embryology, so that in both cases there is no necessary prior recall of items before use. Generally what we style recall *is* use.

There is a very simple and rather beautiful experiment which Henry Head used that may, I think, give us a clue. Before certain of his aphasic patients he set a number of solid shapes of triangles, squares, cubes, and the like, which were to be viewed but not touched. The objects were covered and then either exactly similar or different ones were placed in the hands of the patient behind the patient's back, and he had to indicate whether the object now being tactually explored had or had not previously been among those seen. No patients had any difficulty in making the required identifications accurately, but the *order* of original exposure could not be indicated without difficulty and error. The identification of form was immediate and required no necessary prior recall of the visual qualities concerned. One sensory pattern—tactual—fitted another sensory pattern—visual—of different mode. Head called this process “matching.” It could cope with shape, but order requires the use of a symbol of the word-type, and was out of the range of his particular observers.

Now it has frequently seemed to me that matching, the immediate fitting of one set of responses to another or of one content to another, may well be a process which has a much wider range than is often realized. For every task, for every topic, at every level of psychological development there are perhaps the fit reactions and expressions, and there is perhaps some mechanism characteristic of each level of development which can identify the ones that are fitting or throw out the ones that are unfitting.

I think, perhaps, that what Hadamard suggests in the case of the good mathematician is just as true of the great clinical physician. It is not that he makes fewer mistakes than less-skilled people, but that he knows his mistakes more quickly and does not follow them so often to the stage at which they become irremediable. After, sometimes long after, it may become possible to identify and quite definitely to characterize the item of error. But at the time there is literally nothing except the knowledge that to go on along this line will not fit. The several patterns and functions involved must be very different from those of direct sensorial matching, and the content used may require a highly abstract and symbolic representation, but fundamentally the process is the same at the high level as at the lower.

And, of course, if this is a right way of approach, mental skill, even in its highest reach, is not merely an approximation to temporary convention, but is an achievement of combinations of response which do, as a matter of fact, fit well together. Whether or not a measure of such skill can be obtained in terms of relative sensitivity to errors or false starts is indeed still a matter for investigation; but at least this hypothesis is not beyond the bounds of an empirical study.

NOTE.—Most of the work which I have referred to in these lectures is as yet unpublished, though it has been the subject of a large number of reports, the great majority of them from the Cambridge Psychological Laboratory. I wish to acknowledge first the generous support by the Medical Research Council, through their establishment of a Unit of Applied Psychology at Cambridge; by the R.A.F., chiefly through the Flying Personnel Research Committee; and by the Ministry of Supply, mainly through bodies concerned with tracking problems and the development of servo-mechanisms. There is practically no member of the research and teaching staff of the Cambridge Psychological Laboratory who has not contributed in important measure to the success of the undertakings involved, but it is perhaps permissible to refer especially to the insight and initiative of the late Dr. K. J. W. Craik and to the vital experimental studies of Dr. W. E. Hick, Miss M. A. Vince, Dr. D. Russell Davis, Dr. N. H. Mackworth, Dr. A. W. Carpenter, and Mr. G. C. Grindley.

MODERN TREATMENT IN PSYCHOLOGICAL MEDICINE*

BY

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Progress in psychiatry was for many years slow, and hospitals for mental disorders were used primarily for custodial care rather than therapeutic centres for such illnesses. Between the two world wars, however, considerable progress was made in the treatment of psychiatric conditions, and a milestone was passed when the treatment of G.P.I. was successfully instituted by Wagner-Jauregg in Vienna in 1917. During the same period the treatment of agitated and restless patients was tried under continuous sleep by Klasi of Switzerland and other workers, and this was found to be of considerable value.

It was recognized that schizophrenics rarely suffered from epileptic seizures, so trial was made of the treatment of schizophrenia by inducing epileptic fits with convulsant drugs, among them leptazol and triazol. It was found, however, that in those cases of schizophrenia in which depression was marked the improvement in the depressive element of the illness was striking, while the schizophrenia as a whole was not greatly improved. Depressive illnesses were therefore treated by artificially induced fits, with much more satisfactory results than in schizophrenia. This method of inducing fits by these drugs was, however, found to be unreliable in that fits did not always occur and often caused great fear and apprehension in the patients. The use of convulsant drugs was replaced by a machine which produced fits by passing an electric current through the head. The patient felt no ill effects, and the fits occurred in over 90% of cases.

