might be is already indicated by the first tentative tests in the Gold Coast. Out of 28 adults, two young men aged about 20-25 proved infective. In view of the low gametocyte rate of this group, and the low gametocyte densities encountered under hyperendemic conditions, adults have usually been regarded as of negligible importance as a source of malaria infection. As crescent infections may occur at all ages, including the very oldest inhabitants in the community, the usual blood picture may be giving quite an erroneous impression of the infective status of this group.

The possible role of these cryptic infectors as reservoirs of malaria has also to be considered in the light of recent observations on the distribution of anopheles bites and feeds among different human age groups. With both *A. albimanus* in Jamaica (supported by observations on *A. aquasalis* and *A. bellator* in Trinidad) (Muirhead-Thomson, 1951) and *A. gambiae* in West Africa (Thomas, 1951) it has been shown that in general there is a tendency for mosquitoes to obtain the bulk of their blood meals from older children and adults rather than from infants and toddlers. From this it would appear that an adult with a cryptic infection might be a much more important reservoir of malaria than an equally infective baby, the low infectivity being counterbalanced in nature by the greater number of mosquitoes feeding on the adult.

In trying to understand the conditions leading up to malaria epidemics, or even to seasonal waves of malaria, malariologists have long been influenced by the changing gametocyte rate of the human population as found in routine blood-film examination. It is possible that the difficulties they have encountered in trying to explain the discrepancy between low gametocyte rates and densities in the human population on the one hand, and rapidly increasing infection rates among the anopheline mosquitoes on the other hand, might be due to a much higher proportion of the population actually being infective to mosquitoes for the reasons described above.

Frohne *et al.* (1950), for example, have shown in an area in South Carolina that, despite a remarkable reduction in the parasite rate of the negro population in the proportion of 318 to 1 between 1945 and 1948, infections in wild-caught anopheles still persisted. One of the explanations suggested by these workers was that a higher proportion of the human population is infective to anopheles than is indicated by the monthly parasitaemia rates. They were dealing with a strain of *P. falciparum* which had already been shown by Young and his colleagues to be capable of infecting *A. quadrimaculatus* at extremely low gametocyte densities.

Finally, it is interesting to note that these extremely low gametocyte thresholds of infection have been encountered in three different parts of the world, using three different species of anopheles, and probably as many different strains of *P. falciparum*. One feature common to all three investigations is that the human population experimented with has been negro or of negro origin. It might be worth considering how far these results could be influenced by racial characteristics.

Summary

Observations in Gold Coast villages where malaria is hyperendemic have confirmed previous findings in Jamaica, and by American workers in South Carolina, that some carriers can infect anopheles with *P. falciparum* at a time when the density of gametocytes in the blood is so low that they may be detected only with difficulty in routine blood-film examination.

In the Gold Coast experiments these cryptic carriers formed a significant proportion—roughly one-quarter of all infective carriers. This finding, together with the fact that many good crescent carriers are non-infective to mosquitoes, suggests that the blood-film examination may prove a very deceptive guide to the real malaria infectors in the African or native village community.

The implications of these findings are discussed in the light of recent work on the uneven distribution of anopheles bites and feeds among different human age groups.

The work briefly described above forms the first phase of a research scheme carried out under the control of the Colonial Office and the Colonial Medical Research Committee. It is hoped that a more detailed report will be produced at a later date.

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RHEUMATIC HEART DISEASE COMPLICATING PREGNANCY

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Improvements in antenatal and intranatal care over the past 50 years have resulted in a great reduction in the maternal mortality rate. Advances in particular fields have altered the relative importance of many complications, because some which were formerly of the utmost gravity are now more amenable to treatment. The change is exemplified by an analysis of 328 maternal deaths occurring in 128,474 deliveries in the three Dublin maternity hospitals during the decade 1940-50 (O'Driscoll and Quinn, 1951), the chief causes of which were:

Eclampsia	43
Sepsis (usually complicated)	42
Rheumatic heart disease	35
Accidental haemorrhage	32
Post-partum haemorrhage	25
Ruptured uterus	21
Placenta praevia	17
Non-convulsive toxaeemias	15

These figures demonstrate the importance of rheumatic heart disease as a factor in maternal mortality. No reference is made to other forms of heart disease complicating pregnancy, as few cases were seen and none was fatal.

