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TUBERCULOSIS IN HOSPITAL WORKERS *

BY

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It is perhaps a little previous to enter upon a discussion on this subject, because we are without important facts. We are promised data at the end of the year from the Registrar-General concerning tuberculosis in nurses as compared with other women of the same age, and many of us feel that the figures are going to show a heavy incidence of tuberculosis among nurses. At present we are relying more upon experience than upon facts, and "experience to experience oft opposed leaves truth uncertain." A certain amount of work concerning pulmonary tuberculosis in nurses and doctors has been done, particularly in America and Norway, and a beginning has been made in England. Hospital porters and orderlies do not appear to have been followed up, and so this paper will deal in the main with nurses.

Incidence among Nurses in General Hospitals

Most of the work published is hardly applicable to conditions that prevail in England. Let us, however, review very briefly, as has been done in the Milroy Lectures, 1937, and in the report to the Joint Tuberculosis Council, "Tuberculosis among Nurses," what has been said on the subject. I have freely extracted from these and from the fourth report of the Joint Tuberculosis Council on "Care and After-care Schemes in Tuberculosis."

In 1903 Theodore Williams made investigations among the Brompton Hospital nurses; but it was Heimbeck's work (1928) that first drew serious attention to the matter. In the General Hospital, Oslo, where there are tuberculosis wards and where the nursing training lasts four years, he found that 12 per cent. of all nurses entering developed clinical tuberculosis, those with a negative tuberculin reaction being most vulnerable (29.6 per cent. of the Pirquet-negative, as compared with 2.6 per cent. of the Pirquet-positive). His most recent figures (1936) indicate even more positively than before that nurses unprotected by a previous infection—that is, who are Pirquet-negative on admission—carry a higher liability to contract tuberculous disease.

Shipman and Davis (1933) state that between 6 and 7 per cent. of the student nurses in the University of California Hospital, numbering 387 over the ten-year period 1922–31, developed clinical tuberculosis during their three years' course of training, and that an additional 4 per cent. of those graduating during that period subsequently developed the disease. There are, we understand, no tuberculosis wards in this hospital. The authors found that the majority of the nurses who failed to react to tuberculin on entrance also failed to react on retesting a

year or more later. They observed no special incidence among the non-reactors at entrance.

Pollock and Forsee (1935) state that during a period of ten years, out of 518 trained nurses serving for varying periods at Fitzsimon's Hospital, where there were plenty of possible sources of infection, eight developed tuberculosis. All the 518 had been classed as tuberculo-allergic, apparently on x-ray evidence alone.

Kramer (1934) found that in nursing sisters working in general wards not quite 1 per cent. became ill with tuberculosis, whereas 16 per cent. of those working in tuberculosis wards, even under the best conditions, developed the disease. Although the numbers are too small to stand by themselves it seems significant that of 225 not working in tuberculosis wards only two were affected, while of twenty-five working in those wards four developed the disease.

Geer (1934) states that from 1920 to 1928 the records of the nurses' training school at Ancker Hospital, St. Paul (a general hospital with sanatorium wards), showed an incidence of 4.5 per cent. of tuberculous disease among its nurses—that is, three times the normal expected incidence among young women of the same age group. From September, 1928, to September, 1930, 112 young women entered upon training, and of these 5.5 per cent.—that is, 2.75 per cent. per annum—developed tuberculous disease. On the latter date a strict aseptic technique was instituted, after which only 1.6 per cent. of 181 new entrants developed clinical tuberculosis. The period of observation was from September, 1930, presumably to June, 1932. This aseptic technique involved the wearing of masks, skull-caps, and overalls, with a sharp demarcation of infected from uninfected accommodation, and careful scrubbing of hands and changing of overalls, etc., whenever the nurses moved from infected to uninfected rooms.

Geer found that on the average 30 per cent. were tuberculin-positive on entrance, and close to 100 per cent. reacted before training was completed. He compared the incidence of tuberculosis among the nurses in five other hospitals in St. Paul. In these, although 42 per cent. were tuberculin-positive in the third year of training, no cases of tuberculous disease were encountered in the two-year period reviewed. In the next two years, however, these hospitals showed an incidence of 1 per cent. of tuberculosis. Most of Geer's cases of tuberculosis were non-reactors on entrance. Mücke (1926), over a period of thirty-seven years, found that of 4,284 nurses and nuns 150 developed tuberculosis, of whom twelve died. Up to 1918 the percentage incidence was 1; subsequently it was 4.6. The disease usually developed in from three months to two years after entrance.