Following the abandonment of the convulsion treatment of schizophrenia another milestone was passed by the introduction of the insulin treatment of schizophrenia, which was begun by Sakel of Vienna about ten years ago. Previously a certain number of schizophrenic patients recovered spontaneously by having remissions in their illness, but the prognosis and duration of the condition have been materially altered by the introduction of this form of treatment. At the same time that these physical methods were being developed, psychological methods were also being improved upon. Thanks to the work of Freud and various of his followers, such as Jung and Adler, the psychopathology of mental diseases was understood for the first time. Previously the patient's delusions, thought content, and actions had no meaning to the psychiatrist. Following on the work of Freud, however, it was possible to understand why the patient said, for instance, he was “too wicked to live” or why he was continually washing his hands, etc. From this understanding of the psychopathology of mental illness it became possible to probe into the patient's unconscious mind and so deal with the conflict which was the cause of his neurosis or psychosis. The technique of psycho-analysis was developed by those who themselves had been psycho-analysed, but this is a costly and lengthy form of treatment. Other methods of psychotherapy—to be discussed later—have been evolved for dealing with the patient's illness in a much shorter space of time, and in many cases are just as efficient.

At the outbreak of war in 1939 this roughly was the position regarding the treatment of psychiatric illnesses. It

* A paper read to the Sutton and District Medical Society on Feb. 7, 1947.

was felt that large numbers of psychiatric casualties would occur among the civilian members of the population as a result of air raids, while the Armed Forces would have their quota of psychiatric casualties also. Long and costly methods of treatment would not be possible for large numbers of psychiatric casualties, as neither the psychiatrists nor the beds would be available. Various techniques of treatment were devised, and it is proposed to discuss those which are likely to prove of value in the treatment of psychiatric illness in civilian life, although they were first largely applied to psychiatric illness occurring during the last war. For simplification, treatment may be divided into physical and psychological methods, but in most cases a combination of these can and must be used.

Physical Methods

Continuous Narcosis

For those suffering from acute anxiety, agitation, or acute panic reactions continuous narcosis is an invaluable form of treatment. By this means the patient can be kept in a state of twilight sleep for a period varying from 4 to 14 days. During this time he is completely cut off from stimuli in his environment, and as a result his mind is given complete rest. Various drugs, such as "somnifaine," phenobarbitone, and "dial," can be used for this purpose, but in my experience sodium amytal is the most efficacious. This drug acts rapidly, is rapidly excreted, does not tend to accumulate in the body, and toxic symptoms are not common. The usual dose is 6 gr. (0.4 g.) every four hours, while if additional sedation is necessary 2 dr. (8 g.) of paraldehyde can also be given. The patient, who is treated in a darkened room, can be roused to take his meals, and the next dose of sedative should be given after his meal and after he has used the bed-pan, etc., so that he is not disturbed unnecessarily. It is essential to see that plenty of fluids are taken, as this helps to ward off toxic symptoms. The usual check is kept on pulse, temperature, and blood pressure, while the daily output of urine should also be measured. When the patient is finishing treatment the drug should be gradually withdrawn, as instant withdrawal sometimes produces major epileptic seizures. On coming round from the drug the patient is often "muzzy" for a few days; but the result of the rest in many cases is to remove the acute anxiety symptoms, when the patient is more fit to be approached from the psychological point of view.

Insulin Treatment

Many patients suffering from chronic neurosis, such as anxiety states, tend to lose weight and as a result feel that there is something wrong with their bodily health. In addition their appetite is poor, they do not wish to eat, and a vicious circle is set up. Early in the recent war small doses of insulin were given to such patients in the morning fasting, and it was found that by gradually increasing the dose the patient passed into a state of sopor and became drowsy and calm. The dose of insulin, which starts at 10 units and is increased to about 80 units, is given at 7 a.m., and the patient is allowed to remain in this state of sopor until 10 a.m., when he is given a cup of sweetened tea, 12 oz. (340 g.) of *sauté* potatoes (as a substitute for sugar, owing to the shortage), together with his ordinary breakfast. He is not allowed to go into coma, and after this treatment has been given for five days a week for a few weeks the appetite improves considerably and there is a large gain in weight. The suggestive effect of putting on so much weight is remarkable, and this modified insulin treatment, as it is called, has proved of great value in the more chronic neuroses where loss of weight is a feature. In some cases

where patients are undergoing continuous narcosis and their appetites are poor, modified insulin treatment can be combined with the narcosis with great effect.