To evaluate the problem of rheumatic heart disease in pregnancy a clinical survey was begun by us in the National Maternity Hospital on January 1, 1948, and, for the purpose of this communication, was concluded on January 1, 1952. During these years 250 pregnancies in 175 patients with rheumatic heart disease were studied. The patients were graded according to the recommenda-

tion of the New York Heart Association. The diagnosis, which was in all cases confirmed after pregnancy, was a clinical one, although electrocardiographic and x-ray examinations were routine. Every patient who survived was seen in 1953, so that the follow-up time varied from four years to a minimum of one year.

The average parity of these women was 4. This compares with the figure of 3.3 for all married women in Ireland. In 1,532 years of married life these women had 704 pregnancies—that is, a pregnancy every two years. Of these 704 pregnancies none was artificially terminated and only 29 failed to reach viability.

It is apparent that the number of children borne by these women was related only to their natural fertility. The series is drawn from a population which does not practise contraception, therapeutic abortion, or sterilization. The communication presents the result of uninhibited child-bearing in patients with rheumatic heart disease. Most papers on this subject are open to the criticism that indirect case selection results from these practices.

At the end of the survey 11 women had died. Five died later than one year after confinement (13, 18, 24, 36, and 36 months), and so their deaths are not thought to have been related to pregnancy. Six died during pregnancy or within one year of confinement; these deaths are considered to have been related to pregnancy. They represent a maternal mortality of 3.5%. The number of babies who left hospital alive was 229. The uncorrected foetal loss was 6.4%.

Analysis of 175 Patients

An unequivocal rheumatic history was given by 111 patients, or 63%. A strong family history was obtained in a further six cases. The incidence of the various valvular lesions was as follows:

Lesion	No. of Cases
Mitral stenosis ..	151
Mitral stenosis and aortic regurgitation ..	23
Aortic regurgitation ..	1

Because of the recognized difficulty in diagnosing pure mitral regurgitation (Brigden and Leatham, 1953), 10 patients with harsh mitral systolic murmurs and a personal history of rheumatic disease are grouped under the heading "mitral stenosis." In these cases the predominant defect would appear to be an incompetence of the valve. The importance of history-taking and of careful auscultation at the mitral area is illustrated by these figures.

It has often been said that the heart condition deteriorates with increasing parity. Table I confirms this, but the last column reminds us that increasing parity coincides with increasing age. This may be the relevant factor.

TABLE I

Parity	No. of Cases	Grades III and IV		Average Age
		No.	%	
1	46	15	32.6	28.5
2 to 4	83	30	36.1	33.2
5+	46	21	45.7	38.5

TABLE II

Age	No. of Cases	Grades III and IV	
		No.	%
Under 26 ..	18	8	44.4
26 to 30 ..	39	11	28.2
31 " 35 ..	48	17	35.4
Over 35 ..	70	30	42.9

Table II shows the relative incidence of severe cases in the various age groups. With the striking exception of the youngest group, the number of severe cases increased with age. We formed the opinion that recurrences of acute rheumatism may explain the disproportionately high number in the youngest group. We believe that this constitutes a real danger to young mothers. Further reference is made to this matter.

In 17 of the 29 patients seen in acute congestive heart failure there were, apart from pregnancy, the following important relevant factors:

Auricular fibrillation ..	4
Auricular fibrillation and acute respiratory infection ..	2
Acute respiratory infection ..	4
Acute respiratory infection and hypochromic anaemia; Hb 32% ..	1
Acute pyelitis and hypochromic anaemia; Hb 23% ..	1
Subacute bacterial endocarditis ..	2
Acute rheumatism ..	2
Pre-eclampsia; B.P. 170/110; oedema ..	1

Auricular fibrillation is the most important single factor in precipitating heart failure. Its presence indicates widespread damage to the myocardium. Four additional women with auricular fibrillation were not in failure. Intercurrent infection, particularly of the respiratory tract, anaemia, hypertension, and fluid imbalance are other notable causes of cardiac decompensation during pregnancy. Active rheumatic and bacterial endocarditis caused heart failure in four of the patients in this survey.

It is of interest to note the stage at which failure occurred in these 29 patients. In two it appeared in the first trimester, in seven in the second, and in 14 between the 28th and 36th weeks, but in no instance between the 36th week and the onset of labour. Five failed during labour and one during the puerperium. This experience substantiates the opinion that the strain imposed on the heart by pregnancy steadily increases to the period between the 28th and 36th weeks, and sharply decreases in the last month. It follows that induction of labour is basically an unsound procedure in the treatment of heart disease. The comparatively small number that failed during labour indicates that, given proper management, the danger of labour has been exaggerated. The fact that only one woman failed in the puerperium lends no support to the frequent reiteration that this is a time of particular risk.

