delivery—					
1. Operative delivery—	17	11	4	2	..
percentage		64.71	23.53	11.76	..
2. Hæmorrhage (including M. R. P.)	12	4	..	8	..
percentage		33.33	..	66.67	..
Total	172	76	32	58	6
percentage		44.18	18.60	33.73	3.49

Health in pregnancy of 44 per cent. of the women who died from sepsis (Table 27) was described as good, in 18 per cent. it was poor and in 33 per cent. bad, in the remaining there was no report. The complications of pregnancy and labour will be considered under the separate groups but it must be emphasised that in all groups the importance of anæmia, toxæmia and debilitating conditions especially diarrhœa and dysentery, as predisposing causes to death from sepsis, was very marked.

The day on which death occurred after delivery in sepsis cases is shown in table 28.

TABLE 28
Puerperal sepsis—Day of death after delivery

	Total.	—1 week.	1—2 weeks.	2—3 weeks.	3—4 weeks.	1—2 months.	2 months+	Un-known.
A. Spontaneous delivery at home (including tetanus)	126	8	41	23	13	28	10	3
percentage .		6·35	32·54	18·25	10·32	22·22	7·94	2·38
B. Spontaneous delivery in hospital	39	6	12	11	4	5	1	..
percentage .		15·38	30·77	28·20	10·26	12·83	2·56	..
C. Abnormal delivery—								
1. Operative delivery	36	18	8	6	2	2	..	..
percentage .		50·00	22·22	16·67	5·55	5·55	..	..
2. Hæmorrhage (including M. R. P.).	23	7	7	3	3	2	1	..
percentage .		30·43	30·43	13·04	13·04	8·70	4·35	..
Total	224	39	68	43	22	37	12	3
percentage .		17·41	30·36	19·20	9·82	16·52	5·36	1·33

Group A. Sepsis following spontaneous delivery at home, including deaths from tetanus : 126 deaths.

Tetanus deaths

There were 7 cases in which death was considered to be due to tetanus. Only three of these were admitted to hospital and the diagnosis in the remaining was made from the history given by the relatives after death. Rigidity of the neck and back, inability to swallow and spasms were described. The infant also, of one of these mothers, died with symptoms which suggested that tetanus was the cause. Two of the cases were imported from outside Calcutta.

The home conditions of the Calcutta cases were without exception unsatisfactory. There was overcrowding in all ; none of the homes were described as clean or well-ventilated. Drainage was bad in three of the homes.

Delivery took place at home in each case and was attended only by dais and relations. Labour was described as easy in six cases, and was difficult in one in which the placenta was removed manually by the dai.

Two women who died of tetanus had oedema in pregnancy, another suffered from fever ; the health of the others during pregnancy was said to have been good.

Signs of tetanus began in 3 cases on the 2nd, 4th and 6th days respectively, on the 7th day in 2 and on the 9th day in 1, (information not forthcoming in 1 case).

The 3 cases admitted to hospital received antitetanic serum, the other died at home without any special treatment. Death in all cases occurred within a fortnight of delivery.

Other sepsis deaths after spontaneous delivery at home : 119 cases.

There were 70 Hindus, 48 Mohammedans and 1 Indian Christian in this series of cases, a higher proportion of Mohammedans than was found either in the total deaths due to childbearing or in the total registered births for the same period.

Distribution by age groups showed that more than half the deaths occurred in the age period 20-30 years. There were 20 primiparæ and 99 multiparæ. The largest number of deaths occurred in 3-paræ.

The home conditions of women in this group were found to be considerably worse than those of all sepsis deaths and than all deaths due to childbearing. Overcrowding, bad ventilation and drainage, distant water supply and poverty preponderated.

Health in pregnancy was described as good in 47 cases, poor in 22 and bad in 36, unknown in 14 cases. Only 7 women in the whole series received antenatal care which included examination of the urine although a number of others were seen at some time during pregnancy by doctors or attended hospitals or dispensaries.

Complications of pregnancy.

Anæmia in pregnancy was reported in 59 or 49 per cent. of women who died from sepsis after spontaneous delivery at home. In about a quarter of these, the anæmia was extreme and the sepsis seems to have been merely a terminal event in the course of a severe anæmia. But in some of the others

the history of 'anæmia' was obtained only from relatives of the patient after death, and errors in reporting may have been made, but it is more likely that anæmia was missed than described when it was not present. The importance of anæmia in the aetiology of puerperal sepsis in Calcutta was one of the most striking findings in the enquiry.

We could obtain very little information concerning the cause of the anæmia but in 8 cases it was associated with a history of dysentery or chronic diarrhœa in the same pregnancy.

In 22 cases of anæmia, œdema also was present; this may have been secondary to the anæmia itself, or due to an associated toxæmia of pregnancy, or to other diseases such as epidemic dropsy.

In addition to anæmia and the conditions associated with it, other complications of pregnancy which were mentioned were fever and cough in 4 cases, œdema (without anæmia) in 11 cases, diarrhœa and dysentery (without anæmia) 3 cases and jaundice 1 case.

The attendants at the deliveries of those women who died of sepsis at home were as follows:—

Relatives	12
Dais	90 (5 infants born before arrival).
Midwives	11
Doctors . . . . .	..
Unknown	6
	119

Labour in these cases was spontaneous and in almost all was said to have been easy. Prolonged labour was mentioned in 3 cases but information was not complete and this may be an under-statement. There was 1 case of breech presentation and one pair of twins. Three women in this series had fits which were described by the attendants as 'eclamptic' but in at least two cases were more characteristic of convulsions associated with cerebral embolism.

Information regarding the nature of the delivery of the placenta was impossible to obtain in many cases; it was said to have been incomplete in 2 cases and to have been expressed in 1 case. Perineal laceration was mentioned in only 1 case but this again is probably an under-statement.

Course of the puerperium.

The day of onset of fever is shown in the following table:

TABLE 29

Onset of fever

Day after delivery	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Unknown.
Total 119	9	14	17	15	13	6	9	3	1	4	...	...	...	2	3	1	22

After delivery at home 23 cases were admitted to institutions for treatment when puerperal fever developed, 74 others were seen and treated by doctors at home, and 22 received no skilled treatment as far as could be discovered on enquiry. Amongst those treated by doctors at home there were many who were seen only once and often very late in the course of the disease. Some were never examined as to the pelvic condition or only by a

dai or midwife under the direction of a doctor and many received only bottles of medicine in treatment. It was reported that of those treated at home by doctors, 'injections' were given to 30 cases, and that in at least 14 of these 'serum' was used. Most of these women were very poor and their home conditions extremely bad. It is a serious reflection on the medical services in Calcutta that so many of these women were treated at home, under unsuitable conditions, and money was spent on the kind of injections which modern research has shown to be of very doubtful worth in the treatment of puerperal sepsis, while the provision of skilled nursing under good hygienic conditions was neglected.

In the treatment of 23 cases admitted to hospitals for treatment the use of 'injections' was mentioned in 11, prontosil being given to 3 of these.

Group B. Spontaneous delivery in hospital : 39 deaths.

There were 36 Hindus and 3 Anglo-Indians in this series. The total absence of Mohammedans is perhaps due to the fact that fewer Mohammedan women go to hospital when labour is likely to be normal. The distribution by age and gravidity in these cases differs little from that of sepsis deaths as a whole. The home conditions of these women however were very different from those of the previous group and were definitely better than those of sepsis cases as a whole. There were many more 'clean' houses with good drainage and ventilation. These factors were not directly important from the point of view of source of infection for these women were delivered in hospitals and not in their homes but they show that we are dealing here with a different class of women from the preceding, namely those who were aware of the value of hospital care at the time of delivery. This is borne out by the fact that 23 per cent., a larger number than in the former group, were given antenatal care.

In common with the previous group however there was a large proportion of unhealthy women. Health in pregnancy was described as good in only 12 ; it was poor in 8, bad in 11 and unknown in 8. Anæmia was 'present' in 19 cases, 'severe' in 14. (These are hospital estimations of anæmia on admission and were supported by blood counts in most cases). In 13 cases of anæmia, œdema was also present and 2 of these had a high blood pressure. There were 2 cases of œdema without anæmia. Dysentery and diarrhœa in pregnancy occurred in 4 cases. One woman gave a history of cholera in pregnancy. Prolapse was a complication in another case. Only 10 of the women in this group gave a history of normal pregnancy and were found to be healthy on admission.

All these deliveries were spontaneous and took place in institutions. Information regarding examination before admission to hospital was not complete but 3 cases were said to have been examined outside and this is almost certainly an under-statement. Perineal laceration occurred in 4 cases. One woman had a secondary postpartum hæmorrhage on the 8th day.

There was difficulty with delivery of the placenta in two cases. It was expressed in one and thought to be incomplete in another.

The onset of fever occurred earlier in this group than in the case of those who died of sepsis after delivery at home, and the duration of the illness was on the whole shorter. It seems probable that different and perhaps more virulent organisms were the causative agents in the hospital cases. In 2 cases streptococci were demonstrated.

TABLE 30.

Spontaneous delivery in hospital. Onset of fever after delivery.

Day after delivery.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	unknown.
Total 39.	4	9	10	..	1	1	1	1	1	..	..	..	..	1	10

The case in which fever began on the 14th day was one of erysipelas which developed after discharge from hospital and was probably in no way connected with the delivery.

Complete information with regard to treatment was not forthcoming in all these cases but most had local treatment in the form of douches or intra-uterine medication as well as general treatment including injections of various kinds. Prontosil was given to two cases.

There were 10 women in this group whose pregnancy was normal and who entered hospital at the time of delivery in good condition. It is interesting to consider these in more detail. There were 5 primigravidæ amongst them. Two women had been examined by dais before admission and went to hospital on account of a prolonged first stage of labour at home. They were delivered normally in hospital and may be presumed to have been infected outside. Perineal tears were reported in two other cases and the placenta had to be expressed in a third. In the remaining 5 cases, labour was described as normal and no predisposing or direct cause for the sepsis is known. Fever began between the 1st and 3rd days in 7 cases and on the 6th and 8th days respectively in 2 others. In one case it began on the 14th day and was due to erysipelas. Death occurred before the end of the 1st week in 2 cases, from the 12th to the 18th day in 4 and from 1 to 2½ months after delivery in the remaining 4 cases.

These findings suggest that autogenous infection and droplet infection in *healthy women having spontaneous labours* is a rare cause of maternal death from sepsis in Calcutta.

Group C. Abnormal Delivery. 1. Deaths from sepsis after operative delivery and malpresentation : 36 cases.

There were 36 cases, of which 19 were imported, of operative delivery or malpresentation which resulted in death from sepsis. All except one were admitted to institutions. There were 15 primigravidæ in the series. Distribution by religion showed—Hindu 28, Mohammedan 7, Anglo-Indian 1. There were only 17 Calcutta cases and the numbers are too small to draw any conclusion from information regarding home conditions, but on the whole these seem to have been rather more unsatisfactory than in sepsis cases as a whole. Only 2 had antenatal care.

Health in pregnancy was good in 11, poor in 4 and bad in 2 cases, in the remaining, unknown. The complications of pregnancy were osteomalacia in 1, anæmia in 8, œdema in 6, prolapse in 1, vesico-vaginal fistula 1, gangreen of toe 1, small-pox in pregnancy 1. At the time of delivery albuminuria and high blood pressure were found in 4 cases and 3 others developed eclampsia. Toxæmia seems to have been a contributing factor in at least 19 per cent. of these deaths and anæmia a contributing factor in at least 22 per cent. of the remaining.

Methods of delivery.

Cæsarean Section : 11 cases.—There were 11 deaths from sepsis following Cæsarean section. The classical operation was performed in 2 cases, the lower segment operation in 7, the fundal incision in 1 and Cæsarean hysterectomy in 1. The indications for operation were :—

Contracted pelvis	7 (osteomalacie 1).
Ruptured uterus	1 (Cæs. hysterectomy)-
Prolapse of cervix	1 (Fundal incision).
Transverse presentation	1
Postmature dead fœtus	1
	11

The Cæsarean cases included 3 primiparæ and 8 multiparæ (3 of whom were pregnant for the 9th time). There were 3 imported cases. Health in pregnancy in all non-imported cases was said to have been good. On admission to hospital one woman had severe prolapse with an infected cervix and another had a vesico-vaginal fistula. There was a history of handling by dais at home in 8 cases so that infection was probably introduced before admission to hospital. Two of the remaining were admitted to hospital before labour began and the third at the onset of labour. As far as is known these 3 were not examined outside. Their histories are given in brief :—

1. *Hindu 2-gravida aged 22.*—First delivery was by craniotomy since when she had suffered from a vesico-vaginal fistula. Deformed pelvis and ankylosis of R. hip said to date from an accident in childhood. Liver enlarged. Admitted when labour started because she had been warned operation would be necessary. Lower segment Cæsarean section was performed. Fever began on the same day and the patient died of septic pneumonia on the 16th day.

2. *Hindu primigravida aged 14 years (imported case).*—Admitted to hospital before pains began. Urine—albumen present. Pelvic measurements : I. C. 8", I. S. 7", E. C. 6½", T. D. O. 3¼", promontory "not felt", head floating above the brim. As the baby was small the patient was given a trial labour. As progress was not satisfactory a lower segment Cæsarean section was performed about 12 hours after labour began and a premature infant weighing 3 lbs. 9½ oz. was delivered. Fever began on the 2nd day. Bladder and uterine sepsis developed. A blood culture was negative. Hobb's treatment, pron-tosil and other treatment was given but the patient died a month after delivery.

3. *Hindu 2-gravida aged 22 years (imported case).*—Admitted to hospital a month before delivery with abdominal pain and tenderness and a very slight blood discharge *per vaginam*. The uterus was the size of full-term on admission, no foetal heart sounds were heard then or later. There was no fever. The patient was kept under observation and then medical induction was tried twice and failed. Surgical induction with a stomach tube was tried without result and the patient began to have fever. Laparotomy was performed and the uterus was found to be gangrenous and adherent to surrounding viscera. The fœtus was macerated and the placenta so adherent that it could not be separated. The uterine cavity was packed. The patient died the following day.

Craniotomy : 9 cases.

Craniotomy was performed in 9 cases for the following indications :—

Disproportion	5	(Other complications present were : eclampsia 1, pre-eclampsia 1, hydrocephalus 1).
Impacted face	3	
Rigid cervix	1	
	<hr/>	
	9	
	<hr/>	

All but 1 (and possibly another in which information is incomplete) were examined outside. The exception was a case of eclampsia with disproportion in which forceps delivery was first tried and failed. Craniotomy was done and the patient had secondary hæmorrhage on the 3rd day and died the following day.

Forceps : 8 cases.

The indications for operation in these cases were as follows :—

Prolonged 2nd stage	4
Persistent occip. post	1
Fibroid obstructing labour	1
Face presentation	2
	<hr/>
	8
	<hr/>

Four of these cases were examined by dais outside, in the remaining the information was not forthcoming. Pre-eclamptic condition was present in 2 of the prolonged second stage cases and in one of the face presentations.

Embryotomy and Extraction of Fœtus : 8 cases.

These were 3 cases of transverse presentation all of which were examined by dais outside. Decapitation was performed in hospital.

The remaining cases in this group were 4 cases of breech and one of transverse, the last said to have been delivered by a dai at home.

Source of infection.

Introduction of sepsis probably occurred before admission in all but the 4 cases stated not to have been examined outside (Table 31), for all the cases under the heading 'unknown' were imported and had therefore almost certainly been handled before admission.

TABLE 31.

Sepsis : Operative delivery and malpresentation.

Examination by dais before admission or delivery.

	Total.	Examined by dais.	Not exa- mined.	Unknown.
Cæsarean section	11	7	3	1
Craniotomy	9	7	1	1
Forceps	8	4	..	4
Transverse and breech	8	6	..	2
	<hr/>	<hr/>	<hr/>	<hr/>
	36	24	4	8
	<hr/>	<hr/>	<hr/>	<hr/>

The large number of women who were infected *before* admission is also indicated by the time of onset of fever which began in 19 cases before or on the day of delivery.

TABLE 32.

Operative delivery and malpresentation : Onset of fever

Time	before delivery.	1st day.	2nd day.	3rd day.	4th day.	5th day.	Unknown.
Total 36	6	13	5	4	1	1	6

The day of death after delivery in these cases is shown in table 28.

• **Sepsis following Haemorrhage and Manual Removal of Placenta : 23 deaths**

There were 6 deaths from sepsis in cases of antepartum hæmorrhage due to placenta prævia. There were 16 deaths due to postpartum hæmorrhage which was associated in 12 with manual removal of the placenta and there was also 1 rather obscure case said to be an ovarian cyst complicating labour.