* Read in opening a discussion in the Section of Tuberculosis at the Annual Meeting of the British Medical Association, Belfast, 1937.

Incidence in Tuberculosis Hospitals

Ross of the Manitoba Sanatorium (1930) and Carmalt Jones of New Zealand (1933) also accept the view that tuberculosis is unduly prevalent among nurses. J. S. Whitney (1935) gave a review of the recent literature on the subject. The experience at Vejlebjerg Sanatorium is quoted in *Tubercle* (September, 1935, p. 562). During the period 1914-34, out of 645 sanatorium employees twenty-seven developed tuberculosis while they were working there. Three of the five lift-boys and twenty-two of 404 persons employed in the wards in various capacities developed tuberculosis, whereas no case arose among the hundred kitchen workers. Two of the laundry and dining-room staff became affected. Contrast with this a hydropathic establishment not taking tuberculous cases, where in the five-year period 1929-34 there were 635 employees, only two of whom developed pleurisy. One of them had recently served in a sanatorium.

Gullbring (1936)—quoted by Lillingston—states that from 1918 to July, 1935, in the tuberculosis hospital of Soderby, Sweden, forty-five cases of tuberculosis occurred among a staff of 2,016—that is, 0.2 per cent. The rate was 2.6 per cent. among staff coming in contact with patients but only 1 per cent. among others. The incidence in negative reactors was three times that in positive reactors. In at least one Swedish hospital tuberculin-negative entrants are now being inoculated with B.C.G.

On the other hand, it is commonly believed in this country that the incidence of tuberculosis in nursing staffs is lower in sanatoria and tuberculosis hospitals than in general hospitals, as the experience at the Brompton Hospital, already referred to, suggests. In America Baldwin (1930) states that no case of pulmonary tuberculosis has been known to develop among many hundreds of healthy employees at the Trudeau Sanatorium during forty-five years. In Germany Aufrecht, quoted by Clark (1934), found no case during seventeen years among 263 nurses and attendants in a general hospital where 10 per cent. of the patients were consumptives.

In 1936 Mariette produced a paper dealing with the rate of infection of nurses in various hospitals, in which he compares the incidence of breakdown in tuberculin-negative nurses. He points out that the tuberculin-negative nurse runs a very much greater risk than the tuberculin-positive. This supports the findings of Heimbeck, and so also in a small way does the series at the Cheshire Joint Sanatorium. D'Arcy Hart (1937), in the Milroy Lectures, discusses the question very fully, particularly the matter of tuberculosis in medical students, and makes many valuable suggestions.

It is significant in the investigations that are being carried on that in some hospitals the tuberculin-negative people become tuberculin-positive within a short time, whereas in other hospitals long intervals occur, and not all the tuberculin-negative nurses become tuberculin-positive. The same is possibly true of medical students and of hospital porters—for example, a porter at the Cheshire Joint Sanatorium who is continually carrying patients is still tuberculin-negative after nineteen months' service.

There is a strong impression among medical superintendents in the sanatorium world that very few nurses contract tuberculosis in a sanatorium, and yet it is forced upon the same men that a large number of nurses are admitted to sanatoria from other hospitals. There is a growing feeling also that far too many medical students and young medical men break down with tuberculosis. I have seen no figures for hospital orderlies or porters. However, perhaps one ought to expect an increased number of cases of tuberculosis in the staffs of general hospitals, but that the incidence among nurses in sanatoria ought not to be excessive. We merely have to consider the fact that the nurses are contacts, and, unfortu-

nately, nurses in general hospitals are often contacts of unknown cases of tuberculosis. In a sanatorium they are contacts of known cases, cases that have been educated, and the nurses themselves have been instructed in the method of control.