Method of Delivery

Labour was induced in three women for pre-eclampsia and in no instance for heart disease. The methods used for delivery in the 250 pregnancies were as follows:

Caesarean section ..	7
Forceps or breech extraction ..	47
Laparotomy (see maternal deaths) ..	1 (twins)
Died undelivered ..	2
Spontaneous delivery ..	184 (5 twins)
Evacuation of incomplete abortion ..	4
Complete abortion ..	5

The incidence of caesarean section was 3%, whilst in the whole hospital service it was 1.5%. This discrepancy arose as the result of cases operated on more than once before coming under our care.

Only one caesarean section was performed for heart disease. It was in the early stages of the survey. The patient was subsequently delivered vaginally of her second baby. This illustrates the attitude towards abdominal delivery prompted by the intervening cases. The operation was performed in error resulting from inexperience of this condition. We now believe that rheumatic heart disease is never an indication for section.

Caesarean section was performed once for central placenta praevia, once for severe pre-eclampsia at 30 weeks' gestation and once for absolute disproportion. From fear of rupture of the uterus three operations were carried out on women who had undergone section at least twice previously for heart disease. The cardiac condition did not influence the decision in any of the foregoing six cases.

Six women who had undergone section previously for heart disease were delivered by the natural passages. The assisted vaginal delivery rate of 20% was twice the rate for all the hospital deliveries. The timely but not routine forceps or breech extraction is favoured. Local analgesia, supplemented when necessary by intravenous thiopentone, was used in all operative deliveries.

Maternal Deaths

Six women died during pregnancy or within one year after. A brief description of each follows:

Case 1.—Primigravida aged 25. Emergency admission at 31 weeks' gestation with subacute bacterial endocarditis complicated by embolic hemiplegia. Labour began spontaneously one week later and was terminated by breech extraction. The endocarditis did not respond to treatment, and the patient died 10 weeks after delivery from congestive heart failure. The baby survived.

Case 2.—Primigravida aged 28. Emergency admission at 30 weeks' gestation, moribund from congestive heart failure (grade IV). She was not in labour and died undelivered 12 hours after admission. This patient had mitral stenosis and aortic incompetence. She had been having frequent attacks of haemoptysis for three months before admission and had been partially incapacitated by her heart for several years.

Case 3.—Primigravida aged 24. Emergency admission at 16 weeks' gestation, moribund from congestive heart failure (grade IV). She was not in labour, and died one hour after admission. She had mitral stenosis and aortic regurgitation. No antecedent history was available.

Case 4.—Primigravida aged 23. Emergency admission at 30 weeks' gestation with cardiac decompensation (grade IV). There was considerable enlargement of the heart, tachycardia, and extrasystoles. She had aortic regurgitation and mitral stenosis. Her condition improved considerably in hospital, but frequent bouts of tachycardia were accompanied by relapse into failure. A diagnosis of active rheumatic carditis was made; she had an easy labour at term, ending in low forceps delivery. The baby survived, but the mother died six weeks later from congestive heart failure.

Case 5.—Gravida 2 aged 27. Emergency admission at 32 weeks' gestation with cardiac decompensation of moderate degree (grade III) due to acute bronchitis. She responded well to treatment, ceasing to be a cause of anxiety until three weeks before term. She then developed pneumococcal pneumonia involving the right upper lobe. This caused acute cardiac distress and a fulminating bacterial toxæmia which precipitated the onset of labour 17 hours later. Despite an easy rapid labour lasting six hours, she died five hours after spontaneous delivery in congestive failure; the baby was stillborn.

Case 6.—Gravida 10 aged 39. Emergency admission at 30 weeks with unexplained pyrexia and a twin pregnancy. Her last delivery had been by classical caesarean section for placenta praevia outside our service. On admission her general condition was poor, temperature 100° F. (37.8° C.), pulse 128, haemoglobin 23%, blood pressure 160/90, albumin, a trace; she had mitral stenosis, with considerable enlargement of the heart, and was in congestive heart failure. Subacute bacterial endocarditis was diagnosed, and she was treated with fair response. Her general condition deteriorated again at 34 weeks, and on further investigation it was clear that her symptoms were due to quiet rupture of the uterus. At laparotomy two macerated fetuses and their placentae were in the abdominal cavity, which was heavily infected. A loop of small gut was torn where it adhered to the uterus. Subtotal hysterectomy and bowel resection were performed. The patient died 24 hours later.