There were 21 Hindus, 1 Mahomedan and 1 Indian Christian in this series. All age periods were represented (Table 21). There were 3 primigravidæ and 7 of the multiparæ had had 8 or more pregnancies. There were 11 imported cases. The home conditions of only 12 were forthcoming (Tables 24, 25, 26).

Health in pregnancy was said to have been good in 4 of the Calcutta cases, bad in 8, in the imported cases, unknown.

Placenta Prævia : 6 deaths

Delivery took place in hospital in 3 of these and at home in 2, 1 patient died undelivered. Two of the hospital cases had been examined by dais before admission and probably the third also, as fever was present from before delivery in all three cases. Version and manual removal of the placenta were carried out in two of the hospital cases, the third was delivered spontaneously. At home, 1 case was packed twice by a doctor before delivery and the other was delivered by a dai and admitted to hospital with a retained placenta which was removed manually.

Postpartum Haemorrhage and Manual Removal of Placenta : 16 deaths

There were 4 cases in which labour was normal until after delivery, when postpartum hæmorrhage occurred, but the placenta was delivered spontaneously or was expressed. The histories of these are given in brief :—

1. A primigravida with marked œdema but no albuminuria was admitted to a maternity home. Delivery was spontaneous followed by postpartum hæmorrhage before and after delivery of the placenta. The uterus was packed. Death occurred from sepsis on the 4th day.

2. A 6-para was said to have reached full-term 4 months earlier but since that time the uterus had become smaller. She was delivered of a macerated fœtus at home, had postpartum hæmorrhage and was admitted to hospital the next day. She died of sepsis a fortnight later.

3. A 2-para was delivered of a macerated fœtus at home by a midwife. Postpartum hæmorrhage occurred. The placenta was expressed. Fever began on the third day, she was admitted to hospital on the 7th day and died three weeks later.

4. An 8-para was delivered at home by a midwife. Postpartum hæmorrhage occurred after expulsion of the placenta and bleeding was excessive for 2 days. On the 5th day secondary hæmorrhage occurred and a doctor was called. The patient died of sepsis on the 12th day.

Manual removal of the placenta for *postpartum hæmorrhage* in which labour was otherwise normal was followed by death from sepsis in 12 cases. Delivery took place at home in 10 and in hospital in 2. The attendants in the cases delivered at home were dais in 9 cases and a midwife in 1 case. Manual removal of the placenta was carried out by a doctor at home in 1 case (delivered by a dai) by a midwife in 1 and after removal to hospital in the 3rd stage of labour in 4 cases. In the remaining 4 cases the placenta was partially removed by a dai at home and the removal was completed after admission of the patient to the hospital. In 2 of the cases admitted to hospital removal was delayed for 2 days because the condition of the patient did not allow any further interference. The 2 hospital cases were delivered normally but the placenta was retained and was later removed manually. There was no history of examination before admission.

None of these patients were given blood transfusions. Three were given prontosil when sepsis developed. Fever began on or before the 3rd day in all cases in which information on this point was forthcoming. Two women died on the 4th day, the others lived considerably longer. (Table 28).

ECLAMPSIA AND ALBUMINURIA : 126 DEATHS

(51 imported cases.)

Eclampsia and albuminuria were together responsible for 17·9 per cent. of the deaths due directly to childbearing.

Eclampsia : 102 deaths

Eclampsia alone caused 14 per cent. of deaths due to childbearing and was the third commonest cause of maternal death in Calcutta during the year of the enquiry. It was the most important cause of death in primigravidæ and in women under the age of 20 years.

There were 58 deaths from eclampsia of women whose homes were in Calcutta and 44 imported cases. The distribution by religion was as follows:—

Hindus 85 (83·3 per cent.), Mohammedans 15 (14·7 per cent.) and Indian Christians 2 (1·9 per cent.). The proportion of Hindus in this group is higher than in the total deaths due to childbearing.

Age distribution.

This series of deaths shows a high proportion of young primigravidæ, 52 per cent. of the cases occurred in women under 20 years of age and 69 per cent. were pregnant for the first time. The figures are shown in tables 33 and 34 and are compared with total deaths due to childbearing.

TABLE 33.

Eclampsia deaths by age groups

	Total.	—15	15—19	20—24	25—29	30—34	35—39	40—45	45+	Unknown.
Eclampsia deaths	102	2	51	25	13	6	2	1	..	2
Per cent . . . . .	..	1.96	50.00	24.51	12.75	5.88	1.96	0.98	..	1.96
Total deaths due to childbearing	701	5	147	192	143	104	56	22	1	31
Per cent		0.71	20.97	27.39	20.40	14.84	7.99	3.14	0.14	4.42

Deaths from Eclampsia in very young women.

There were 7 deaths from eclampsia in girls of 14 and 15 years, 4 were Calcutta cases and 3 were imported. Warning symptoms of toxæmia were present in four of these, and none reported in three. One case only was seen by a doctor during pregnancy, but the urine was not examined. In no case was antenatal care reported. Three were cases of antepartum eclampsia, two of intrapartum eclampsia and two of postpartum eclampsia. Three died undelivered. These cases do not present any markedly different histories from the older women but on account of the early age at which death occurred, their histories are given in brief.

(a) Calcutta Cases.

1. A Bengali Brahmin primigravida, aged 14 years. Did no household work during pregnancy ; observed purdah. Diet : rice and meat and/or fish occasionally and 1-2 pau milk daily. House fairly clean, 3 persons living in one badly-ventilated room.

Thin and anæmic ; a history of ? epidemic dropsy ; diarrhoea during pregnancy. No prenatal care or examination of urine during pregnancy. Was admitted to a maternity home at full-term for palpitations and weakness. Oedema and albuminuria present, blood pressure 110 (systolic). Developed antepartum eclampsia ; had eight fits and died undelivered.

2. A Bengali Mohammedan primigravida, aged 14 years. Did no household work during pregnancy ; observed purdah. Diet : rice and wheat and occasionally meat and/or fish and less than $\frac{1}{2}$ pau milk daily. Family income less than Rs. 4 per head per month. House fairly clean, seven persons in 2 badly-ventilated rooms. Thin and anæmic; no warning symptoms reported, no antenatal care given. Delivered at home by a midwife of a full-term living child. Fits began one hour after delivery and continued at frequent intervals. Was given an injection of morphia at home and admitted to hospital 15 hours after delivery with œdema of lungs, suppression of urine, blood pressure 110/80. Died three hours later.

3. A Bengali Hindu primigravida, aged 15 years. No work during pregnancy ; observed purdah. Diet : rice and meat and/or fish occasionally, 1-2 pau milk daily. Family income less than Rs. 4 per head per month. House fairly clean ; 2 persons in one badly-ventilated room. Oedema for $1\frac{1}{2}$ months before onset of eclampsia but no antenatal treatment. Admitted to hospital with ante-partum fits, œdema and albuminuria (blood pressure 125/100) and died undelivered.

4. A Bengali Hindu primigravida aged 15 years. No work during pregnancy ; observed purdah. Diet : wheat and occasionally fish and/or meat. 1-2 pau milk daily. Family income Rs. 25-40 per month per head. House clean, 10 people in 3 well-ventilated rooms. Was seen at least once during pregnancy by a doctor, but urine was not examined. Oedema for a week before onset of full-term labour. Developed intrapartum fits and was sent to hospital by a doctor. Comatose on admission, œdema of feet, albuminuria, blood pressure 150/110. Delivered of a living child by forceps. Died two days later.

(b) Imported cases.

5. A Bengali Hindu primigravida aged 15 years. Oedema (? duration) in pregnancy. Began labour in the 9th month and developed intrapartum

fits. Admitted to hospital with œdema and albuminuria, blood pressure 140 (systolic). Membranes ruptured artificially and a living child delivered with forceps. Had 10 fits during and after labour and died 8 hours after delivery.

6. A Bengali Hindu primigravida, aged 15 years. No history of prenatal period. Admitted to hospital, after delivery of a full-term living child at home, with postpartum eclampsia. First fit 2 hours after delivery. No œdema on admission, albumen present, blood pressure 130/80. Had 8 fits and died 17 hours after delivery.

7. A (? Bengali) Hindu primigravida, aged 15 years. History of œdema in pregnancy. Admitted to hospital with eclamptic fits, not in labour. Oedema and albuminuria, blood pressure 110/65. Membranes ruptured on admission. Died after a few hours undelivered.

TABLE 34.

Eclampsia deaths by gravidity

	Total.	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	10th+	Un- known.
Eclampsia deaths .	102	71	11	7	5	1	..	1	1	2	..	1	2
Per cent. . . .	..	69.61	10.78	6.86	4.91	0.98	..	0.98	0.98	1.96	..	0.98	1.96
Total deaths due to childbearing .	701	207	113	120	66	18	28	24	23	19	8	20	25
Per cent. . . .	..	29.53	16.12	17.12	9.42	6.85	3.99	3.42	3.28	2.71	1.14	2.85	3.57

The foregoing table shows that 69 per cent. deaths from eclampsia occurred in primigravidæ. Eclampsia caused one third (33·6 per cent.) of deaths of all primigravidæ in the series of deaths due directly to childbearing.

Time of onset of fits.

It is usual to divide eclampsia cases according to the time at which fits begin. In this series there were 53 cases of antepartum eclampsia, 33 cases of intrapartum and 14 cases of postpartum eclampsia. In two cases this information was not forthcoming. The incidence of antepartum eclampsia is higher and that of intrapartum lower than has been found in similar investigations carried on in other countries. It seems possible therefore that more detailed enquiries in our cases would have elicited the information that some of the intrapartum cases started fits before labour, but that labour had begun by the time they came under skilled observation. Because of this possible discrepancy the cases have been divided into two groups only, (a) antepartum and intrapartum and (b) postpartum.

In the series of 102 cases there were 32 in which death occurred before delivery. The time of death of the remaining 70 in relation to delivery is shown in the following table.

TABLE 35

Time of death after delivery in 70 eclampsia cases

	Total.	—24 hours.	1—3 days.	4—7 days.	1—3 Weeks.
Ante and Intrapartum	56	26	25	5	..
Postpartum	14	6	4	2	2
Total	70	32	29	7	2

The effect of the strain of labour on the toxæmic mother is clearly shown by these figures, for 39 per cent. of the deaths in the antepartum and intrapartum group died less than a day after delivery and a further 46 per cent. before three days had passed. In the postpartum group the length of time between the first fit and death in the six cases dying within 24 hours varied between 1 hour and 16 hours.

TABLE 36

Stage of pregnancy at time of death—102 eclampsia cases

Month of pregnancy.	Ante and intrapartum eclampsia.	Post- partum eclampsia.	Total eclampsia deaths.
6th	2	..	2
7th	3	1	4
8th	15	..	15
9th	15	3	18
Full-term	48	9	57
Unknown	5	1	6
	88	14	102

The foregoing table shows that more than half of the antepartum and intrapartum cases developed fits before full-term had been reached. Postpartum eclampsia was less commonly associated with prematurity.

There were 44 imported cases in the eclampsia series and as home visits, could not be paid to these, our knowledge regarding living conditions, diet, prenatal care and the occurrence of warning symptoms of toxæmia, is confined to the remaining 58 cases. The following figures regarding overcrowding and ventilation, income per head, work during pregnancy and observance of purdah show that compared with the whole series of deaths from childbearing causes, (which are the only figures we have for comparison), the eclampsia cases lived under better hygienic conditions, took a rather more varied diet and were of a somewhat higher social status than the majority of women who died from childbearing. This is at least partly due to the high proportion of primigravida in the eclampsia series, but it seems probable that the newly married woman in her first pregnancy, from whom very little if any work seems to be required in the middle class homes, observing purdah, taking little or no exercise and taking a good diet may be more liable to toxæmia than her more active, less well-fed and socially poorer sister.

TABLE 37
Home Conditions

Home conditions.	Eclampsia cases.	Per cent.	Total deaths due to childbearing (per cent).*
*House clean	12	20.69	21.60
fair	37	63.79	48.25
dirty	8	13.79	28.79
unstated	1	1.73	1.36
Overcrowding	21	36.21	48.05
No overcrowding	37	63.79	50.00
Unstated . . . . .	..	..	1.95
Badly ventilated	36	62.07	65.17
Ventilation good	22	37.93	34.44
Unstated . . . . .	..	..	0.39

TABLE 38
Income per head

	Total.	—Rs. 4—	—Rs. 10—	—Rs. 25—	—Rs. 50	Rs. 50+	Un- known.
Eclampsia cases	58	7	23	15	3	5	5
Per cent. . . . .	..	12.07	39.66	25.86	5.17	8.62	8.62
Total childbearing (ex- cluding imported)	518	79	243	118	20	33	21
Per cent. . . . .	..	15.37	47.28	22.96	3.89	6.42	4.08

*Excluding imported cases.

TABLE 39
Work during pregnancy and Purdah

	Eclampsia.		Total childbearing (excluding imported).	
		Per cent.		Per cent.
No work	18	31·03	114	22·18
Housework	40	68·97	390	75·88
Other work . . . . .	..	..	8	1·56
Not stated . . . . .	..	..	2	0·38
Purdah	52	89·66	407	79·18
Non-purdah	6	10·34	104	20·24
Unstated . . . . .	..	..	3	0·58

The nutrition of the eclampsia cases, being estimated from questions asked in most cases of the relatives, can be relied upon very little. But most of these women were said to have been well-nourished. Amongst the 58 Calcutta cases only 7 were described as 'thin', the rest were 'average' or 'fat' and in 2 the information was not forthcoming.

TABLE 40
Diet

	Total.	R ₁	R ₂	R ₃	W ₁	W ₂	W ₃	M ₁	M ₂	M ₃	Un-known.
Eclampsia deaths	58	...	8	1	...	6	...	7	28	8	...
Per cent. . . . .	...	...	13·79	1·73	...	10·34	...	12·07	48·28	13·79	...
Total childbearing	514	11	102	9	21	18	3	84	203	54	9
Per cent. . . . .	...	2·14	19·84	1·75	4·09	3·50	0·58	16·34	39·49	10·51	1·76

TABLE 41
Milk (daily quantity)

	Total.	0	—½ pau.	—1 pau.	—2 pau.	2 pau.+	Unstated.
Eclampsia deaths	58	10	14	17	12	5	..
Per cent. . . . .	..	17·24	24·14	29·31	20·69	8·62	..
Total deaths child-bearing	514	111	120	138	85	36	24
Per cent. . . . .	..	21·59	23·35	26·85	16·54	7·00	4·67

Antenatal Care

In discussing this very important question of antenatal care in connection with eclampsia deaths it must be emphasised again that we may not be in possession of all the facts in every case. Information for example regarding the examination of the urine might only have been correctly obtained if the women herself could have been questioned, for hospital out-patient and dispensary records of these cases have often not been available and except when a doctor could be visited or the hospital in-patient notes consulted, the

relations statements have had to be accepted. In respect of the toxæmias however especially careful questioning with regard to antenatal care was carried out and it is believed that the facts presented are a fair representation of what actually happened.

The information shows that in 58 eclampsia cases in which home visits were paid only 18 (or 31 per cent.) had been 'seen' by a doctor or had attended a dispensary or hospital during the antenatal period, and of these 18 only 3 had their urine examined, and only *one* had urine examination done on several occasions. In this last case the advice which was given when albumen was found in the urine, was not followed by the patient.

The small number of women who sought advice in pregnancy is the more remarkable when we consider the time of onset of symptoms of toxæmia in these cases, and leads one to the conclusion that the presence of œdema in pregnancy is considered of little importance in Calcutta. This fact was repeatedly commented on by the investigators as a result of their home visiting. When the relations of a woman who had suffered from œdema in pregnancy were asked why she had not seen a doctor or gone to hospital, they replied that swelling was an ordinary thing for a woman to have during pregnancy especially in the first pregnancy. In one house to which a visit was paid on account of a maternal death associated with œdema which had lately occurred, another pregnant woman was found suffering from the same symptoms. Even in this case the relations said that they had not thought it necessary to get treatment for her.

This attitude is probably partly due to the prevalence in Calcutta of anæmia, epidemic dropsy and other diseases associated with swelling of feet, but it demonstrates the need for an educational campaign in order that the public may realise the dangers of this condition in pregnancy especially when it occurs in primigravida.

Warning symptoms of toxæmia.