Examination of Contacts

The contact in the home is a very different person from the known contact in a sanatorium or hospital. There should be segregation of the case in the home; but in hospitals, particularly in a sanatorium, of necessity we must treat the case and teach those who are carrying out the treatment. The unknown case of tuberculosis will always be a danger. The fact that in England to-day one might walk up to a constable and spit under his nose and get away with it is a revelation of our slackness in dealing with the chief cause of tuberculosis. There can be no tuberculosis without tubercle bacilli, and there cannot be many tubercle bacilli when the heinousness of coughing and spitting indiscriminately is realized and abolished. To-day much is being made of the danger from tuberculous milk, too little of the gravity of spitting.

Again, contact examination has proved that the young adult is far more susceptible to tuberculosis than children; so the interest in contact examination has rightly been transferred to the young adult. That nurses, medical students, porters, etc., are contacts need not be unduly stressed, as we believe that if people know what to do and the patient is taught what he has to do the chances of infection from pulmonary tuberculosis are extremely small. In other words, from an educated consumptive a well-fed, well-housed, properly conducted nurse is not likely to contract pulmonary tuberculosis.

A fact of importance, and one that should be emphasized, is that the nurse or medical student who does happen to develop pulmonary tuberculosis will usually be diagnosed very much earlier, and therefore the chance of recovery is infinitely greater. This is especially true when such personnel are considered as contacts and examined regularly as a routine. Tuberculosis as an infection in the personnel will definitely exist; but as a disease it will be rare, and mere infection most often is harmless.

We must remember, too, that the imaginary or the definite high incidence of tuberculosis among medical students and nurses may also be due to the fact that they are quickly examined, and any thorough overhaul of a staff will usually reveal symptomless tuberculosis in certain members—for example, the Metropolitan Life Assurance Company of America found that 0.4 per cent. of young adults on their staff had pulmonary tuberculosis, whereas the incidence among young adults in the community generally was only 0.2 per cent.

Another encouraging fact, as pointed out by Mariette, is that while the percentage of deaths for all women 20 to 50 years of age on discharge from his sanatorium since January, 1916, is 29.6 per cent., only 5.7 per cent. of all nurses who were patients had died of tuberculosis in the same time.

PRECAUTIONARY MEASURES

Patients admitted to every kind of hospital should be taught the essential precautions that should be taken to prevent a spread of any germs from their mouth, whether they have tuberculosis or not. The precautions are simple and involve the proper disposal of sputum, the proper covering of the mouth, and the proper use of handkerchiefs. It is equally important, if we are in earnest about the conquest of tuberculosis, that all patients admitted for whatever disease should have a thorough examination of their sputum and a technically satisfactory radiograph of their chest. This should be properly interpreted. These procedures ought to be as much a routine as the examination of the urine; for tuberculosis is a disease that may be symptomless and

may be overlooked because of a broken leg, pneumonia, or appendicitis, and until our medical residents and nurses realize this and are taught what to do in the matter of the precautions mentioned we shall get an unwarrantable incidence of tuberculosis; but when these methods are adopted there will be a great limitation in the dangers, with a consequent fall in the disease.

There is a difficulty in ascertaining the incidence of tuberculosis, as contacts do not necessarily get their disease at once. There is an unknown interval of incubation, which may be anything over three years. I do not know of any hospital that keeps a real "follow-up" of its staff, though certain hospitals maintain that they are aware of what has happened to the nurses that trained with them; but inquiries do not seem to justify this claim, and a statement made by certain ladies in high positions in the nursing world that they have never known a case of tuberculosis in their nurses makes one feel that they do not know tuberculosis when they see it.

Investigation of Causes of Breakdown

First and foremost investigations in other countries show that the rate of breakdown among nurses in general hospitals is fairly high. Ferguson of Saskatchewan reports that 5.14 per cent. of all patients under treatment are nurses or nurses in training, and an additional 1.2 per cent. are other hospital attendants—that is, the incidence of breakdown among nurses in general hospitals in Saskatchewan was 12.7 per 1,000, which is twelve times that among the general population and eight times that found among 3,376 normal students, mostly females, and approximately of the same age group as the nurses. At the Cheshire Joint Sanatorium, where all new members of the staff are Mantoux-tested and radiographed, one out of fifty-four nurses who were Mantoux-positive developed tuberculosis in six months. Out of eleven Mantoux-negative nurses two became tuberculous; whereas out of forty Mantoux-positive and three Mantoux-negative female domestics none developed the disease. Likewise, of a small outdoor staff of six males, five of whom were Mantoux-positive, none has developed tuberculosis, and the other male is still Mantoux-negative nineteen months later.