All six who died were unbooked patients; not one had received antenatal care at the hospital before admission to the wards in heart failure. There was a 20% fatality rate in unbooked patients. No booked patient died. This emphasizes the importance of routine examination of the heart of every midwifery patient. It also emphasizes the importance of efficient antenatal care. It has been our experience with emergency admissions that frequently neither the patient nor her doctor knew that heart disease existed until symptoms of heart failure appeared. The explanation is that many practitioners do not examine the heart of a pregnant woman because they are unaware of the frequency and gravity of heart disease. This fact demands the attention of all engaged in teaching obstetrics.

A striking feature of the fatal cases was the preponderance of the young and the primigravidae. The only exception was Case 6, who would probably have survived if her uterus had not ruptured. Was it because these women were young or because they were primigravidae that they died; or were these matters merely of coincidence? Three of these fatal cases had aortic incompetence.

Case 1 died from subacute bacterial endocarditis 10 weeks after an easy delivery. It may be assumed that neither age nor parity was of importance here. Case 5 died in congestive failure precipitated by lobar pneumonia and aggravated by the untimely onset of labour, albeit rapid and easy. This death was not influenced by age or parity. Case 4, a primigravida aged 23, died six weeks after a normal delivery. She was under our care long enough for us to be satisfied that the deterioration of her heart was due to active rheumatic carditis. This was related to her age. Case 3 died from congestive failure at 16 weeks' gestation. She was 24 years old, and we suggest that her youth exposed her to a recrudescence of acute rheumatism. Her parity was hardly an important factor. Case 2 died similarly, in congestive failure at 30 weeks' gestation. That she was a primigravida was not likely to have been of importance, because she was not in labour. A rheumatic recurrence is offered to explain this fatality in a woman of 28 years.

It is our opinion that age and parity were matters of simple coincidence in Cases 1, 5, and 6, and that age rather than parity was an important factor in Cases 2, 3, and 4. The young mother who is by coincidence usually a primigravida is prone to reactivation of her disease, and we agree with others that this is of the greatest importance in determining a fatal issue (McKeown, 1948, 1950; Kennedy, 1950; Castleden *et al.*, 1951).

Paradoxically, most of the deaths occurred in the groups which contained the smallest number of severe cases—that is, in the younger women and women of low parity. Although most of the patients in failure were older and of high parity, only one of these died, and she as the result of a ruptured uterus. None of the women with fibrillation died. The inference is that the heart damaged by rheumatic disease is not likely to result in death if proper care be given, unless the mother's youth exposes her to the risk of reactivation of the disease.

The five women who died more than a year after delivery were all amongst the older age groups (33, 35, 37, 37, and 48 years), and all died from heart failure. They had reached the end phase of their disease. The fact that they survived their latest pregnancy by more than a year suggests that pregnancy did not contribute to these deaths.

Contraception, Therapeutic Abortion, and Sterilization

Contraception, therapeutic abortion, and sterilization are not practised in this city. There were 229 healthy surviving children born to these 175 women in the four-year period. It is of interest to consider the effect that the absence of these practices had on the maternal survival rate.

Women with heart disease are commonly advised to have only two children, and to ensure this the patient is often sterilized after the second delivery. Had this procedure been adopted in our series many operations would have been done, as a result of which one woman would have been saved from death due to rupture of the scar of a classical section carried out for placenta praevia.

All six women who died were seen too late in pregnancy or too advanced in heart failure for therapeutic abortion to be performed. Since no woman who received antenatal care at the hospital was lost, one might be justified in assuming that proper antenatal care would have been more likely to save them than therapeutic abortion.

It is unlikely that the practice of contraception would have affected the mortality from heart disease, since four

women died on their first pregnancy, and the only one who died later than the second pregnancy did not die from heart disease.

Had sterilization, abortion, and contraception been considered in the management of these cases they would have been applied to those who survived and not to those who died.

The dangers of these procedures have never been systematically presented. The indications, ages, parity, and maternal mortality figures in a series of cases treated by these methods would render an assessment of their advantages, or otherwise, possible. Until such figures appear it seems that good antenatal care can be expected to serve a mother better than either therapeutic abortion or sterilization.

Outcome of 250 Pregnancies

Of the 250 pregnancies observed, six were twin pregnancies. The outcome may be summarized as follows:

Surviving infants	..	..	..	..	229
Stillbirths	..	..	..	..	10
Neonatal deaths	..	..	..	..	6
Abortions and miscarriages	..	..	..	..	9
Died undelivered	..	..	..	..	2

Estimating the percentage of stillbirths and neonatal deaths on the number of infants delivered (245) who weighed more than 2 lb. 12 oz. (1.25 kg.), we obtain the figures of 4% and 2.4% respectively. The corresponding figures for all deliveries in the hospital over the same period were 3.8% and 2.4%.