In 50 of the 58 Calcutta cases there were warning symptoms reported, and it is probable that in others a more complete history would have revealed that the number was even larger. These warning symptoms were as follows:—

Oedema	45 cases.
Headache and vomiting	3 "
Vomiting	1 case.
Headache	1 "
	50
No warning symptoms	8 (13·8%)
	58

The duration of the warning œdema in the 45 cases in which it was present is shown below. In 41 per cent. of these cases œdema had been present for nearly a month or longer before eclampsia occurred, and in 31 per cent. of cases the œdema was said to have been present for less than 2 weeks. These times are very approximate, and the duration was almost certainly longer than was stated by the relatives of the woman after death.

Duration of Oedema before Onset of Eclampsia

Total cases.	—1 week.	—2 weeks.	—3 weeks.	—1 month.	—2 months.	—3 months.	Unknown-cases.
45	10	3	..	12	8	4	8

Of the Calcutta deaths from eclampsia 13·8 per cent. were, or were reported to be, 'fulminating,' i.e., the condition developed without warning. If illnesses of under a week are included, this number is 39 per cent. But it is probable that if more exact information had been forthcoming this figure would have been found to be lower, and in any case it will be recognised that adequate antenatal supervision, had it been given, would in some of these cases have resulted in the detection of a rising blood pressure, or albuminuria before subjective symptoms sufficiently marked to have been noticed and remembered by the relatives of the woman after her death, had made their appearance.

The apathy which was so noticeable in the reaction of the patient and her relatives towards warning symptoms of eclampsia is in marked contrast to the energy which was shown in getting skilled treatment for the patient when eclampsia developed. In the whole eclampsia series, 92 per cent. of cases received institutional treatment, a very high proportion indeed, compared with institutional treatment given to total deaths due to childbearing. The place of treatment is shown below.

Place of treatment of 102 eclampsia cases.

	Total.	Home.	Hospital.	Maternity Home.	Unknown.
Undelivered cases	32	1	27	3	1
Delivered cases	70	7	60*	2	1
	102	8	87	5	2

On account of the fact that so many cases of eclampsia were admitted to hospitals for treatment a certain amount of information was available regarding the condition of the patients after onset of the fits had occurred.

Oedema was mentioned as present in 53 of the total 102 cases (information lacking in many cases) and it is probable that the number was much larger than this. The condition of the urine showed the following :—

Albumen present	Cases.
Suppression of urine	85
Albumen absent	3
Urine not examined or no report	2
	12
	102

There was a record of at least one blood pressure reading in 88 of the 102 cases. The highest figures recorded in each case are shown in the following table :—

Blood Pressure in 88 Eclampsia Deaths

Systolic.					Diastolic.			
—125 mm.	—150 mm.	—175 mm.	—200 mm.	200+ mm.	—80 mm.	—100 mm.	100+ mm.	Un- recorded.
15	32	28	10	3	12	32	39	5

*7 admitted after delivery at home.

Very high blood pressures were not numerous but as in many cases there was only one record made, and this sometimes when the patient was just delivered, or moribund, it is possible that higher figures may have occurred at other stages of the disease. The highest systolic pressure reported was 210 and the highest diastolic 150 mm.

Method of delivery.

Rupture of membranes to induce labour was performed in 27 cases in the series. Forceps were applied in 28 of the 70 cases (40 per cent.) in which delivery was effected. Craniotomy was performed in 5 and in one case of contracted pelvis a lower segment Caesarean section was done. Delivery was spontaneous in 52 per cent. cases in which delivery occurred before death.

Fate of the infant.

There were 43 infants born alive and 27 were stillborn. If the cases in which the mother died undelivered are included the total foetal mortality in the eclampsia series was 58 per cent.

There were no twin pregnancies in this series of eclampsia deaths.

ALBUMINURIA : 24 DEATHS

Albuminuria without convulsions occurred in 24 cases. The deaths have been divided into three groups :

Pre-eclamptic toxæmia	10
Albuminuria with severe anæmia	13
Pyelo-nephritis	1
	<hr/>
	24
	<hr/>

Pre-eclamptic toxæmia—10 deaths

These cases showed a history of œdema for a varying period before death, accompanied by albuminuria which was found before or at the time of delivery. The blood pressure was raised in all, except one in which it was taken at home and was probably not a correct reading. The highest blood pressure reported was 224/160. In 4 cases some prenatal treatment was given, including a urine examination, but in no case was regular prenatal care carried out. Hospital treatment was given in 7 cases and 3 were treated at home ; 4 died undelivered.

One case was complicated by obstructed labour which was treated by pituitrin without proper examination of the patient and in spite of the toxæmia. The history was as follows :—

A Hindu 3-para, aged 17 years. (1st pregnancy, 3 months abortion in 1934 ; 2nd pregnancy in 1935, prolonged labour at full-term, stillborn child). The third pregnancy went to full-term. The labour began at home with a dai in attendance who examined the patient and reported to a private doctor that the os was fully dilated but the head was not advancing. Without examining the patient the doctor gave an injection of pituitrin. As there was still no progress the patient was taken to hospital where her condition on admission was described as very poor, blood-pressure, 160-105, urine loaded with albumen. The pelvis was moderately contracted and the presentation was occipito-posterior. The patient died while she was being prepared for Caesarean section.

Many avoidable factors were present in this case. Lack of antenatal care in the course of which pelvic contraction and the toxæmia should have been discovered ; lack of skill and error of judgment at the time of labour in the use of pituitrin in a case of toxæmia with disproportion ; and finally the delay in sending the case to hospital.

Albuminuria and Anæmia—13 cases

These cases were severely anæmic women but as marked signs of toxæmia were present they have been put into this group. It is impossible to say how much the anæmia or the toxæmia was the important factor in causing death or whether chronic renal disease was the underlying condition. The blood pressure was raised in all cases in which it was reported (except one taken just following delivery) and albumen was present in large quantity. Death occurred before delivery in 5 of the 13 cases.

Pyelo-nephritis—1 case

A 7-para with a history of epidemic dropsy, had œdema for 3½ months and latterly headache and vomiting. She was treated at home by a private doctor who said that the urine contained much albumen and pus. She died undelivered at the 8th month.

OTHER TOXÆMIAS OF PREGNANCY—15 DEATHS

(4 imported cases)

The group, " other toxæmias of pregnancy " includes 11 deaths from hyperemesis gravidarum and 4 others.

Hyperemesis : 11 deaths

There were 6 Hindus, 3 Mohammedans and 2 Anglo-Indians, who died of hyperemesis ; 4 were primigravidæ and 7 were multiparæ. Two of the multiparæ gave histories of excessive vomiting in previous pregnancies. The ages of these women lay between 14 and 35 years. In other countries, hyperemesis gravidarum tends to occur more frequently amongst women of higher social status. These cases are very few, but excluding imported cases, the family of one was described as rich, of three as fairly well-off and of three as poor.

The duration of symptoms was not recorded in all cases. The stage of pregnancy at the time of death was the 2nd month in three, the 3rd month in three, the 4th month in 1, the 5th month in two, full-term in one and unrecorded in one.

Oedema was present in two cases, in one of which the woman was very anæmic. Albumen was detected in 4, was stated to be absent in 3 ; others no record. The blood pressure was only reported in 1 case and was not high.

Treatment was given by doctors at home or in hospitals to all these women, except one who died at home without being seen by any doctor. Five were treated entirely at home of whom 3 aborted spontaneously and two died undelivered. Five were admitted to hospitals of whom 1 aborted spontaneously, 2 were induced by insertion of a tent followed by evacuation of the uterus, and 2 died undelivered.

A relapse after previous remission of symptoms, which has been mentioned as particularly dangerous in other maternal mortality series of deaths from

hyperemesis, occurred in one case in our series : an Anglo-Indian patient, para 5, was admitted to a hospital in the 3rd month of pregnancy for excessive vomiting. She left hospital against advice and was treated at home. After 2 months the vomiting became worse again and she was re-admitted with jaundice and died the following day undelivered.

There was one case of excessive vomiting in connection with full-term delivery. The patient was a Hindu aged only 14 years, pregnancy was said to be normal until the ninth month when she was admitted to hospital with fever, vomiting and abdominal pain and discharged better after 4 days. At full-term she was delivered normally at home of a living child. Vomiting began almost immediately after delivery and she was admitted to hospital the following day. There the spleen was found to be palpable, the blood pressure 124/98, albumen, a trace. There was no cedema and no jaundice. Persistent vomiting continued and after 4 days the patient died, no diagnosis having been made. The blood examination for malaria was negative.

The remaining 4 cases which have been included in this group were 3 in which jaundice was the prominent symptom and 1 in which high blood pressure and a trace of albumen in the urine was the only abnormal finding.

A summary of the history in these cases follows :—

1. Hindu primigravida aged 16, 8 months pregnant, was admitted to hospital with jaundice, duration not stated. Albumen was present in the urine. She was delivered of a stillborn infant and died three hours later.
2. Hindu 3-gravida aged 24, at or near full-term, suffering from jaundice and vomiting, was attended by a doctor at home. Urine showed a trace of albumen. A stillborn child was delivered normally but the patient died 18 hours later.
3. Hindu 2-gravida aged 17, 7 months pregnant, had jaundice and dimness of vision for 15 days at home, and was admitted to hospital. Urine, albumen, a trace ; Van den Bergh, direct positive. The patient was delivered spontaneously of a stillborn child but died 12 hours later.
4. Hindu 3-gravida aged 23, full-term, had suffered from cedema for a month before admission to hospital. Urine a trace of albumen, blood pressure 170-120. She was delivered normally of a living child and died the following day.

No *post mortem* examinations were carried out in any of these cases and no diagnosis other than 'toxæmia of pregnancy' was made.

Acute yellow atrophy is a possible diagnosis in the jaundiced cases, but the information was too meagre to justify such a conclusion.

THROMBOSIS, EMBOLISM AND SUDDEN DEATH—11 DEATHS

There was very meagre evidence for the cause of death in several of the cases in this group. No *post mortems* were carried out. All the deaths occurred within a few days of delivery, the symptoms were said to have developed suddenly without warning and the patient died shortly afterwards.

Death took place in hospital in 5 cases and the diagnosis of 'embolism' was made. The remaining 6 cases were delivered and died at home. The attendants at the time of delivery at home were a midwife in 1 and dais in 5, and in only one of the 6 cases was a doctor present before death.

Hospital deaths diagnosed as due to ' Embolism '

1. A Hindu 4-gravida, healthy in pregnancy was admitted to hospital with a transverse presentation. Internal version was done. Six hours later she suddenly became cyanosed, developed acute respiratory distress and died after 20 minutes.

2. A Hindu 1-gravida was admitted to hospital with disproportion after examination by a midwife outside. She was delivered with forceps. There was fever on the 3rd day and on the 4th day she suddenly complained of precordial pain and dyspnoea and died 3½ hours later.

3. A Hindu 2-gravida, anæmic, had a normal delivery in hospital. Two days later she suddenly developed cyanosis and respiratory distress and died after an hour.

4. A Hindu 6-gravida was admitted to hospital for incomplete 5 months abortion. She had been suffering from dysentery and had an enlarged spleen. The uterus was evacuated. Hæmorrhage was considerable but there was said to be no sepsis. On the 4th day she had a sudden convulsion, became unconscious and died shortly afterwards.

5. A Mohammedan 2-para, anæmic, was delivered at home by a midwife and admitted to hospital on the 2nd day on account of fever. She died the same day and was thought to be a case of embolism. The history suggests that anæmia and the shock of transfer to hospital may have caused sudden heart failure, but as information regarding the case was very limited the diagnosis made in the hospital has been adopted.

' Sudden death ' at home

One of these cases developed signs of femoral thrombosis on the day of delivery, the leg becoming swollen and painful. A doctor saw this patient and contrary to his advice she got up and walked. She complained of sudden very acute distress and died after a few minutes.

The information regarding the remaining five cases was not sufficient to make a diagnosis of anything but ' sudden death '. But data and relations present at the time of delivery stated that labour in each case was easy and normal and there was no excess of bleeding and that suddenly a few hours or days after delivery the women had a sudden attack of acute distress and died within a few minutes.

ACCIDENTS OF LABOUR : 26 DEATHS

(11 imported cases)

This is a group of cases in which death was caused by the shock of labour itself. Most were associated with difficult labour but a few occurred in connection with spontaneous delivery. The total represents only 3.71 per cent. of the deaths due directly to childbearing, a small number in proportion to the frequency of this cause of death found in other maternal mortality surveys. Obstructed labour is not common in Calcutta ; disproportion is less often met with than in many parts of India and osteomalacic pelvic deformities are almost unknown outside the Marwari community. The incidence of osteomalacia amongst Marwari women in Calcutta is worthy of closer study and a consideration of their living conditions, habits and diet might throw more light on the causation of the disease. Not only osteomalacia but rickets in childhood are common in this community with the result that pelvic deformities are often met with. There were 2 deaths from obstructed labour in Marwari women with a history of osteomalacia.

The cases in this group fall into two groups : those in which death occurred in association with difficult labour (19 cases) and deaths from shock after spontaneous delivery (7 cases).

Difficult labour—19 deaths

There were 17 Hindus and 2 Mohammedans in this group.

Ten cases were imported and nearly all of these were brought to Calcutta very late in labour ; all but one died less than 24 hours after admission to hospital.

There were 3 primigravidae and 16 multiparae, and more than half the deaths occurred between 25 and 35 years of age. All were delivered in hospitals. Malpresentation or disproportion were present in 16 cases, prolonged labour due to either inertia or disproportion in 2 and carcinoma of cervix in one. The causes of difficulty at the time of labour are shown in the following table :—

Contracted pelvis	7
Transverse or breech	2
Hydrocephalus	2
Large fœtus	1
Obstructed labour : ? cause	4
Uterine inertia	2
Carcinoma of cervix	1
	<hr/>
	19
	<hr/>

Ruptured Uterus.

There were 4 cases in which the uterus ruptured. In 3 rupture had occurred before admission to hospital and in 1 the time of rupture was doubtful. The first three were imported cases of obstructed labour, one due to a hydrocephalic fœtus, the second to transverse presentation and the third to contracted pelvis. The Calcutta case was a Marwari woman, 3-gravida with a history of a normal first labour and a prolonged second labour which resulted in the birth of a stillborn child. At the time of the third delivery she was seen at home by a midwife, who sent her to hospital, where she was admitted 24 hours after labour began. The child was delivered with forceps when it was found that the uterus was ruptured and the placenta lying between the layers of the broad ligament. The uterus was packed. The woman died two days later of shock and sepsis.

The treatment of these cases of difficult labour is shown in the following table :—

Cæsarean Section.

Classical	4
Lower segment	2
Cæsarean hysterectomy	1
Decapitation	1
Craniotomy	1
Extraction of fœtus	1
Forceps	2
Packing of ruptured uterus	1
Died undelivered	6
	<hr/>
	19
	<hr/>

Cæsarean Section : 7 cases.

The woman who was delivered by Cæsarean hysterectomy was a case of carcinoma of cervix admitted to hospital before labour began. She died of shock 2 days after delivery.

In the 4 cases on whom classical Cæsarean was performed, the membranes were not ruptured on admission to hospital. The operation was performed after trial labour in 1 and for disproportion in the other 3. The lower segment operation was performed in 2 cases after prolonged labour and death occurred from shock.

Spontaneous Delivery

There were 7 women (all Hindus) who died from the shock of labour which was spontaneous. It seems likely that more complete information might have revealed other reasons for death. In the case of 5, health during pregnancy was said to have been poor, 3 were somewhat anæmic (of whom 2 had œdema), 1 had suffered from asthma and another had fever in the week before delivery, but none of these conditions seemed to be sufficient to cause death which occurred, in all cases but one, less than 26 hours after delivery.

The place of delivery was at home in 3, in hospital in 2, in a maternity home in 1 and in a taxi on the way to hospital in 1. The attendants were relatives in 2, a midwife in 1, a hospital in 2 and a maternity home in 1.

The 2 cases attended by relatives were said to have been precipitate labours. The third case suffered from asthma and was said to have had a prolonged labour in a maternity home. Somewhat excessive bleeding was mentioned in the fourth case, a woman who also had fever before admission and a blood pressure of 154 systolic, and died half an hour later. The fifth case delivered at home by a dai had a retained placenta, but the relatives denied bleeding. A doctor was called and attempted removal without success and she was eventually admitted to hospital, but was by that time in a very low condition and died almost immediately with the placenta still undelivered. If the history in this case can be relied upon it may have been a case of placenta accreta. The sixth case was one of triplets. Labour in hospital was spontaneous but rather prolonged and the patient died of shock 18 hours later. Toxæmia was also a factor ; the blood pressure was 160/95 and there was œdema, but the urine was free from albumen. The history of the 7th case was a particularly strange one. A multigravida whose health during pregnancy was described as good was delivered normally of a living child by a trained midwife. Almost immediately after delivery she complained of sudden severe abdominal pain which the midwife thought was due to 'after pains' and gave a dose of ergot. The pain was not relieved so a doctor was called. In the mean time a hot water bottle was given by the midwife and this relieved the pain somewhat for about 10 minutes. The doctor arrived and examined the patient and the placenta and could find no cause for the pain. He gave pituitrin and ergot. The pain increased and the woman died 6 hours after delivery.