What are the possible causes of a breakdown with tuberculosis among medical students and nurses? First, they run the ordinary risks of disease common to mankind; secondly, they are in a very true sense obviously contacts of known or unknown cases of tuberculosis; and, thirdly, the patients in most hospitals have not been taught what to do with their sputum. Nor have the doctors and nurses been made to realize that they are contacts, and their education in this matter has been sadly lacking—for example, the white coat of the house-surgeon should never be worn anywhere except on his rounds. That medical men should indulge in taking a white coat in which they have examined patients, rubbed along beds, etc., into a residency is anything but hygienic. The white coat is rightly considered a badge of some importance; but worn in the residency it becomes the uniform of the ignorant, and though accepted as good form is nevertheless an abomination.

What, then, must be done? It appears to me that two things are essential: first, to fight against the breakdown from tuberculosis; and, secondly, to deal with those who unfortunately suffer the breakdown.

Medical Residents

As to the medical residents, there is little they need do to protect themselves beyond realizing that a ward is ever a dangerous place, that their white coats should be left in the ward annexe, and that they themselves should take proper precautions and live a hygienic life. At the commencement of their career they should be Mantoux-tested,

radiographed, and overhauled. Further examination should be repeated when necessary.

Conditions of Nursing Service

It may be said that any discussion about the dangers to which nurses are exposed is likely to increase the already grave shortage. However, all hospitals have a duty to their employees, and particularly to their nurses, and I think the position of nurses might be reviewed in the light of advances in the care of the personnel of modern industry, where every effort is made to save fatigue, where hours are shortened, and where methods for the proper use of leisure are taught. Nothing that I have said or that anyone has published should turn a single woman away from the nursing profession any more than it should turn anyone away from the medical profession.

The first question concerns the conditions of the nursing service. Are these by any modern standards what they ought to be? Is it not common sense that girls are not volunteering for the nursing profession because of the conditions under which they have to labour? In the investigation of the Joint Tuberculosis Council all sorts of answers were given as to the number of hours worked by a nurse. It should not be forgotten that the nurse to-day has to do her ordinary ward work and in addition prepare for examinations. The reports of the *Lancet* Commission deserve the most serious attention from the hospital world. The Commission's recommendation of a fifty-one-hour week for nurses is on the harsh side. Why should a nurse work fifty-one hours a week in addition to study?

To say that the *Lancet* Commission has done harm to the nursing profession is to misstate the facts. To say that it is impossible to shorten the hours of nurses is again wilfully to refuse to face facts. It is for the hospitals to put their house in order. When women understand that the working hours of nurses are forty or forty-four per week and there is a reasonable opportunity given to them for study; that though the pay in the early years is rightly not much the housing conditions and the feeding are good; and that on becoming fully trained there will be ample salary and absolute freedom for the trained staff when not on duty—then there will be a return of women to the nursing profession. The modern trained nurse ought to be given the same freedom as a business girl; all that the hospital is entitled to ask of her is that she shall be on duty to time, be fit for her duty, and do her duty, and when that duty is over she should be given the opportunity to conduct herself as any business woman would. In certain hospitals, owing to lack of room, sisters and staff nurses have had to live out, and there has been no trouble. At the Cheshire Joint Sanatorium for over four years the trained staff have run their own residential club, and it has been a glorious success. Living-in for trained staff ought to be abolished.

As to "off-duty periods," these are not matters to be arranged from day to day or week to week. All members of the nursing staff should know their off-duty period for weeks ahead. This is a simple matter of organization, and only grave emergency should be a justification for altering it.