Two of the stillbirths were examples of hydrops foetalis; rupture of a classical section scar in a case of twin pregnancy caused the death of two infants; two infants died as the result of extensive placental infarcts due to pre-eclampsia (one of these mothers suffered from diabetes); a central placenta praevia caused another stillbirth; and one was a macerated twin, its fellow surviving. In none of these eight cases did the maternal heart condition affect the foetal loss. In the other two cases of stillbirth the mothers were suffering from cardiac decompensation, but it is likely that the stillbirths would have otherwise resulted: one mother suffered from primary uterine inertia, and the foetal heart ceased after labour had lasted 80 hours; the other was suffering from an overwhelming toxæmia due to acute lobar pneumonia.

Not one of the six neonatal deaths was related to maternal heart disease. Two resulted from congenital malformations, one was caused by pneumococcal meningitis, and one by laceration of the tentorium cerebelli. One baby was found to have atelectasis following prolapse of the cord, and another suffering from laryngismus died suddenly when 6 days old. Each case was examined at necropsy.

The nine abortions or miscarriages give the surprisingly low incidence of 3.6%. The incidence of abortions and miscarriages in the hospital over the same period was 7.5%. As many women do not attend in early pregnancy and abort outside hospital, these figures may not be reliable. But the figure for the heart cases seems to be confirmed by the fact that these women had borne, in all, 704 pregnancies, including those under consideration, and only 29 (4%) had terminated before the period of viability. It can be confidently stated that none of the nine abortions or miscarriages were caused by rheumatic heart disease.

In the case of the two women who died before delivery the foetal loss can clearly be attributed to the heart condition.

Since rheumatic carditis did not affect the survival of more than four conceptions in 256 it seems fair to assume that the prospects of a healthy child in a woman who suffers from this disease is virtually the same as in one who does not. In assessing these figures it must be remembered that therapeutic abortion was not performed, so that 89.5% of all conceptions seen at the hospital resulted in surviving children.

Conclusion

As already stated, the cases recorded in this paper were totally unselected; contraception, termination, and sterilization were never practised. Furthermore, the patients were mainly drawn from the under-privileged groups, with poor home conditions and no home help, who are fertile to a degree which workers in other countries rarely see.

Diagnosis is the first and clearly the most important aspect of the problem of rheumatic heart disease in pregnancy. That it is simple is illustrated by the preponderance of mitral stenosis and the frequency of a rheumatic history. The functional systolic murmur so common in pregnancy may lead to the suspicion of disease more often than it exists, but failure to recognize existing disease is a more serious error. In the present series all of the fatalities occurred in cases which were not diagnosed until failure was established.

Rest is the natural sequel to diagnosis. Cases without significant limitation of cardiac reserve are allowed to go home. They are advised specific rest hours, which are systematically increased until they are admitted to hospital two weeks before term. Patients with limitation of cardiac reserve are admitted to hospital without delay and are not discharged until after delivery. The importance attached to rest is signified by the total of 5,250 days which the women in the present series spent in the antenatal wards of the hospital—that is, an average of 21 days before each delivery.

Digitalization, diuresis, venesection, etc., are adopted as in the standard management of heart disease. Valvotomy is now an additional weapon.

Heart disease is not regarded as an indication for induction of premature labour or for caesarean section. Forceps extraction is often employed to abbreviate the second stage of labour. Post-partum haemorrhage is never encouraged or permitted to continue, venesection being a much safer method of reducing the circulatory volume when necessary.

Summary

The case histories of 175 women in 250 pregnancies over a period of four years are analysed.

Rheumatic heart disease is a common complication in pregnancy (1.7%).

The diagnosis is a simple clinical one.

Early diagnosis is imperative if fatalities are to be avoided.

There was no maternal death in 220 booked cases.

It is considered that there is no place for therapeutic abortion or sterilization.

This survey was begun during the Mastership of Dr. A. W. Spain. We are grateful to him for his interest and stimulating advice.

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A revised edition of *Social Work* is now available in the "Careers for Men and Women" series issued by the Ministry of Labour and National Service (H.M.S.O., price 1s. 6d.). Information is given on the scope of each career, the pre-entry qualifications needed, the amount, cost, and type of training required, and the professional opportunities available after qualification. Among the careers described in the booklet are almoner, psychiatric social worker, mental health officer, moral welfare worker, home teacher of the blind, and family case worker. This is a useful booklet for anyone likely to be asked for advice in the choice of a career closely related to medicine.