**OTHER OR UNSPECIFIED CONDITIONS OF THE PUERPERAL STATE :
10 DEATHS**

This group includes 1 death from puerperal insanity. The woman was a Mohammedan 3-para, aged 30 with a history of insanity after a previous labour. She was delivered normally by a dai at home, developed signs of acute mania and was admitted to hospital on the day following labour. She died three days later.

The remaining 9 cases are a miscellaneous group in which the cause of death was unknown. In one information was withheld; in the others it was so incomplete that it has not been possible to assign them to any of the foregoing groups and they have been entered here as 'child-birth unqualified'. Such evidence as was forthcoming suggested that the cause of death was directly due to childbearing and not to an intercurrent disease. All but one died at home and four were seen by no doctor before death. The one who was admitted to hospital died undelivered in the first stage of labour and no diagnosis was made.

ANÆMIA—165 DEATHS

41 Imported Cases

Deaths which have been classed as due to anæmia *per se* represent 23·53 per cent. of deaths due directly to childbearing and next to sepsis were the most frequent cause of maternal death in Calcutta. The importance of anæmia is far greater than these figures show for deaths have been assigned to this group only when no other cause of death such as sepsis, toxæmia, or hæmorrhage was present, and there are many deaths from such causes in which anæmia was an important, perhaps the most important, contributing factor.

There were 123 Hindus, 36 Mohammedans, 5 Indian Christians and 1 Anglo-Indian in this group, 41 cases were imported from outside Calcutta.

Anæmia caused death at all periods of the childbearing life and the distribution of deaths by age differed little from that of all deaths due to childbearing, (Table 42), but there were somewhat fewer deaths under 20 years.

TABLE 42
Anæmia deaths, distribution by age periods

	Age.	—15	—20	—25	—30	—35	—40	—45	45+	Un- known.
Anæmia . . .	165	...	21	56	36	23	14	3	1	11
Per cent. . .	...	...	12·73	33·94	21·82	13·94	8·48	1·82	0·60	6·67
<i>Total deaths due to childbearing . . .</i>	701	5	147	192	143	104	56	22	1	31
Per cent. . .	...	0·71	20·97	27·39	20·40	14·84	7·99	3·14	0·14	4·42

There were as many as 28 deaths from anæmia in primigravidæ but the largest number occurred in women pregnant for the 3rd time. (Table 43).

TABLE 43
Anæmia deaths by gravidity

	No. of preg- nancy.	1	2	3	4	5	6	7	8	9	10	10+	Un- known
Anæmia . . .	165	25	33	36	23	13	5	3	4	7	...	5	8
Per cent. . .	...	16·96	20·00	21·82	13·94	7·88	3·03	1·82	2·42	4·24	...	3·03	4·85
Childbearing . . .	701	207	113	120	66	48	28	24	23	19	8	20	25
Per cent. . .	...	29·53	16·12	17·12	9·42	6·85	3·99	3·42	3·28	2·71	1·14	2·85	3·57

In this series of deaths 10 per cent. occurred in connection with pregnancy of less than six months duration, 42 per cent. with premature births and the remaining with full-term pregnancy (or unstated). The duration of pregnancy at delivery (or death, if undelivered) is shown in Table 44.

TABLE 44

Anæmia deaths, duration of pregnancy in months

Months pregnant	3	4	5	6	7	8	9	full-term	unstated
Total 165	1	1	4	12	23	27	20	67	10

Home Conditions.

The home conditions of women who died from anæmia were on the whole rather more unsatisfactory than those of total childbearing causes but all degrees of social status were represented. Overcrowding was more common than in the whole series and a larger proportion of homes were described as dirty, but ventilation, water supply and drainage were similar in proportion to those of the whole series. The figures relating to these facts refer only to Calcutta cases (124 deaths).

TABLE 45

Anæmia deaths. Overcrowding (excluding imported cases)

	Total.	Over-crowding.	No over-crowding.	Unstated.
Anæmia deaths	124	75	45	4
Per cent.	..	60.48	36.29	3.23
Total childbearing deaths	514	247	257	10
Per cent.	..	48.05	50.00	1.95

Those women who observed purdah were not more numerous amongst the anæmia cases than in the total series.

TABLE 46

Anæmia deaths. Observation of purdah (excluding imported cases)

	Total.	Purdah.	Non-purdah.	Unstated.
Anæmia deaths	124	95	28	1
Per cent.	..	76.61	22.58	0.81
Total childbearing deaths	514	407	104	3
Per cent.	..	79.18	20.24	0.58

The income per head and the diet and milk taken during pregnancy showed no marked differences from those of childbearing deaths as a whole.

Course of pregnancy.

It was difficult to obtain accurate information regarding the duration of symptoms in cases of anæmia because of the insidious onset of the disease and the fact that in many cases reports of the relatives were the main source of information. Oedema was reported to have been present in 137 cases, 'no oedema' in 11 (unknown 17). The duration of oedema was said to have been 1-3 months in 46 cases and 1-3 weeks in 15 cases, in the remaining the time was not stated.

Other abnormal conditions which were reported to have occurred during pregnancy were mainly gastro-intestinal : dysentery 11 cases ; diarrhoea 25, stomatitis 10, excessive vomiting 10, hæmatemesis 1, fever 5.

Whether these symptoms accompanied or preceded the anæmia it was not possible to ascertain. The association between diarrhoea and dysentery and anæmia in pregnancy has been mentioned earlier.

There was a history of enlarged liver and spleen in 5 cases, enlarged liver alone in 2 and enlarged spleen in 1 case. But as some of these cases were never examined by a doctor before death this is without doubt an understatement.

Antenatal care.

An antenatal examination which included testing of the urine on at least one occasion was reported to have been given to only 32 women in the anæmia group, 18 of whom were attended by doctors at home or at a dispensary, while 13 went to hospital for in or out-patient treatment and 1 was treated at a maternity home. In addition to these, a further 37 women were *seen* by doctors at home or at a hospital at some time during the course of their pregnancy, but no examination of the urine was said to have been made.

Cases of anæmia associated with albuminuria and high blood pressure or other definite signs pointing to toxæmia, have been classified in the toxæmia of pregnancy groups but it was often very difficult to know whether the case was primarily an anæmia with albumen in the later stages, which commonly occurs, or a case of primary toxæmia of pregnancy associated with severe anæmia. The relationship between anæmia and toxæmia in this country is so little understood that in dealing with classification of maternal death by cause these mixed conditions give rise to great difficulty even when they have been investigated in hospitals. It is inevitable therefore that in our series errors in classification have been made and that there has been some overlapping of the anæmia and toxæmia groups.

There was a record of urine examination, during pregnancy or at the time of labour, in 57 cases in this series and in 38 of these a trace or more of albumen was found.

Labour.

Death occurred before delivery in 26 cases of which 16 were admitted to hospitals or maternity homes for treatment.

The place of delivery of the remaining 139 was at home in 69, in hospital in 62 and in a maternity home in 6 cases (unknown 2). The attendant at delivery at home was as follows :—

Attendant at delivery at home.

Relatives	18
Dais	30
Midwives	11
Doctor	1
Unknown	9
	<hr/>
	69

There were 12 women who died without being seen by a doctor either before or after delivery, and 5 who were seen during pregnancy but were not seen between the time of delivery and death. The insidious onset of the symptoms

of anæmia, the fact that many of the women who suffer from this condition have experienced similar but less severe symptoms in a previous pregnancy and above all the popular idea that swelling of the feet and increasing pallor are common happenings in pregnancy (as indeed they are in Calcutta), doubtless contributed to the failure to get treatment in so many cases. Apart from those who were never seen by a doctor at any time, there were many who were admitted to hospital far too late for treatment to be effective, or who were seen by doctors at home only just before death.

Delivery of the fœtus was spontaneous in all cases but 2, in one of which forceps were applied and in the other craniotomy performed. Difficulty with the expulsion of the placenta was mentioned in 7 cases. Excessive bleeding was mentioned in 5 cases. There were 5 cases of twins, a proportion considerably higher than the normal incidence and an indication of the increased risk of anæmia in multiple pregnancy.

Consideration of the time of death in relation to delivery shows how badly the severely anæmic woman stands the strain of labour. Almost half the deaths in delivered cases occurred within 3 days after labour, and 36 of these took place within 24 hours of delivery.

TABLE 47
Anæmia deaths. Time of death after delivery

Total Cases	—24 hrs.	1—3 days.	4—6 days.	1—2 weeks.	2½—4 weeks.	1—2 months.	2½—3 months.	Unknown.
139	36	28	12	17	10	20	13	3

Pathological reports.

Far too little information was forthcoming in most of these cases for any conclusion to be reached as to the type or cause of the anæmia. Hæmoglobin estimations were made in 60 cases, but the methods varied and in many only the Tallqvist method was used.

Red blood cell counts were done in 55 cases. A summary of the findings is given below. When more than one report was available, the lowest has been taken.

Red blood cell counts per cmm. in 55 anæmia deaths

Total	—1 million.	—2 million.	—3 million.
55	28	25	2

Hæmoglobin estimations in 60 anæmia deaths

Total	10 per cent. or less.	11—20 per cent.	21—39 per cent.	31—40 per cent.	41—50 per cent.
60	8	33	14	4	1

There were 54 cases in which both the hæmoglobin and the red blood count was recorded and in these the colour index was above 1 in 19 cases, below 1 in 31 and equal to 1 in 4 cases. Different methods of technique and rough hæmoglobin estimations vitiate these figures and no correct idea can be gained from them regarding the relative prevalence of the macrocytic and microcytic types of anæmia in causing maternal death in Calcutta.

Examination of the faeces was reported in only 9 cases and in 2 of these *ankylostoma duodenale* was present. It is therefore impossible to say how far ankylostomiasis is a factor in causing anæmia deaths in this city. Other investigators have found it to be small.

Treatment.

Information regarding treatment was not sufficiently complete for discussion to be worth while except to emphasise that it seemed to have been of a very casual and intermittent nature in most cases. There was marked failure to realise the necessity for urgent and intensive treatment in the period before delivery. In addition to iron and liver preparations which were used, but often only in useless quantities, blood transfusions were given in 2 cases, and injections of whole blood in several others. At some stage of pregnancy, labour or the puerperum, 51 per cent. of the women who died from anæmia were admitted to institutions for treatment.

Apart from dealing with aetiological factors, the most effective way of preventing maternal deaths from anæmia is by early and unremitting antenatal care, including the provision of sufficient beds for severe cases so that intensive treatment can be carried out in the limited time which remains before the mother has to undergo the added strain of labour. That antenatal care must be regular and unremitting is shown by the following case history of a woman who was healthy when examined at an antenatal clinic in the 7th month of pregnancy and died of anæmia 2 months later.

A Hindu, 2-gravida, aged 18 years, visited a welfare centre on May 14th 1936. She gave a history of swelling of the body during her first pregnancy but when seen she was well nourished, not apparently anæmic and had no œdemæ. The uterus was the size of 26 weeks. Examinations were negative except that a trace of albumen was found in the urine. The blood pressure was 115/60. A month later she was followed up by a health visitor at home and was at that time found to be anæmic with swelling of feet, and was advised to come again to the Welfare Centre for examination. This advice she failed to follow. When the health visitor paid her next monthly visit she was told that the woman had died after premature delivery in a hospital. The report obtained from the hospital stated that her condition on admission was extremely poor. The red blood count was 840,000, the hæmoglobin 10 per cent. The urine contained albumen. She had begun labour the day following admission and died a few hours after delivery.

In 2 months this woman had passed from a state of apparently good health to one of the most extreme anæmia. During this time the only symptoms of which any history could be obtained were œdema, which had been present for at least a month, and diarrhœa which developed during the last week and led to her being taken to hospital.

Fate of the Infant

The fetal mortality (including abortions and undelivered cases) was 1 per cent. This is largely due to the number of premature births.

TABLE 48

165 Anaemia deaths. Fate of the infant

Born alive	78
Born dead (including abortions)	61
Undelivered	26
Unknown	5

170

(including 5 pairs of twins).

CHAPTER II.

Class II.

MATERNAL DEATHS FROM ASSOCIATED DISEASES : 186 CASES

Tuberculosis : 77 deaths

Tuberculosis was the most frequent cause in the group of maternal deaths due to diseases associated with childbearing. The number of women whose tuberculosis was aggravated by childbearing and who died as a result during the year was very much larger than these figures show, but in accordance with the method chosen for the selection of maternal deaths in this enquiry, only those cases have been included in which either death occurred during pregnancy or the puerperium or symptoms were first noticed during this period. There were 77 deaths which fulfilled these conditions.

There were 7 cases diagnosed as abdominal tuberculosis, the remaining were the pulmonary form of the disease.

In this series there were 39 Hindus (50·65 per cent.), 36 Mohammedans (46·75 per cent.) and 2 Indian Christians (2·60 per cent.). The proportion of Mohammedans amongst women who died of tuberculosis associated with pregnancy was considerably higher than the proportion of Mohammedans amongst women who died from maternal deaths due to all causes during the period of the enquiry, and was also higher than the proportion of Mohammedans amongst total registered births (*i.e.* the population at risk) during the period of the enquiry (page 20).

Poverty, overcrowding, lack of cleanliness, bad ventilation and drainage, were all high in proportion in this series. More than half the families to which these women belonged lived in only one room and the average number in family of the whole series of cases was 5 persons including children.

The distribution by age and gravidity is shown in Tables 49 and 50 and compared with that of total maternal deaths. It was found that 54 per cent. of the deaths from tuberculosis occurred between the ages of 15 and 25 years and 75 per cent. in association with the first, second and third pregnancies.

TABLE 49

Distribution by age

	Total.	—15	—20	—25	—30	—35	—40	—45	45+	Un- known.
Tuberculosis deaths	77	...	19	23	14	12	6	2	...	1
Per cent. . . . .	...	24·68	29·87	18·18	15·58	7·79	2·60	...	...	1·30
Total maternal deaths	887	8	186	243	182	134	72	25	1	38
Per cent. . . . .	...	0·90	20·97	27·40	20·52	15·11	8·12	2·81	0·11	4·06

TABLE 50

Distribution by gravidity

	Total.	1	2	3	4	5	6	7	8	9	10	10+	Un- known.
Tuberculosis deaths	77	23	23	12	3	7	1	2	4	1	1	...	...
Per cent. . . . .	...	29·37	29·87	15·58	3·90	9·09	1·30	2·60	5·19	1·30	1·30	...	...
Total maternal deaths	887	262	151	149	77	66	37	29	32	22	10	24	28
Per cent. . . . .	...	29·54	17·02	16·80	8·63	7·44	4·17	3·27	3·61	2·43	1·13	2·70	3·16

Health before pregnancy was said to have been good in 55, poor in 10 and bad in 7 (unknown 5). Health during pregnancy, or during the latter part of

it was in nearly all cases poor or bad. The duration of symptoms was not obtained in all, but cough and fever were complained of for several months before delivery in the majority of cases. Regular antenatal care was reported in 15 cases in this series, while 33 other women were seen by a doctor or attended a hospital at some time during pregnancy; 28 were seen by no doctor at all, although, some of these took medicine at home; (unknown 1).

The duration of pregnancy at the time of delivery (or death if undelivered) is shown in Table 51. There were a large number of premature deliveries in this series of deaths.

TABLE 51

Duration of Pregnancy

Total months—	3	4	5	6	7	8	9	10	Unknown.
Deaths 77	1	2	3	3	10	11	8	38	1

The place of delivery was at home in 50 cases, in hospitals in 15 and in maternity homes in 5 cases; 7 died undelivered.

The infant was born alive in 41 cases, was stillborn in 26 cases and the pregnancy terminated by abortion, or death occurred before delivery, in 10.

The total foetal and neonatal mortality in this series was 72 per cent.