Nursing Uniform

Fewer hospitals have for long shown the correct use of a nursing uniform. Overalls are left behind in a changing-room before the nurse attends for meals or goes off duty. A simple uniform can be provided for the nurse to come and go between the ward and the nurses' home, and in the ward there should be facilities for changing into an overall and for rechanging and scrubbing up before leaving. One cannot understand how it is that the nurse's apron, infected at the bedside, is permitted at hospital tables and in recreation rooms.

Personal Hygiene

This is one of the first things that a nurse should be taught, and it is well that a simple leaflet should be given her before taking up duties at the hospital. The following is in use at the Cheshire Joint Sanatorium:

IF YOU ADOPT STRICT PRECAUTIONS THE DANGER OF CONTRACTING ANY INFECTIOUS DISEASE IS REMOTE. THIS IS PARTICULARLY TRUE OF PULMONARY TUBERCULOSIS

1. Sanatorium routine—ample air, food, rest, and cleanliness—is not only best for treatment, but also for prevention.

Abundance of air and daylight in sitting-rooms and particularly in bedrooms. Abundance of food at regular meal times. Abundance of bed—at least eight hours per night. General cleanliness of the body and sufficient exercise.

Suggestions:

If you feel a little tired, rest when off duty, and if your tiredness persists, report sick.

If you fear that you have any symptoms of tuberculosis, report at once. Examination will ease your mind.

Wash your hands thoroughly after handling infectious material, and always before leaving the wards. Get out of uniform as soon as you can.

2. *Patients.*—Be relentless in enforcing the standing order for handkerchief and sputum disposal. There is danger in the unseen spray resulting from coughing, loud talking, and laughter. Therefore insist upon the patient covering the mouth when coughing, and discourage loud talking and laughter.

This leaflet should be amplified by personal instruction; I quote from the report of the Joint Tuberculosis Council:

"Particular emphasis should be laid upon the importance of thorough hand-washing after attending the patient, also before meals and on going off duty: ample facilities should be provided for this. The risks of spray infection should be specially emphasized. Every nurse in dealing with tuberculous patients should feel she will be supported in demanding their scrupulous attention to regulations as regards the use of sputum cups and personal habits."

Age of Entry

Young women are at an age of greater susceptibility to tuberculosis, and it is probably wise, though not essential, that the age limit should be 18 years; for, with due precautions and proper conditions, I think the chance of contracting the disease is negligible. Some urge that the age for entering the nursing profession ought to be raised to 21. I doubt the wisdom of this, for with the reduction in tuberculosis, tubercularization is becoming less and less, and it is quite possible that at 21 your prospective nurse will still be a negative reactor.

The Negative Reactor

Should these girls be rejected if they are Mantoux-negative? On the other hand, should they be refused because they are Mantoux-positive? So far as medical students are concerned it is futile to talk of rejecting the medical student because he is a Mantoux-negative. It is equally futile to talk of rejecting a nurse on such grounds, for in the future we shall probably find very many more negative reactors, and when protected properly the nurse, particularly in a sanatorium, will be infected with tuberculosis with difficulty; but there is no gainsaying that the negative reactor has in the past contracted the disease much more often than the positive reactor. Thus there is all the more reason for keeping a sharp look-out. The negative reactor should be examined radiologically every three months, should be weighed monthly, and should be placed under the special care of a senior member of the staff, to whom she should report her every ailment or symptom. The results of the use of B.C.G. by Heimbeck and Wallgren are most encouraging, but I doubt if it is

necessary to introduce a general inoculation at this stage. My own feeling is that a specially watchful eye, coupled with proper education of the nurse and patient, will probably prove sufficient.

The Positive Reactor

The positive reactor must submit to a complete physical examination and a radiograph of the chest, be encouraged to report sick on the slightest provocation, and undergo a complete re-examination at least every year. In a word, therefore, my suggestion is that women before being accepted as nurses should be Mantoux-tested, thoroughly examined, and x-rayed. The radiograph should be repeated every three months with the negative reactors and whenever they are sick, and at least annually with the positive reactors. Infectious technique must be taught and be insisted upon early in the training of the nurse, and her hours of work must be well regulated, her housing conditions put in order, and insistence made upon rest and ample sleep.

For all patients admitted to a hospital x-ray films of the chest and sputum examinations should be a routine. Young doctors entering on their course should be also subjected to a similar examination as the nurses, as well as all persons employed within the gates of an institution, though apparently the risk is negligible.