There is no institution in Calcutta which provides for the special antenatal and intranatal treatment of tuberculous women. The maternity hospitals and wards have no arrangements for isolation and prolonged in-patient treatment of such cases and so in the interest of their other patients do not admit them, except unknowingly or in emergency. The result of this is that the care of the mother with tuberculosis is one of the most difficult problems in maternal welfare work in this city. The condition of the family with limited means, in which the newly-delivered mother is struggling against advancing tuberculosis is truly pitiable. The home becomes neglected, the food is not properly prepared and the children have every opportunity of developing the disease and adding to the sickness in the house. The newly-born infant of ten dies (in this series 50 per cent. infants born alive had died at the time of investigation) either from tuberculosis or from some other infection, and if it lives it exhausts the mother still more, whether it is breast-fed or whether it has to have artificial feeds prepared for it.

Advice about the woman taking proper rest, her need of good food and careful disinfection is all but useless when the family lives in one room and it is the mother who is sick. The most effective solution of this vast problem would seem to be the provision of institutional treatment for the tuberculous mother during pregnancy and after delivery, when exacerbations of the disease so often occur. The newly-born infant might then be segregated and brought up under good conditions with some hope of success, and the mother before returning to her family could be taught some reliable method of contraception.

Heart disease : 9 deaths

There were 9 cases in which the history, symptoms and signs suggested chronic heart disease. Many others, in which the cause of death was described as heart failure or heart disease, were clearly cases of anæmia or toxæmia of pregnancy and these have been included under their own headings. Mistakes however in cases with insufficient data are likely to have been made and this figure may be too small.

There were 8 multiparae and 1 primigravida in the series. Only 3 cases received hospital treatment, the others were treated by doctors at home.

In 5 of the 9 cases there was both a history of rheumatic fever and signs of heart disease, the remaining showed the typical picture of congestive heart failure. In 3 of the cases without definite history of rheumatism heart failure had occurred in earlier pregnancies. Death took place before delivery in 5 cases and the duration of pregnancy was full-term in only two. A 4-para with mitral stenosis who died undelivered at the 7th month had been repeatedly urged sterilisation on account of the heart lesion but this had been refused as she had no living child.

Kidney Diseases : 2 deaths

Two deaths occurred from uræmia in which there was a history of chronic renal disease. It is possible that other cases which should have been included here have been grouped under albuminuria of pregnancy.

Acute Yellow Atrophy of Liver : 1 death

This patient was admitted to hospital with a short history of jaundice, dimness of vision and constipation, was delivered of a stillborn infant and died in coma 2 days later. The diagnosis of acute yellow atrophy was made in the hospital but was not confirmed by *post mortem* examination.

Pneumonia : 22 deaths

There were 22 deaths from pneumonia, (lobar and broncho-pneumonia could not be divided), in which as far as could be ascertained, no sepsis or other cause of death was present. Death occurred in pregnancy in 4 cases and in 4 others signs of pneumonia were already present when delivery or abortion took place. In the others pneumonia developed after delivery, and it is probable that in some of these the pneumonia was of the septic type or tuberculous in origin and should have been classed to these groups, but in the absence of definite evidence the cases have had to be included in this group. In the puerperal cases delivery or abortion was spontaneous in all but three, two of which were delivered by Cæsarean section and one by forceps.

The health in pregnancy was said to have been good in the case of only 5 of the women who died from pneumonia. Death took place at home in 13 cases and in hospital in 9 cases.

Influenza : 6 deaths

There were 6 maternal deaths from influenza and 5 of these occurred in the short period between December 23rd and January 2nd.

Asthma : 2 deaths

Asthma and heart failure was the cause of death in 2 cases.

Dysentery : 10 deaths

It has been pointed out earlier that dysentery appears to be an aetiological factor of some importance in the development of anæmia in pregnancy and that it also plays a part in predisposing to puerperal sepsis. It is probable that this group of dysentery deaths would have been larger if more accurate records of some of the anæmia cases had been available and the primary cause

had been recognised. In this analysis only those deaths in which symptoms of dysentery occurred *during* the fatal illness have been classified as deaths from this cause.

Further classification according to type of dysentery was not possible, although 2 cases were given treatment for amoebic dysentery. There were 4 acute cases ; one occurred in pregnancy and three in the puerperum and these women died 2-3 weeks after the onset of symptoms. In 6 cases the disease was chronic ; 2 deaths took place in pregnancy and 4 after delivery.

Diarrhoea : 11 deaths

It is probable that some of these deaths should have been included amongst those due to tuberculosis ; others may have been cases of chronic dysentery and it is very possible that others were cases of anæmia with marked intestinal symptoms. A more accurate diagnosis than ' diarrhoea ' could not be reached on account of insufficient information.

Cholera : 6 deaths

These deaths occurred between April 12th and July 1st, 1937. Health in pregnancy before onset of symptoms was good in all. Three women died undelivered and in the case of the other 3, labour began with the onset of cholera symptoms, and although delivery was effected these mothers died less than 24 hours later.

The 3 infants delivered (2 of which were premature) were stillborn.

Food poisoning : 1 death

This was a case with symptoms of acute gastro-enteritis which developed a fortnight after normal delivery at home. Death occurred the following day. There was some doubt as to whether this was food poisoning or another case of cholera.

Enteric : 11 deaths

There were 9 Hindus, 1 Mohammadan and 1 Indian Christian in this series. Fever began before delivery in 8 cases (1 died undelivered) and in the remaining during the puerperum. Hospital treatment was given to 4 cases and the others were treated at home by general practitioners.

Smallpox : 5 deaths

This enquiry began in June 1936 after the small-pox epidemic of that year and these 5 deaths occurred with one exception in the first half of 1937 when comparatively few cases of small-pox occurred in Calcutta city. Had the enquiry begun a few months earlier, small-pox, and therefore associated diseases, would have formed a much higher proportion of maternal deaths.

Delivery in each of these 5 cases was closely associated with the appearance of the true rash. The following table shows this and also the fate of the infant.

TABLE 52

Time of appearance of true rash and fate of the infant—5 small-pox deaths

Appearance of rash.	Fate of foetus.
1. 1 day before delivery	6/12 foetus—stillborn.
2. Day of delivery	F. T. foetus—stillborn.
3. 1 day after delivery	9/12 foetus—alive—died 4 days later.
4. 3 days after delivery	8/12 foetus—stillborn.
5. 4 days after delivery	F. T. foetus—alive—died 10 days later.

Other deaths from associated diseases

There were 3 maternal deaths from malaria (1 cerebral malaria) and 1 death from each of the following: cerebrospinal meningitis, diphtheria, kala-azar, burns.

There were 3 deaths thought to be due to epidemic dropsy. This is almost certainly an understatement but diagnosis of this condition from information collected after death, is so difficult that mistakes are inevitable. The diagnosis of epidemic dropsy was only accepted when other members of the family had shown signs of the same condition.

There were 13 cases to which no cause of death could be assigned after all possible enquiries had been made. Such evidence as was forthcoming pointed to an associated disease rather than a complication of pregnancy being the cause of death and these cases have therefore been included in this group.

A note on the fate of the foetus in pregnancies which resulted in death of the mother

In this series of 887 maternal deaths 46 per cent. of infants were born alive and 28 per cent. were stillborn. The total foetal mortality including abortions, ectopics and undelivered cases was 50 per cent. Table 53 shows the figures for the childbearing and associated groups and for the whole series.

TABLE 53

Fate of the foetus

	Childbearing.		Associated.		Total.	
Born alive	333	46.84%	80	43.01%	413	46.04%
Stillborn	191	26.86%	60	32.26%	251	27.98%
Abortion	52	7.31%	12	6.54%	64	7.13%
Ectopic	6	0.84%	..	..	6	0.67%
Undelivered	100	14.07%	32	17.20%	132	14.72%
Unknown	29	4.08%	2	1.08%	31	3.46%
	711*		186		897*	

Enquiry was made regarding the condition of the infant at the time of the follow-up visits to the homes of the women who had died. These visits took place in most cases within a few days of the mothers' deaths, so that complete information with regard to the neonatal mortality has not been obtained, but it was reported that 55 per cent. of the infants born alive had died by time the mothers' deaths were followed up. This gives a combined foetal and neonatal mortality of 65.77 per cent.

TABLE 54

Alive at report.	Childbearing.		Associated.		Total.	
Alive	191	57.36%	39	48.75%	230	55.69%
Dead	99	29.73%	38	47.50%	137	33.17%
Unknown	43	12.91%	3	3.75%	46	11.14%
	333		80		413	

* Includes multiple pregnancy : twins 8, triplets 1.

References.

1. Final Report of the Departmental Committee on Maternal Mortality and Morbidity. Ministry of Health Publication. His Majesty's Stationery Office, London, 1932.
2. Report on Maternal Morbidity and Mortality in Scotland. By C. A. Douglas and P. L. Mckinlay. Department of Health for Scotland Publication, Edinburgh, 1935.
3. Maternal Mortality in Fifteen States. Children's Bureau Publication, No. 223. Government Printing Office, Washington, 1934.
4. Maternal Mortality in New York City. By the New York Academy of Medicine Committee on Public Health Relations. Published by the Commonwealth Fund, New York, 1933.
5. Report of Investigation of 1073 Maternal Deaths in New South Wales during 1929-33. By E. S. Morris and E. S. Morgan. Department of Public Health Publication. New South Wales, 1934.
6. Report on an Investigation into Maternal Mortality. Ministry of Health Publication. His Majesty's Stationery Office, London, 1937.
7. Report on an Investigation into the Causes of Maternal Mortality in the City of Madras. By A. L. Mudaliyar, M.D., F.C.O.G. Government Press, Madras, 1933.
8. Report on the A. M. W. I. Returns from Women's Hospitals in India, 1935, 1936 (M. I. Neal), 1937 (W. M. Cole), Journal of the Association of Medical Women in India, August 1936, August 1937, November 1938.
9. Report of the Health Officer, Corporation of Calcutta, 1933, 1934, 1935, 1936.
10. Kerr, J. M. Munro—Maternal Mortality and Morbidity, E. & S. Livingstone, Edinburgh, 1933.
11. Manual of the International List of Causes of Death, (1929 Revision). His Majesty's Stationery Office, London, 1931.
12. An Enquiry into certain Public Health Aspects of Village Life in India by Major-General Sir John Megaw, K.C.I.E., K.H.P., D. G., I. M. S., 1933.
13. Maternity Conditions and Anæmia in the Assam Tea Gardens by M. I. Balfour. Journal of the Association of Medical Women in India, 1933.

APPENDIX A

TABLE 1.—DEATH RATES ACCORDING TO AGE AND SEX (1936)*

	British India.		Bengal.		Delhi Province.		Calcutta.**	
	M.	F.	M.	F.	M.	F.	M.	F.
1—5 years .	35.8	33.0	30.5	29.7	36.8	37.3	39.6	34.6
5—10 years .	9.5	9.5	11.7	13.0	7.8	8.1	18.2	18.7
10—15 years .	5.9	5.8	7.6	6.9	5.9	8.5	13.4	15.0
15—20 years .	8.0	9.8	10.1	13.3	6.7	14.2	9.2	15.9
20—30 years .	9.4	11.8	11.6	15.9	7.0	15.6	23.5	47.2
30—40 years .	11.9	12.6	14.5	15.8	8.5	15.2	12.0	27.9
40—50 years .	17.9	15.1	21.9	19.7	16.5	18.9	25.2	44.8
50—60 years .	29.9	25.7	35.5	31.1	27.3	31.5	41.3	65.0
60 years & over	82.2	77.0	81.3	76.2	91.5	105.7	57.0	8.7

* Report of the Public Health Commissioner, 1936.

** Report of the Health Officer, Calcutta Corporation, 1936.

APPENDIX A

TABLE 3.—MATERNAL DEATHS BY CAUSE (INTERNATIONAL LIST) IN CERTAIN WOMEN'S HOSPITALS IN INDIA (A. M. W. I. RETURNS 1935-38) COMPARED WITH CALCUTTA MATERNAL DEATHS I. R. F. A. ENQUIRY, 1936-37.

International List.	Women's Hospitals (1935-38)		Calcutta, I. R. F. A. Enquiry (1937).	
	Deaths.	Per cent.	Deaths.	Per cent.
140. Abortion (septic)	64	2.54	33	4.71
141. Abortion (non-septic)	10	0.39	4	0.57
142. Ectopic gestation	18	0.71	6	0.86
143. Other accidents of pregnancy	11	0.43	7	1.00
144. Puerperal haemorrhage	327	12.99	74	10.56
145. Puerperal sepsis	781	31.02	224	31.95
146. Albuminuria and eclampsia	375	14.89	126	17.97
147. Other toxæmias	56	2.22	15	2.14
148. Embolism and thrombosis	82	3.26	11	1.57
149. Shock and accidents of childbirth	339	13.47	26	3.71
150. Other puerperal conditions	12	0.47	10	1.43
Anæmia	442	17.56	165	23.53
Total	2,517	99.95	701	100.00
Maternal deaths due to Associated diseases	487		186	
Unclassified	28			
Grand Total	3,032		887	

APPENDIX B.—CALCUTTA ENQUIRY

TABLE 1.—MATERNAL DEATHS BY 4 WEEKLY PERIODS

Four weekly periods.	Deaths due directly to childbearing.	Rate per 1000 live births.	Deaths due to assoc. diseases.	Rate per 1000 live births.	Total deaths.	Rate per 1000 live births.
Week ending June 20, 1936 to week ending July 11, 1936.	43	22·81	10	5·31	53	28·12
Week ending July 18, 1936 to week ending August 8, 1936	64	33·21	19	9·86	83	43·07
Week ending August 15, 1936 to week ending September 5, 1936	54	20·29	9	3·38	63	23·67
Week ending September 12, 1936 to week ending October 3, 1936	79	29·83	8	3·02	87	32·65
Week ending October 10, 1936 to week ending October 31, 1936	67	29·12	14	6·08	81	35·20
Week ending November 7, 1936 to week ending November 28, 1936	76	30·64	22	8·87	98	39·51
Week ending December 5, 1936 to week ending December 26, 1936	62	22·56	21	7·64	83	30·20
Week ending January 2, 1937 to week ending January 23, 1937	64	23·37	17	6·21	81	29·58
Week ending January 30, 1937 to week ending February 20, 1937	44	19·68	17	7·60	61	27·28
Week ending February 27, 1937 to week ending March 20, 1937	48	22·72	10	4·73	58	27·45
Week ending March 27, 1937 to week ending April 17, 1937	31	17·48	12	6·77	43	24·25
Week ending April 24, 1937 to week ending May 15, 1937	41	21·44	13	6·80	54	28·24
Week ending May 22, 1937 to week ending June 12, 1937	26	15·37	13	7·63	39	23·05

APPENDIX B

TABLE 2.—MATERNAL DEATHS BY AGE

Years	—15	—20	—25	—30	—35	—40	—45	45 +	Unknown	Total.
<i>Deaths due directly to child-bearing</i>	5	147	192	143	104	55	22	1	31	701
Per cent	0.71	20.97	27.37	20.40	14.84	7.99	3.14	0.14	4.42	
<i>Deaths due to associated diseases</i>	3	39	51	39	30	16	3	...	5	186
Per cent	1.61	20.97	27.42	20.97	16.13	8.60	1.01	...	2.69	
Total Maternal deaths	8	186	243	182	134	72	25	1	36	887
Per cent	0.90	20.97	27.39	20.52	15.11	8.12	2.82	0.11	4.06	

TABLE 3.—MATERNAL DEATHS BY GRAVIDITY

Number of pregnancy.	1	2	3	4	5	6	7	8	9	10	10 +	Unstated.	Total.
<i>Deaths due directly to childbearing</i>	207	113	120	65	45	25	24	23	19	8	20	25	701
Per cent.	29.53	16.12	17.12	9.42	6.55	3.99	3.42	3.28	2.71	1.14	2.85	3.57	
<i>Deaths due to associated diseases.</i>	55	38	29	11	18	9	5	9	3	2	4	3	186
Per cent.	29.57	20.43	15.59	5.91	9.68	4.84	2.69	4.84	1.61	1.07	2.15	1.61	
Total Maternal deaths.	262	151	149	77	66	37	29	32	22	10	24	28	887
Per cent.	29.54	17.02	16.80	8.68	7.44	4.17	3.27	3.61	2.48	1.13	2.70	3.16	

APPENDIX B

TABLE 4.—GRAVIDITY IN RELATION TO MATERNAL MORTALITY (Actual figures)

Number of pregnancy.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Un- known.	
<i>Deaths due directly to child-bearing.</i>																					
Abortion (septic)	6	3	7	6	5	1	1	1	1	1	...	...	...	...	...	...	...	...	...	1
Abortion (non-septic)	...	1	1	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...
Ectopic gestation	1	2	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Other accidents of pregnancy	2	...	...	1	...	1	...	1	...	1	...	...	...	...	...	...	...	...	...	1
Puerperal haemorrhage	21	5	8	5	9	5	6	6	...	1	3	1	1	...	...	...	...	...	1	3
Puerperal sepsis	50	42	47	23	11	11	9	4	11	4	2	2	...	...	...	...	...	...	...	8
Puerperal albuminuria and convulsions	81	14	11	4	4	1	2	3	...	...	2	1	...	...	...	...	...	...	...	3
Other toxæmias of pregnancy	5	3	4	...	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Thrombosis and embolism	5	3	...	2	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other accidents of childbirth	4	6	5	...	2	1	2	2	1	1	1	1	...	...	...	...	...	...	...	...
Other and unspecified conditions of puerperal state	4	1	1	1	...	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...
Anaemia	28	33	36	23	13	5	3	6	5	...	...	3	...	1	...	...	...	...	1	3
<i>Deaths due to associated diseases.</i>																					
Tuberculosis	23	23	12	3	7	1	2	4	1	1	...	...	...	...	...	...	...	...	...	...
Others	32	15	17	8	11	8	3	5	2	1	2	1	...	...	...	...	1	...	...	3
All causes	262	151	149	77	66	37	29	32	22	10	10	9	1	1	...	...	1	...	2	28
Percentage	29.54	17.02	16.80	8.68	7.44	4.17	3.27	3.61	2.48	1.13	1.13	...	1.01	0.11	0.11	...	0.11	...	0.23	3.16	

APPENDIX B}

TABLE 5.—AGE OF MOTHER IN RELATION TO MATERNAL MORTALITY (Actual figures)

Age.	—15	—20	—25	—30	—35	—40	—45	45+	Unknown.	Total.
<i>Deaths due directly to childbearing.</i>										
Abortion (septic)	...	3	12	7	5	4	1	...	1	33
Abortion (non-septic)	...	1	1	...	...	2	...	...	...	4
Ectopic gestation	...	...	...	2	1	1	1	...	1	6
Other accidents of pregnancy	...	...	...	3	1	...	1	...	2	7
Puerperal haemorrhage	...	13	11	17	17	13	2	...	1	74
Puerperal sepsis	2	34	68	47	36	15	12	...	10	224
Puerperal albuminuria and convulsions	...	59	52	18	8	3	1	...	3	126
Other toxæmias of pregnancy	1	6	3	1	4	...	...	...	...	15
Thrombosis and embolism	...	3	2	6	1	...	...	...	...	11
Other accidents of childbirth	...	4	4	6	6	3	1	...	2	26
Other and unspecified conditions of puerperal state	...	3	3	1	2	1	...	...	...	10
Anæmia	...	21	56	36	23	14	3	1	11	165
<i>Deaths due to associated diseases.</i>										
Tuberculosis	...	19	23	14	12	6	2	...	1	77
Others	3	20	28	25	18	10	1	...	4	109
All causes	8	186	248	182	134	72	25	1	36	887
Percentage at each age period	0·00	20·97	27·30	20·52	15·11	8·12	2·82	0·11	4·06	...

APPENDIX B

TABLE 6.—DURATION OF PREGNANCY IN RELATION TO MATERNAL MORTALITY (Actual figures)

Months pregnant.	1	2	3	4	5	6	7	8	9	10	Unknown.	Total.
<i>Deaths due directly to child bearing.</i>												
Abortion (septic)	1	6	9	7	8	1	...	...	...	...	1	33
Abortion (non-septic)	1	2	...	1	...	...	...	...	...	...	4
Ectopic gestation	3	1	...	...	...	...	...	...	1	1	6
Other accidents of pregnancy	1	1	1	1	2	...	...	...	1	7
Puerperal haemorrhage	1	2	6	4	11	47	3	74
Puerperal sepsis	1	20	24	35	130	14	224
Puerperal albuminuria and convulsions	4	6	20	29	61	6	126
Other toxæmias of pregnancy	2	3	...	2	...	1	1	...	2	2	15
Thrombosis and embolism	1	...	...	1	1	8	...	11
Other accidents of childbirth	1	2	2	20	1	26
Other and unspecified conditions of puerperal state	1	8	1	10
Anaemia	1	1	4	12	23	27	20	67	10	165
<hr/>												
<i>Associated diseases</i>	1	2	6	10	12	28	29	17	76	5	186
<hr/>												
All causes	1	13	19	17	28	33	87	108	116	420	45	887
<hr/>												
Percentage	0·11	1·47	2·14	1·92	3·16	3·72	9·81	12·17	13·08	47·35	5·07	

APPENDIX B

TABLE 7.—HOME CONDITIONS BY MAIN CAUSES OF DEATH

Excluding imported cases

(Percentage distribution)

Home conditions.		Puerperal sepsis.	Anæmia.	Ecl. and alb.	Other causes.	Total maternal deaths due to child- bearing.	Total deaths due to associated diseases.	Total maternal deaths.
		(172 deaths).	(124 deaths).	(75 deaths).	(143 deaths).	(514 deaths.)	(170 deaths.)	(684 deaths).
House	{ clean . . .	18.02	21.77	22.67	25.17	21.60	22.94	21.93
	{ fair . . .	40.12	45.16	62.67	53.15	48.25	37.06	45.47
	{ dirty . . .	40.70	31.45	13.33	20.28	28.79	38.24	31.14
	{ unstated . . .	1.16	1.61	1.33	1.40	1.36	1.76	1.46
Overcrowding . . .	56.40	60.48	37.33	32.87	48.05	52.35	49.12	
No overcrowding . . .	43.02	36.29	62.67	63.64	50.00	46.47	49.12	
Unstated . . .	0.58	3.23	...	3.49	1.95	1.18	1.75	
Ventilation	{ good . . .	30.81	31.45	34.67	41.26	34.44	33.53	34.21
	{ bad . . .	63.60	63.55	65.33	58.04	65.17	65.29	65.20
	{ unstated . . .	0.58	...	...	0.70	0.39	1.18	0.58
Drainage	{ good . . .	33.37	42.74	44.00	46.85	42.61	38.82	41.67
	{ bad . . .	61.63	57.26	56.00	52.45	57.20	60.00	57.89
	{ unstated . . .	...	...	...	0.70	0.19	1.18	0.44

APPENDIX B (a)

TABLE 8.—WATER SUPPLY—PERCENTAGE DISTRIBUTION

	Tap in house.	Near house.	Far from house.	No tap.	Unstated.	Total.
Puerperal sepsis	36.05	44.19	18.02	0.58	1.16	100.00
Puerperal albuminuria and convulsions	61.33	21.33	16.00	...	1.33	100.00
Anæmia	46.77	34.68	18.55	...	...	100.00
Other causes	60.84	25.87	11.89	0.70	0.70	100.00
<i>Total childbearing</i>	49.22	33.46	16.15	0.39	0.78	100.00
<i>Total associated</i>	45.29	26.47	25.88	1.18	1.18	100.00
Total maternal deaths	48.25	31.72	18.57	0.58	0.88	100.00

APPENDIX C

FORM USED IN THE ENQUIRY

Strictly confidential, for medical use only.

ALL INDIA INSTITUTE OF HYGIENE AND PUBLIC HEALTH, CALCUTTA

MATERNAL MORTALITY ENQUIRY

Under the auspices of the Indian Research Fund Association

(Maternal deaths during Pregnancy or within four weeks after the termination of Pregnancy, or later if illness originated during Pregnancy, Child birth or Puerperium.)

I, II, III, Serial No.	Name.										
IV, V, Ward Under investigation.	Husband or father's name.										
VI Religion	H.	M.	IC.	A.I.	others (state)						
	0	1	2	3	4						
Caste (Hindu)	Br.	Vaid.	Kaya.	Bania.	Kshatria.	Others. (state).					
	5	6	7	8	9	10					
VII Province	Bengal,	B. & O.,	U.P.,	C.P.,	Punj.,	Bom.,	Mad.,	Assam	& others		
	1	2	3	4	5	6	7	8	9		
VIII Age	-15,	-20,	-25,	-30,	-35,	-40,	-45,	45+			
	1	2	3	4	5	6	7	8			
<i>Address.</i>											
Marital Status.	S. M. W.										
9											
IX Home conditions	No. of living rooms.										
X No. of inmates	-12	1	2	3	4	5	6	7	8	9	
XI	+12	1	2	3	4	5	6	7	8	9	
XII Cleanliness of house	(clean, fair, dirty)							Overcrowding (yes or no)			
	0		1	2					3		4
Water supply	Tap in house,		Tap near house,			Tap far house,		No tap			
	5		6			7		8			
Ventilation	Satisfactory,				Not satisfactory.						
	9				10						
XIII Drainage.	Good			Bad							
	0			1							

Father of Infant.

(a) occupation	(b) family income per month									
(c) Income per head per month. Rs.	-2,	-4,	-7	-10,	-15,	-25,	-40,	-50,	50+	
	2	3	4	5	6	7	8	9	10	
XIV Date of death.	Duration of pregnancy.									
	1,	2,	3,	4,	5,	6,	7,	8,	9,	
	0	1	2	3	4	5	6	7	8	9
Date of confinement.	{ Interval (Hours) to death (days).									

XV If death during pregnancy. Yes No If death after termination of pregnancy
 1 2 Yes No
 3 4

Certified causes of death { 1.
 2.

If Autopsy.

Pregnancies (If obtainable) including present one.

No.	Year.	Term prem. or aborn.	Complications during			Child.		
			Pregn.	Labour.	Puer.	Born alive.	Born dead.	Living.
XVI	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							

XVII Prenatal work Nil, Housework, Factory, Coolie, Clerk, Teacher, others, Purdah Yes No
 Student 5 6 7 8

Work ceased (days before birth)

General health (a) before preg. (b) during preg. Previous illness. (e.g. heart, kidney, sepsis, tuber.).

Habits (drug or alcoholic) Nutrition (thin, av., fat)

XVIII Diet* R₁ R₂ R₃ W₁ W₂ W₃ M₁ M₂ M₃
 1 2 3 4 5 6 7 8 9

XIX Milk 0 -1/2 pau, -1 pau, -2 pau, 2 pau +
 1 2 3 4 5

Narrow Pelvis Yes or No Excessive sickness. Puffiness.
 6 7

Fits Yes or No Varicose veins. Purulent discharge. Gen ital orcs.
 8 9

XX Osteomalacia Symptoms. Yes or No Anæmia
 0 1

When doctor or midwife engaged.

If Prenatal examinations { Doctor or A. N. Clinic examination advice given Date Results Advice ignored
 Yes or No 2 3

Condition of urine. Alb. present or absent, not examined.
 4 5 6

* R₁ Rice and vegetarian.

W₁ Wheat, "atta" and vegetarian.

M₁ Mixed (R₁ + W₁)

R₂ Rice and occasionally meat or fish or both.

W₂ Wheat and occasionally fish or meat or both.

M₂ Mixed (R₂ + W₂)

R₃ Rice and fish or meat both regularly.

W₃ Wheat and fish or meat both regularly.

M₃ Mixed (R₃ + W₃)

BRIEF SUMMARY OF THE CASE

AT HOME	Date	Hour	Remarks.
---------	------	------	----------

7
 Doctor arrived (M. or F.)
 Midwife arrived.
 Indigenous dai.
 Relatives.

IN HOSPITAL OR MATERNITY HOME

8
 Time of admission
 When first seen by Doctor
 Pains began
 Membranes ruptured
 { Spontaneous
 { Artificial
 Or fully dilated
 Baby born { alive
 9
 { still
 10 Condition of baby
 at date of report
 Placenta delivered

XXI ABORTION Yes or No

	0	1	
Probable cause			
Duration of pregnancy			
Date of first symptoms			
Treatment			
Delay in summoning aid			
Cause of death (1) Sepsis	2		P. M. findings
(2) Hemorrhage	3		

TOXEMIAS OF PREGNANCY Yes or No

	4	5	
Probable date of conception			Duration of pregnancy
Past history of renal disease			
TOXEMIC Symptoms, if any, in earlier pregnancies.			
Calendar month of appearance and nature of symptoms in pregnancy under inquiry.			
Examinations of urine made, not made.			Alb. present—absent.
TREATMENT, if any, for albuminuria—at home			
			in hospital
Blood Pressure			If raised, when first detected
FITS Yes or No		ante, intra, or post partum	Number of date of
	6 7		
Operative interference.	Yes or No		Nature and date
	8 9		
Other treatment.			P. M. findings.

XXII HÆMORRHAGE Yes or No
0 1

Ante-Partum (Placenta prævia, accidental) Was doctor immediately available ?
2 3

Had patient been told to report bleeding or faintness

How was this treated (midwife, doctor, method)

TREATMENT

By midwife

By doctor

Was patient removed to hospital ? If not why ?

Condition on arrival at hospital

Treatment in hospital

POST-PARTUM Yes or No
4 5

Before or after expulsion of placenta Probable cause

TREATMENT

By midwife

By doctor

P. M. findings

DIFFICULT LABOUR Yes or No
6 7

PRESENTATION AND POSITION

Disproportion between foetus and pelvis. Yes or No
8 9

Was difficulty anticipated ? Steps taken, if any

XXIII Operative interference (at home—in hospital)
1 2

Forceps
3

Indication

Time of application

Condition of cervix

Descent of head in pelvis.

Version
4

Cæsarean section, reasons, (Classical, Lower Segment, Hysterectomy) Craniotomy or
5 embryotomy
6

Other operative treatment, nature
7

Manual removal of retained placenta or membranes

Anæsthetic or narcotic

By whom administered

Duration

How treated

Laceration of genital tract

Condition of patient at end of labour.

PUERPERAL SEPSIS Yes or No
8 9

Condition of patient at onset of labour

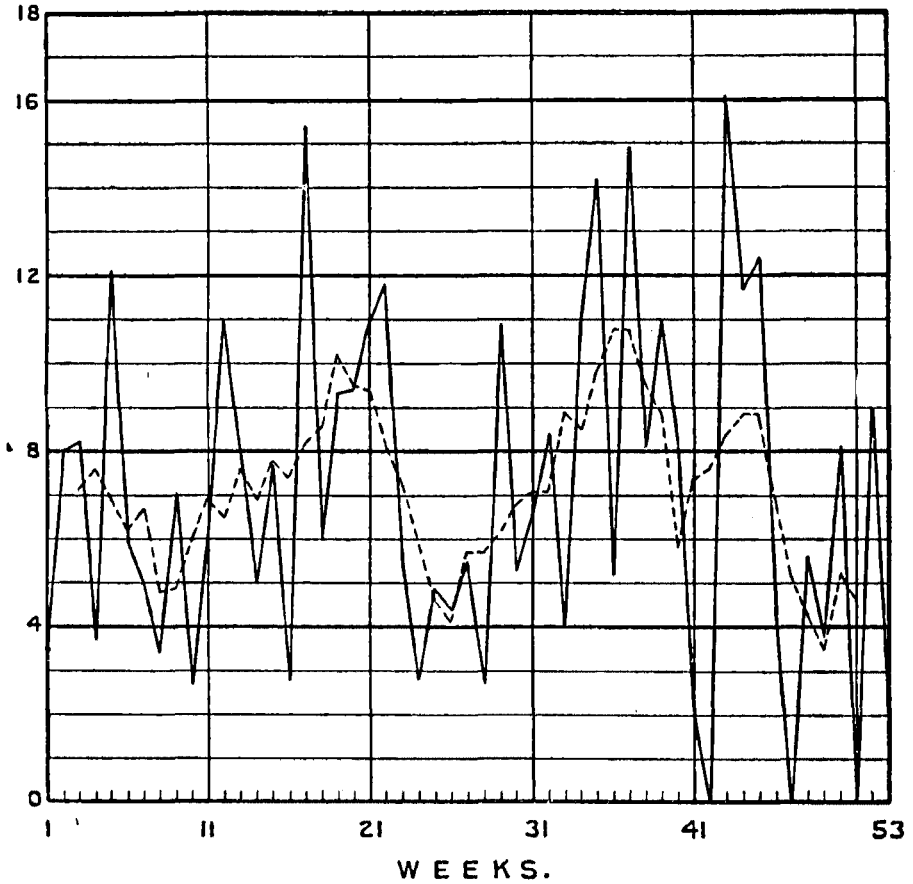
General

Local

Was there abnormal vaginal discharge ?

Treatment before labour.