The Question of Superannuation

What of those who break down with tuberculosis, whether they be medical men, nurses, or porters? In my opinion they should be regarded as suffering from an industrial disease and entitled to full treatment and full consideration thereafter.

The report of the British Medical Association on the questions raised by the College of Nursing seems unsatisfactory, for I think it is not true that "local authorities are discharging their responsibilities in this matter to the utmost." How can it be said that local authorities are doing their utmost when those who break down with tuberculosis are, when later they become fit, rejected because of superannuation? From the point of view of superannuation authorities, to get tuberculosis is far more serious to a nurse or a doctor than to be inflicted with syphilis. The mere hint of tuberculosis, irrespective of its extent or even its absolute cure, will banish them and hinder them for all time because of the boggy of superannuation.

It has been pointed out that a nurse breaking down with tuberculosis usually does so at an early stage, and we know to-day that early tuberculosis is to all intents and purposes curable; yet, once labelled, she is rejected by most local authorities because of superannuation. The majority of medical superintendents of experience are in favour of employing tuberculous staff. According to Burhoe of the After-Care Section of the National Tuberculosis Association, in the United States 3,520 ex-patients were employed in different types of work—physicians, nurses, dentists, etc. According to the experience in that country the tuberculous individual, if guided in his choice of work under expert medical opinion, rarely fails to make good.

Over half a million pounds per annum is being spent on wages to the staffs of sanatoria in England, and if a quarter of that amount were paid to ex-patients it would exceed enormously the amount paid in wages to workmen in the various employment schemes and settlements in the country.

The time is ripe for local authorities to realize that many openings could be found for the tuberculous ex-patient on the staff of a sanatorium. This would be a good thing not only for the ex-patient but also for the community. The mere fact of having tuberculosis is no ground for employment; the fact of having tuberculosis, with general fitness for work and progress towards arrest,

is also no ground for refusing employment in a sanatorium. Since no one is entitled to superannuation benefit until the lapse of ten years the tuberculous staff might be accepted under such schemes without grave risk of bankrupting them, "as a tuberculous man who has survived ten years has an expectation of life not widely different from the normal population" (Dr. Trayer).

REFERENCES

- Baldwin, E. R. (1930). *U.S. Vet. Bur. M. Bull.*, **6**, 1.
 Clark (1934). *Pacific Coast J. Nurs.*
 Geer, E. K. (1934). *Amer. Rev. Tuberc.*, **29**, 88.
 Gullbring, A. (1936). *Nord. med. Tidskr.*, **11**, 14.
 Hart, D'Arcy (1937). *Lancet*, **1**, 969, 1033, 1093.
 Heimbeck, J. (1928). *Arch. intern. Med.*, **41**, 336.
 — (1936). *Tubercle*, **18**, 97.
 Jones, Carmalt (1933). *Ibid.*, **15**, 59.
 Kramer, H. (1934). *Z. Tuberk.*, **71**, 165.
 Mariette, E. S. (1936). *Amer. J. Nurs.*, **36**, 605.
 Mücke (1926). *Beitr. klin. Tuberk.*, **64**, 165.
 Pollock, W. C., and Forsee, J. H. (1935). *Amer. Rev. Tuberc.*, **31**, 203.
 Ross, E. L. (1930). *Canad. med. Ass. J.*, **22**, 347.
 Shipman, S. J., and Davis, E. A. (1933). *Amer. Rev. Tuberc.*, **27**, 474.
 Whitney, J. S. (1935). *Amer. J. Nurs.*, **35**, 367.
 Williams, T. (1903). *British Medical Journal*, **1**, 589.

VINYL ETHER AS AN ANAESTHETIC AGENT*

BY

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Although I have had some experience in the use of vinyl ether during the past two years, I cannot claim to be in any way responsible for the great amount of experimental work that has placed this agent upon a scientific basis as an anaesthetic.

This is, I believe, the first occasion upon which vinyl ether has been the sole subject of a discussion at an anaesthetics meeting in Great Britain and Ireland, and I should like to open with a short account of the work which led to its use as an anaesthetic and to give you some of its chemical and physiological properties.

History

Leake and Chen in 1930 demonstrated that vinyl ether possessed anaesthetic properties, and in 1931 a purer and more stable product was prepared in the research laboratories of Merck and Co. by Ruigh and Major and was used as an anaesthetic on dogs by Knoefel, Guedel, and Leake. These investigators found that dogs were more easily anaesthetized by vinyl ether than by chloroform. They also found that the period of recovery was rapid and free from vomiting; moreover, they did not notice any significant pathological effect on the various organs.

The first experiments on human beings were conducted in 1933 by Gelfan and Bell, who after trying vinyl ether upon themselves considered it worthy of clinical study. The first extensive account of vinyl ether anaesthesia in man was published in 1934, when Goldschmidt and his colleagues reported having used it in operations in 461 mixed cases. In all these cases vinyl ether appeared to have no undesirable effect on respiration, the circulation, the liver, or the kidneys.

Since then a number of anaesthetists have recorded their experiences with this agent, and the early claims for its

safety seem to be well founded. Its especial advantages in certain well-defined indications are now being recognized. Wesley Bourne is particularly enthusiastic for the use of vinyl ether as the anaesthetic of choice in obstetric cases. The first report of its use in England occurred in 1935, when Sir Francis Shipway recorded a series of 314 cases. Besides these there are many reports which uphold the claim that it is of great benefit in short anaesthetics, for its rapidity of action and for its use as an adjunct to gas-and-oxygen anaesthesia.

I may here quote from a report by Beach of Philadelphia on a series of 2,630 cases:

"In endeavouring to place vinyl ether in the notch in which it seems most suitable our experience leaves us to suggest that it is most suitable in:

1. Minor surgery in short cases.
2. Major surgery only as a supplementary agent to the gases such as nitrous oxide and ethylene, where increased relaxation is required.
3. As an induction agent, especially in children, in an ethyl ether follow-on.
4. Obstetrical analgesia and short anaesthetics.
5. In dental surgery.
6. For short simple cases in the home or office, of the ambulatory type, and in cases where a gas machine is not available."

It is interesting to note that Beach administers vinyl ether by the open method when using it alone, but, on the other hand, Wesley Bourne, its most enthusiastic supporter, invariably uses a closed system with carbon dioxide absorption. For major operations this appears to be the method of choice, and I feel sure you will agree that this is so when we discuss its administration.

Chemistry of Vinyl Ether

Vinyl ether is a very volatile, clear, colourless liquid. It possesses a characteristic odour, said by some to resemble garlic, while others compare it to acetylene. It has a specific gravity of 0.77, and a boiling point of 28.31° C. (83° F.). Its chemical formula is $\begin{matrix} \text{CH}_2\text{CH} \\ \text{CH}_2\text{CH} \end{matrix} > \text{O}$, from which it is seen that vinyl ether is really a divinyl oxide, whereas ethyl ether has the formula $\begin{matrix} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{matrix} > \text{O}$, and is thus a diethyl oxide.

Vinyl ether undergoes certain oxidation changes when exposed to light or air for any length of time, and for this reason 3.5 per cent. absolute alcohol is added and 0.01 per cent. of a non-volatile oxidation inhibitor. If vinyl ether is kept for more than twenty-four hours after the container has been opened it rapidly loses its potency and thus greater quantities are required to effect anaesthesia. No toxic effect has, however, been noticed after using stale vinyl ether.

It is highly inflammable, and the same precautions are essential in its use as would be required for ethyl ether. The following table gives the limits of inflammability of both vinyl ether and ethyl ether (Guedel, 1937).

Vinyl ether and air	..	..	..	1.70-27.00 %
Ethyl ether and air	..	..	..	1.85-36.50 %
Vinyl ether and oxygen	..	..	..	1.85-85.00 %
Ethyl ether and oxygen	..	..	..	2.10-82.00 %

From this it is seen that in anaesthetic proportions vinyl ether combined with air or oxygen produces a highly explosive mixture.

* Read in opening a discussion in the Section of Pharmacology and Therapeutics, including Anaesthetics, at the Annual Meeting of the British Medical Association, Belfast, 1937.