No. 6
**PUERPERAL SEPSIS WEEKLY MORTALITY
 RATE PER 1,000 BIRTHS**



WEEKLY MORTALITY ———
 SMOOTHED CURVE - - - - -

The serial numbers of weeks relate to the corresponding periods shown in column 2 of table I in Appendix D.

DISINFECTION. Precautions during and after labour—antiseptics used.

XXIV 1. Patient (preparation of perineum, vulva)
 2. Attendant (1) Hospital (2) non-hospital. Dr., Midwife, Dai, Relatives

0	1	2	3	4
---	---	---	---	---

Were sterile surgical sheets, towels, pads, etc. used ?
 Sutures
 Vaginal examinations number By whom made
 Precaution taken on each occasion

COMPLICATION OF LABOUR.

TRAUMA—nature and method of treatment
 PLACENTA AND MEMBRANES—spontaneous—expressed—manual removal
 Complete or incomplete
 Toilet of patient after labour
 NURSING—During puerperium including local treatment
 Day of onset of fever Signs of local or general infection
 Treatment { at home
 in hospital
 Day of death Bacteriological findings
 Suggested source of infection Associated septic cases, if any.
 P. M. findings

ANÆMIA.	No	Yes (1)	Primary (of pregnancy)	(2) Secondary
	5		6	7
	(3) Doubtful		Any pathological reports	
	8		9	

Was there any difficulty in the conduct of the case which in the opinion of the Medical Officer or the attendant, might have been prevented by medical or other assistance?

Has the Medical Officer or the Attendant any suggestion to offer as to the prevention of the condition which caused death?

Comments by medical investigator.

Signature.

Comments by practitioner in charge of case

Final remarks by Investigator

XXV Cause of death	1	2	3	4	5	6	7	8	9	10	11
(International list)	0	1	2	3	4	5	6	7	8	9	10

XXVI 1.

2.

3.

4.

5.

Signature

Date

APPENDIX D

A STATISTICAL STUDY OF THE SEASONAL INCIDENCE OF MATERNAL MORTALITY DUE TO (1) PUERPERAL SEPSIS, (2) ECLAMPSIA AND (3) ANÆMIA

BY

S. SWAROOP, M. A.

(All-India Institute of Hygiene and Public Health, Calcutta).

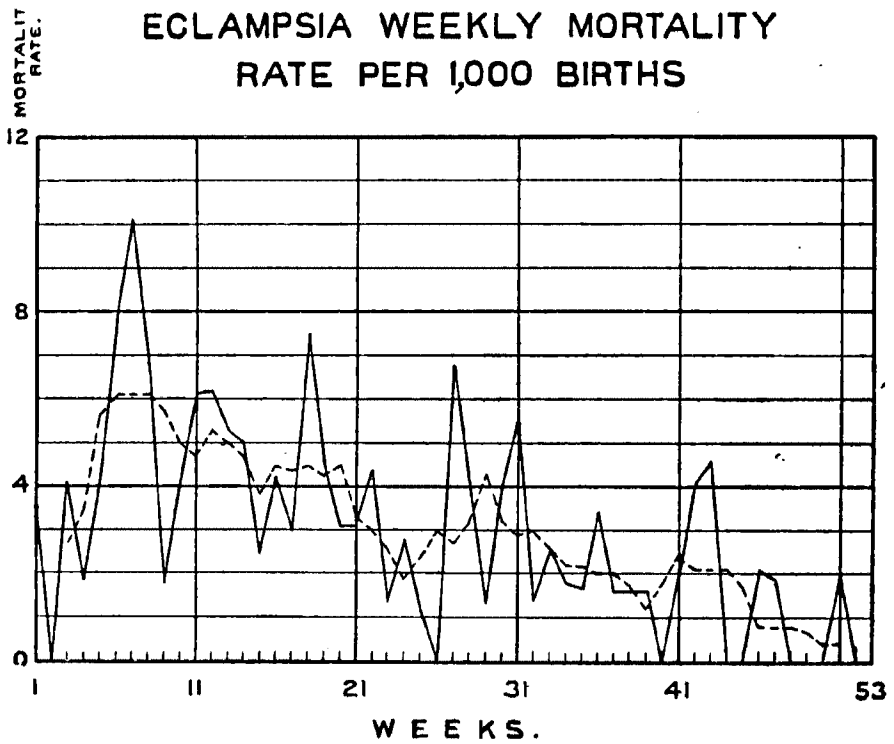
The following table sets out the weekly distribution of total births* and maternal deaths due to the above mentioned causes.

TABLE I.—Weekly distribution of births and deaths due to (1) puerperal sepsis, (2) eclampsia and (3) anæmia.

No.	Week ending with	Total births.	Deaths due to			Rate per 1000 births.		
			Puerperal sepsis.	Eclampsia.	Anaemia.	Puerperal sepsis.	Eclampsia.	Anæmia
1	2	3	4	5	6	7	8	9
1	June 20, 1936 . . .	570	2	2	...	3.51	3.51	...
2	June 27, 1936 . . .	499	4	...	2	8.02	...	4.01
3	July 4, 1936 . . .	487	4	2	3	8.21	4.11	6.16
4	July 11, 1936 . . .	542	2	1	2	3.69	1.85	3.69
5	July 18, 1936 . . .	496	6	2	2	12.10	4.03	4.03
6	July 25, 1936 . . .	505	3	4	1	5.94	7.92	1.98
7	August 1, 1936 . . .	599	3	6	2	5.01	10.14	3.34
8	August 8, 1936 . . .	587	2	4	2	3.41	6.81	3.41
9	August 15, 1936 . . .	566	4	1	3	7.07	1.77	5.30
10	August 22, 1936 . . .	735	2	3	3	2.72	4.08	4.08
11	August 29, 1936 . . .	649	4	4	2	6.16	6.16	3.03
12	September 5, 1936 . . .	637	7	4	3	10.99	6.23	4.71
13	September 12, 1936 . . .	748	6	4	4	8.02	5.35	5.35
14	September 19, 1936 . . .	788	4	4	2	5.08	5.08	2.54
15	September 26, 1936 . . .	780	6	2	7	7.69	2.56	8.97
16	October 3, 1936 . . .	702	2	3	3	2.85	4.27	4.27
17	October 10, 1936 . . .	647	10	2	6	15.46	3.09	9.27
18	October 17, 1936 . . .	662	4	5	3	6.04	7.55	4.53
19	October 24, 1936 . . .	641	6	3	1	9.36	4.68	1.56
20	October 31, 1936 . . .	635	6	2	5	9.45	3.15	7.87
21	November 7, 1936 . . .	696	7	2	7	11.01	3.14	11.01
22	November 14, 1936 . . .	674	8	3	5	11.87	4.45	7.42
23	November 21, 1936 . . .	705	4	1	3	5.67	1.42	4.26
24	November 28, 1936 . . .	698	2	2	11	2.86	2.86	15.76
25	December 5, 1936 . . .	810	4	1	5	4.94	1.23	6.17
26	December 12, 1936 . . .	677	3	...	8	4.43	...	11.82
27	December 19, 1936 . . .	729	4	5	8	5.39	6.86	10.97

* Births mean live births in Calcutta as recorded by the Inquiry during the period, week ended 20th June 1936 to week ended 19th June 1937.

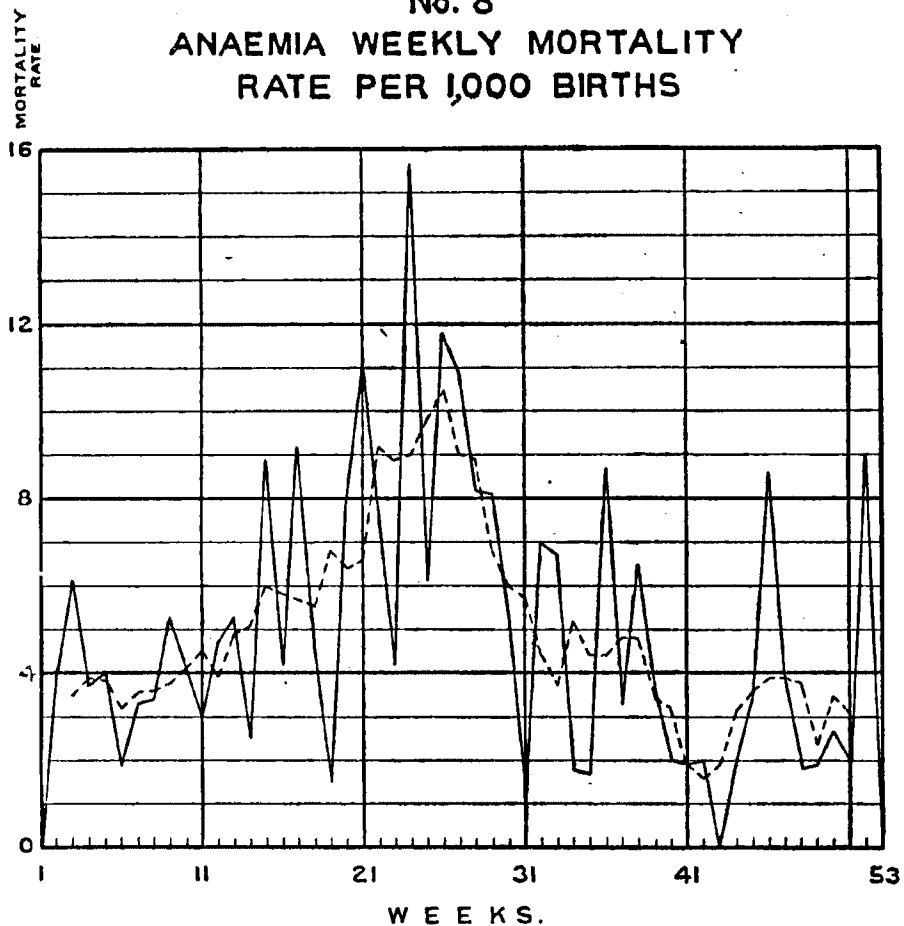
No.7
ECLAMPSIA WEEKLY MORTALITY
RATE PER 1,000 BIRTHS



WEEKLY MORTALITY ———
SMOOTHED CURVE.....

The serial numbers of weeks relate to the corresponding periods shown in column 2 of table I in Appendix D.

No. 8
ANAEMIA WEEKLY MORTALITY
RATE PER 1,000 BIRTHS



WEEKLY MORTALITY. ———

SMOOTHED CURVE - - - - -

The serial numbers of weeks relate to the corresponding periods shown in column 2 of table I in Appendix D.

Table I—contd.

No.	Week ending with.	Total births.	Deaths due to			Rate per 1000 births.		
			Puerperal sepsis.	Eclampsia.	Anæmia.	Puerperal sepsis.	Eclampsia.	Anæmia.
1	2	3	4	5	6	7	8	9
28	December 26, 1936	730	2	3	6	2.74	4.11	8.22
29	January 2, 1937	735	8	1	6	10.88	1.36	8.10
30	January 9, 1937	747	4	3	4	5.35	4.02	5.35
31	January 16, 1937	736	5	4	1	6.79	5.43	1.30
32	January 23, 1937	709	6	1	5	8.46	1.41	7.05
33	January 30, 1937	744	3	2	5	4.03	2.69	6.72
34	February 6, 1937	545	6	1	1	11.01	1.83	1.83
35	February 13, 1937	561	8	1	1	14.26	1.78	1.78
36	February 20, 1937	573	3	2	5	5.23	3.49	8.73
37	February 27, 1937	604	9	1	2	14.90	1.65	3.31
38	March 6, 1937	615	5	1	4	8.13	1.63	6.50
39	March 13, 1937	542	6	2	2	11.07	3.69	3.69
40	March 20, 1937	492	4	...	1	8.13	...	2.03
41	March 27, 1937	508	1	1	1	1.97	1.97	1.97
42	April 3, 1937	483	...	2	1	...	4.14	2.07
43	April 10, 1937	434	7	2	...	16.13	4.61	...
44	April 17, 1937	510	6	...	1	11.78	...	1.00
45	April 24, 1937	564	7	...	2	12.41	...	3.55
46	May 1, 1937	464	2	1	4	4.31	2.15	8.62
47	May 8, 1937	512	...	1	2	...	1.95	3.01
48	May 15, 1937	533	3	...	1	5.63	...	1.88
49	May 22, 1937	519	2	...	1	3.85	...	1.03
50	May 29, 1937	370	3	...	1	8.11	...	2.70
51	June 5, 1937	502	...	1	1	...	1.99	1.00
52	June 12, 1937	441	4	...	4	9.07	...	9.07
53	June 19, 1937	430	1	...	...	2.33	...	...

The weekly rates for puerperal sepsis, eclampsia and anæmia are shown in diagrams 6, 7 and 8. These weekly rates have been smoothed by five-weekly moving averages and the smoothed curves are also shown. The curve for puerperal sepsis shows the largest fluctuation and the smoothed curve suggests at least two nodes. The smoothed curve for eclampsia suggests a relatively high incidence during the early part of the enquiry and a tendency for decline in the succeeding months. The smoothed curve for anæmia is unimodal. These weekly distributions will be discussed later.

SEASONAL VARIATION OF WEEKLY BIRTHS

It will be seen from column 3 of the above table that there is a considerable variation in the number of births from week to week. The significance of this variation has been tested as follows. The average number of births per week over the whole period is 604. Deviations between this average and the weekly births have been worked out and their squares summed. This sum on division by 604 gives Pearson's $\chi^2=1016.9$ for 53 cells. The value is clearly significant for 52 degrees of freedom. There has therefore been a significant variation in the number of births from week to week during the period of the enquiry. Weekly births are shown in chart 2 by a thin line. This curve has been smoothed by five-weekly moving averages and the smoothed curve is shown on the same chart by a dotted line. Both the curves indicate a gradual rise and then a fall.

SEASONAL INCIDENCE OF MATERNAL MORTALITY DUE TO SPECIFIC CAUSES

For a study of the influence of season on maternal deaths due to specific causes the following procedure has been adopted. The hypothesis that we want to test is whether the mortality rate has remained steady over the period 20th June 1936 to 19th June 1937. For each disease the average death rate for the whole period is calculated by working out the ratio of total deaths to total births. Further, as it has been shown that weekly births have varied significantly from week to week, allowance is made for this variation by calculating, on the basis of the average death rate, the expected number of deaths during each week. The differences between the actual weekly deaths and those expected are squared and divided by the respective expected values. Summing up the values thus obtained we get an estimate of χ^2 for 52 degrees of freedom, the probability of which is judged by reference to the appropriate table.

For example, the total deaths due to puerperal sepsis are 224 against 32,007 births. This gives an average rate of 6.9985 per thousand births. The fourth column of the following table gives the expected deaths for each week and the last column gives the contributions of each week to χ^2 and is obtained by squaring the discrepancies between those expected and the actuals and dividing by the expected.

TABLE II.—The contribution of each week to the value of χ^2 .

No. of weeks.	Births (total).	Deaths due to puerperal sepsis.	Expected deaths.	Discrepancy squared and divided by expected deaths.
1	2	3	4	5
1.	570	2	3.99	.9925
2.	499	4	3.49	.0745
3.	487	4	3.41	.1021
4.	542	2	3.79	.8454
5.	496	6	3.47	1.8446
6.	505	3	3.54	.0824
7.	599	3	4.19	.3380
8.	587	2	4.11	1.0832
9.	566	4	3.96	.0004
10.	735	2	5.15	1.9267
11.	649	4	4.54	.0642
12.	637	7	4.46	1.4465
13.	748	6	5.24	.1102
14.	788	4	5.52	.4186
15.	780	6	5.46	.0334
16.	702	2	4.91	1.7247
17.	647	10	4.53	6.6051
18.	662	4	4.63	.0857
19.	641	6	4.49	.5078
20.	635	6	4.49	.5078
21.	636	7	4.45	1.4612
22.	674	8	4.72	2.2793
23.	705	4	4.94	.1789
24.	698	2	4.89	1.7079
25.	810	4	5.67	.4919
26.	677	3	4.74	.6387
27.	729	4	5.10	.2373
28.	730	2	5.11	1.8928
29.	735	8	5.15	1.5772
30.	747	4	5.23	.2893
31.	736	5	5.15	.0044
32.	709	6	4.96	.2181
33.	744	3	5.21	.9374
34.	545	6	3.82	1.2441
35.	561	8	3.93	4.2150
36.	573	3	4.01	2.5439
37.	604	9	4.23	5.3789
38.	615	5	4.31	.1105
39.	542	6	3.79	1.2867
40.	492	4	3.44	.0912
41.	508	1	3.56	1.8409
42.	483	..	3.38	3.3800
43.	434	7	3.04	5.1584
44.	510	6	3.57	1.6540
45.	564	7	3.95	2.3551
46.	464	2	3.25	4.8077
47.	512	..	3.53	3.5800
48.	533	3	3.73	.1429
49.	519	2	3.63	.7319
50.	370	3	2.59	.0649
51.	502	..	3.51	3.5100
52.	441	4	3.09	.2680
53.	430	1	3.01	1.3422

224

224.07

 $\chi^2=74.4686$

Similar values of χ^2 have been calculated for eclampsia and anæmia. The corresponding values of probability are calculated for 52 degrees of freedom by referring the quantity $\sqrt{2\chi^2} - \sqrt{103}$ to normal curve tables. The values for all the three causes are given in the table below.

TABLE III.—The results of significance tests on weekly figures of three specific causes of maternal mortality.

Cause of mortality.	Value of χ^2	Probability.
Puerperal sepsis	74.4686	.04
Eclampsia	53.1336	.87
Anæmia	69.3108	.11
All three taken together	61.1500	.37

From table III, we see that out of these three causes only puerperal sepsis shows a tendency towards a significant variation. Eclampsia and anæmia do not show any significant variation from week to week. All the three causes taken together also do not show any significance.

In the above calculations we have related the deaths in a week to the births of the same week. This may not be correct in every case. A birth occurring in a particular week may cause a maternal death in any of the succeeding weeks. It is therefore necessary, in the case of each of these three causes of death, to ascertain the mean period which elapses between a birth and the maternal death resulting from it.

In the case of some maternal deaths this period was not recorded. Leaving out these few cases from consideration the following three distributions have been prepared from the individual records of maternal deaths.

TABLE IV.—Frequency distribution of maternal deaths due to three causes (1) eclampsia, (2) anæmia and (3) puerperal sepsis with regard to the period in weeks that elapsed after birth before the resulting maternal death occurred.

Deaths occurring within:—	Cause of maternal death.		
	Eclampsia.	Anæmia.	Puerperal Sepsis.
0 to 1 weeks	67	76	32
1 to 2 „	1	13	66
2 to 3 „ . . . . .	..	9	45
3 to 4 „	2	4	21
4 to 5 „ . . . . .	..	10	21
5 to 6 „ . . . . .	..	1	4
6 to 7 „ . . . . .	..	4	14
7 to 8 „ . . . . .	..	..	4
8 to 9 „ . . . . .	..	4	4
9 to 10 „ . . . . .	..	..	..
10 to 11 „ . . . . .	..	2	3
11 to 12 „ . . . . .	..	1	..
12 to 13 „ . . . . .	..	5	4
13 to 14 „ . . . . .	..	..	..
14 to 15 „ . . . . .	..	..	..
15 to 16 „ . . . . .	..	..	..
16 to 17 „ . . . . .	..	..	..
17 to 18 „ . . . . .	..	3	2
Total	70	130	220

These distributions show that, with the exception of puerperal sepsis, the largest number of deaths occurred during the first week of child birth. The mean periods in weeks between child birth and maternal death are:—

Eclampsia	0.600
Anæmia	2.700
Puerperal sepsis.	3.132

Allowance for these periods has been made by working out χ^2 's after relating the weekly births to deaths occurring in the weeks with a time lag of one, two and three weeks respectively. The following table sets out the results obtained.

TABLE V.—Results of significance tests on weekly figures for three specific causes of maternal mortality when time lag is taken into consideration.

Cause of death.	Time lag.	Value of χ^2	Probability.	Significance.
Puerperal sepsis	Nil.	74.469	.04	Significant.
	1 week	72.546	.05	„
	2 weeks	61.868	.23	Not significant.
	3 weeks	57.096	.41	„
Eclampsia	Nil	53.134	.87	Not significant.
	1 week	58.019	.47	„
	2 weeks	57.295	.44	„
	3 weeks	56.344	.44	„
Anæmia	Nil	69.311	.11	Not significant.
	1 week	64.696	.19	„
	2 weeks	68.385	.08	„
	3 weeks	70.821	.04	Significant.

Puerperal Sepsis—

The χ^2 test without time lag shows that there has been a significant variation in the death rates due to this cause. This statement holds even when allowance is made for a time lag of one week but when we allow time lags equal to the mean periods of two or three weeks the significance disappears. It may be mentioned that the χ^2 test is intended only to establish whether the weekly figures bring out any significant departure from the average experience. The test does not take into account the regularity or otherwise of these weekly fluctuations. The two curves in chart 6 show, on the other hand, the seasonal distribution of the mortality rates due to this cause. The smoothed curve suggests a bimodal distribution but the fluctuations of the original curve are so wide that little significance can be attached to the regularity of trend that the smooth curve might suggest. In all probability mortality from puerperal sepsis does not show any seasonal periodicity.

Eclampsia—

The χ^2 tests fail to bring out a significant variation in the weekly figures. The smoothed curve, however, suggests a high incidence in the beginning of the period and then a gradual decline. The significance of this decline was tested by taking the weekly figures as well as by combining them into four weekly groups. In both cases the slopes of fitted straight lines were found to be insignificant. We, therefore, conclude that a significant seasonal variation in eclampsia incidence has not been established.

Anæmia—

The χ^2 test without time lag does not show any significant variation in the weekly rates. No significance is established until a time lag of three weeks is allowed for, the approximate mean period being 2.7 weeks. The smoothed graph shows a distinctly unimodal curve. While it cannot be stated that a seasonal periodicity has been established for this cause of mortality there is perhaps more indication of its seasonal periodicity than in respect of eclampsia and puerperal sepsis.

Conclusion—

- (1) There is significant variation from week to week in the occurrence of deliveries.
- (2) The existence of a seasonal variation in puerperal sepsis is doubtful.
- (3) The data fail to establish a significant seasonal variation in eclampsia incidence.
- (4) There is an indication of a unimodal seasonal variation in anæmia.

APPENDIX E

ECLAMPSIA AND HUMIDITY

BY

S. SWAROOP, M.A.

The following analysis has been carried out for the purpose of ascertaining whether any relationship exists between eclampsia incidence and humidity.

A coefficient of correlation worked out between—

- (i) Weekly deaths from eclampsia per 1,000 deliveries in the same week, and
 (ii) Mean relative humidity of the same week in Calcutta was found to be 0.3605.

This is a significant value and therefore indicates the existence of association between the two factors. It could, further, be argued that the humidity may not be exercising an immediate influence but that its effect may be showing itself more clearly in the incidence of the succeeding weeks. With this point in view correlations have been worked out between the above two factors after making allowance for time lags of one, two and three weeks and the coefficients of correlation are 0.4717, 0.5349 and 0.4156 respectively. There is an increase in value up to time lag of two weeks, the suggestion being that the influence of relative humidity may be felt over succeeding weeks also.

Similar correlations were tried on absolute humidity figures. The values for absolute humidity were obtained by calculating daily absolute humidity figures from records of dry and wet bulb thermometers. The pressure was assumed to have remained constant because the variation in pressure were so small as not to introduce any significant difference in the absolute humidity figures. The mean weekly absolute humidity figures were calculated from these daily values.

The correlations are given in the following table.

Table I giving the correlation coefficients between (i) eclampsia death rate per 1,000 deliveries in the same week, (ii) the mean absolute humidity during the week.

Time lag.	Coefficient of correlation.	Significance.
Nil	0.1241	Not significant.
One week	0.2125	Do.
Two weeks	0.2450	Do.
Three weeks	0.2096	Do.

All the values of correlation coefficient are insignificant and hence the existence of association between these factors is not established.

It may be stated that the incidence of the disease as judged by the death rate cannot be an exact picture of the disease occurrence. Further, the effect of humidity may be of great significance at the time of onset of eclampsia cases than on deaths. For this purpose weekly figures for the time of occurrence of first fits of eclampsia cases were made into rates per 1,000 deliveries in the same week and coefficients of correlation were worked out between these weekly figures and the corresponding data relating to the mean relative and absolute humidity. The correlations are given in the tables below:—

Table II giving the coefficients of correlation between (i) first fits of eclampsia per 1,000 deliveries, (ii) mean weekly relative humidity.

Time lag.	Coefficient of correlation.	Significance.
Nil	0.3103	Significant.
One week	0.4488	Do.
Two weeks	0.4261	Do.
Three weeks	0.3501	Do.

Table III showing the coefficients of correlation between (i) first fits of eclampsia: per 1,000 deliveries (ii) mean weekly absolute humidity.

Time lag.	Coefficient of correlation.	Significance.
Nil	0.1036	Not significant.
One week	0.1776	Do.
Two weeks	0.1947	Do.
Three weeks	0.1717	Do.

It will be noticed from these tables that fits of eclampsia do not show any significant correlation with absolute humidity and although the association with relative humidity is significant, the following table shows that it is lower than that existing between eclampsia mortality rate and relative humidity.

Table IV. Comparison between correlation coefficients calculated between relative humidity and (1) eclampsia death rates per 1,000 deliveries or (2) first fits of eclampsia per 1,000 deliveries.

Time lags.	Coefficient of correlation between relative humidity and	
	eclampsia death rate per 1,000 deliveries.	first fits of eclampsia per 1,000, deliveries.
Nil	0.3605	0.3103
One week	0.4714	0.4488
Two weeks	0.5349	0.4261
Three weeks	0.4156	0.3501

In expressing the association between eclampsia incidence (measured in terms of deaths or first fits of the disease) and humidity (relative or absolute) one point of importance has to be noted. The data relate to a period of a year and both the series of figures may exhibit some seasonal variation. If, therefore, a common cause had been affecting both these sets of figures independently and in the same way a certain amount of spurious association will be introduced even if the humidity and eclampsia were not associated with each other. Therefore the significance of the correlations established above needs further examination.

One way of eliminating the effect of spurious correlation is to try the total figures for the whole year. For this purpose the yearly eclampsia death rates per 1,000 deliveries for a number of hospitals in India (A. M. W. I. August 1937) were calculated and were then correlated with the mean relative humidity figures for the respective places. The figures are shown in the table below :-

Table V showing the yearly eclampsia death rates calculated per 1,000 deliveries and the respective mean relative humidity figures for the year 1936.

Hospital.	Relative humidity.	Eclampsia mortality rate per 1,000 births.
1. Government Victoria, Madras	77	1.65
2. Lady Dufferin, Karachi	74	2.04
3. Maternity Hospital, Agra	58	0.60
4. Dufferin Hospital, Calcutta	84	2.50
5. Victoria Zenana, Delhi	66	0.58
6. Hardinge Hospital, Delhi	66	0.86
7. Lady Aitchinson Hospital, Lahore	68	1.15
8. Dufferin Hospital, Lucknow	72	0.61
9. Dufferin Hospital, Allahabad	69	0.91
10. Dufferin Hospital, Cawnpore	71	0.98
11. Daga Hospital, Nagpur	65	1.02

Hospital.	Relative humidity.	Eclampsia mortality rate per 1,000 births.
12. Dufferin Hospital, Amraoti	57	0·85
13. Lady Hardinge Hospital, Akola	60	0·60
14. S. M. V. Hospital, Surat	71	2·85
15. Zenana Hospital, D. I. K.	57	0·41
16. Iswari Memorial, Benares	68	4·20
17. Elgin Hospital, Gaya	63	3·14
18. Elgin Hospital, Jubbulpore	68	·82
19. Lady Reading Hospital, Simla	57	1·42
20. Municipal Zenana, Peshawar	62	1·55
21. Ganesh Das, Shillong	76	..
22. Gosha Hospital, Vizagapatam	77	2·13
23. Vanivilas Hospital, Bangalore	80	0·39
24. Cama Hospital, Bombay	78	1·00
25. W. and Children's Hospital, Trivandrum	82	1·27
26. Memorial Hospital, Ludhiana	63	0·14
27. Rainy Hospital, Bombay	77	1·99
28. St. Stephen's Hospital, Delhi	66	1·70
29. American Mission Hospital, Madras	69	3·31
30. Kenniard Hospital, Lucknow	72	0·90
31. St. Margaret, Poona	65	1·67
32. Muir Memorial, Nagpur	65	1·13
33. Holdworth Memorial Hospital, Mysore	77	1·62
34. Zenana Hospital, Srinagar	81	6·08
35. Women Mission Hospital, Ajmer	56	2·42
36. Temala Hospital, Jodhpur	50	1·27
37. C. M. S. Hospital, Multan	57	1·24
Total	2524	59·00

The coefficient of correlation is 0·2437 which for 37 pairs of observations is not significant. This therefore throws doubt on the significance of the results previously obtained.

An analysis of variance and covariance was tried by Dr. K. C. K. E. Raja (A. M. W. I. August 1936) on humidity and eclampsia mortality figures taken from the returns of different hospitals in India for 1935 to find out whether any association existed between eclampsia death rates and relative or absolute humidity, after the effect of season and place was removed from the data. His analysis failed to establish any significant association but correlation for relative humidity was found to be greater in value than that for absolute humidity. This is in accordance with our results.

Similar analysis has been carried out on 1936 figures as well as on 1935 and 1936 figures taken together. He analysed data relating to 24 different places but it is seen that comparable data for 1935 and 1936 are available for only 19 places and the following analysis has been carried out on returns of these 19 places only.

The advantage of this statistical technique is that by its application it is possible to remove the effect of all causes which may introduce spurious correlation. In our case, as has been stated already, season may be one of the causes. The analysis of variance shows that in 1935 and also in 1936 the places have varied significantly from each other in regard to incidence as well as humidity. (Table VI and VII). Different places may, for various causes, have been affected in different ways so far as their relation to humidity figures is concerned. This may be another source of spurious correlation which can be eliminated by this process. The following tables set out the result of the analyses of variance and covariance.

Table VI.—Analysis of variance and covariance for data relating to monthly maternal mortality rate per 10,000 births and relative humidity during 1935.

Source of variation.	Degrees of freedom.	Eclampsia maternal mortality.		Relative humidity.		Sum of products.	Coefficient of correlation.
		sum of squares.	mean variance.	sum of squares.	mean variance.		
Season .	11	1028195·45	93472·31	29207·48	2655·23	85256·32	
Place .	18	6168663·15	342703·51	23333·48	1296·30	75916·71	
Residual.	198	13170811·38	66519·25	27376·52	138·27	40670·18	+·0677*
Total .	227	20367669·98	89725·42	79917·48	352·06	201843·21	

*Dr. Raja's value for this correlation = .0721. The slight difference of .0035 is perhaps due to the omission of data for 5 places.

Table VII.—Analysis of variance and covariance for data relating to monthly maternal mortality rate per 10,000 births and relative humidity during 1936.

Source of variation.	Degrees of freedom.	Eclampsia maternal mortality.		Relative humidity.		Sum of products.	Coefficient of correlation.
		sum of squares.	mean variance.	sum of squares.	mean variance.		
Season .	11	303092·25	27553·84	23893·50	2172·14	—1954·52	
Place .	18	2473335·97	137407·55	16871·77	926·21	1611·141	
Residual .	198	8718891·92	44034·81	26534·75	103·71	—29623·41	—·0700
Total .	227	11495320·14	50640·18	61100·02	269·16	—15466·42	

Table VIII.—Trivariate analysis of variance and covariance for data regarding monthly maternal mortality rate per 10,000 births and relative humidity during 1935 and 1936.

Source of variation.	Degrees of freedom.	Eclampsia maternal mortality.		Relative humidity		Sum of products.	Coefficient of correlation.
		sum of squares.	mean variance.	sum of squares.	mean variance.		
Year . . .	1	3949·48	3949·48	912·33	912·33	—1898·22	
Months . . .	11	511578·51	46507·14	49830·06	4530·01	44028·57	
Hospitals . . .	18	7767835·61	431546·42	38804·95	2155·83	97911·41	
Interactions :—							
Years—months . . .	11	819709·20	74519·02	3270·90	297·35	39273·22	
Months—Places . . .	198	11881183·49	60005·98	41916·31	211·70	7722·09	
Years—Places . . .	18	874163·52	48564·64	1200·29	66·68	—5883·29	
Residual . . .	198	10008519·80	50548·08	5994·98	30·28	3274·79	+·0134
Total . . .	455	31866939·61	70037·23	141929·23	311·93	184478·57	

The correlation coefficient corresponding to the residual row represents the intrinsic association existing between eclampsia and humidity. Correlations for 1935 and 1936 are +·0677 and —·0700 respectively. For the combined figures of 1935 and 1936 the coefficient of correlation after removing from it the spurious effect which factors associated with season, place and year may have introduced, is +·0134. All the values are insignificant.

The association between eclampsia and humidity cannot, therefore, be said to have been established.