Insulin Coma

This treatment is used for all forms of schizophrenia, but is said to be most effective in the paranoid types. It has been found of value not only in cutting short the attack but also in resocializing a patient for whom a poor prognosis would previously have been given. There are certain physical contraindications to this method of treatment, and in those patients who have had tuberculosis there is a definite risk of reactivating the infection; so for this reason it is unwise to use the treatment in such cases; nor should it be used where there are grave circulatory or kidney disturbances. The treatment can obviously be given only in hospital, with nursing and medical staff specially trained in the method. The ideal arrangement is to have a complete unit with medical and nursing staff in continual attendance during treatment, with emergency trays containing equipment for both nasal and intravenous methods of interruption of the coma always at hand. In addition, trays containing stimulants such as adrenaline, nikethamide, etc., should always be ready. As in the modified insulin method of treatment, the patient is given his injection of insulin at 7 a.m. fasting, the usual commencing dose being 10 units. The dose is increased daily by 10 units, and in a number of cases 300 units or more may be required to induce coma. The patient gradually goes into coma with profuse sweating, often stertorous breathing and restlessness, and is allowed to remain in coma for about half an hour. However, should he develop epileptic fits, irregular pulse, falling blood pressure, respiratory stridor, etc., the coma must be interrupted at once. As a routine this is done nasally by giving 33% glucose; if the condition is urgent it is given intravenously.

When the patient is roused he is rubbed down, put into dry clothes and a dry bed, and given sweetened tea and a meal. It is necessary to keep the pulse, respiration, temperature, and other such records carefully from the time he is given the insulin until he comes out of his coma, and such patients, after treatment, should not be allowed far from their ward, as they may develop late hypoglycaemia. Patients should be encouraged to carry some lump sugar or chocolate in case they feel faint. The patient is allowed up by lunch-time and then takes part in the other forms of treatment, etc., to be mentioned later. As with modified insulin, treatment is given five days a week. Most favourable cases respond in two months, but if no improvement occurs after the third month the likelihood of recovery is poor.

Electric Convulsion Therapy

This form of treatment is now used effectively in depressive illnesses. It has been found of most value in depressive illnesses which are constitutional or endogenous and arise from the personality of the patient. Where, however, the illness is reactive to an external situation convulsion therapy can be of help in giving a "fillip" to the patient when he seems to be stuck in a groove and unable to make progress. In those forms of depression occurring at the involutional period it is probably of the greatest value. Here again the contraindications are similar to those for insulin treatment, while patients with high blood pressure, arteriosclerosis, and brittle bones are not good subjects. The patient is given the treatment fasting, and at our hospital he is controlled in a special jacket which helps in preventing fractures (the commonest being a

crush fracture of the lumbo-sacral spine) that occasionally occur, while a gag is inserted in the mouth to prevent tongue-biting. If the patient is nervous he can be given 3 gr. (0.2 g.) of sodium amytal before the treatment, while patients who suffer from rheumatoid arthritis with some stiffness of the joints have been given tubocurarine to produce muscular weakness so that the pull on the bones will not be so great. When the patient is held in the correct position a current is passed through his head by means of two electrodes, and a typical major epileptiform attack occurs. He is put back to bed, and for a time may be confused and complain that he cannot remember. These symptoms clear up in the course of a few hours and may recur temporarily when the next fit is given. Some authorities maintain that permanent memory disturbance and intellectual impairment result from this form of treatment, but this seems to be the case only when the treatment is given too frequently. The number of fits depends on the progress made, and in some cases an occasional fit as an out-patient keeps the patient going, whereas otherwise his condition would be chronic and mean a permanent stay in hospital.

Prefrontal Leucotomy

Moniz first used this operation on patients suffering from incurable mental disorders. After injecting alcohol into the subcortical white matter of the prefrontal lobes cores of white matter in the prefrontal areas were separated with a steel leucotome but not removed. Since Moniz first employed the method various techniques have been devised; it is obviously not practicable to describe the technique here, as the operation can be successfully carried out only by a neurosurgeon. Post-operative care and nursing are important, a careful check being kept on the pulse, respiration, and blood pressure for at least 48 hours. For restlessness $1\frac{1}{2}$ gr. (0.1 g.) of soluble phenobarbitone may be given intramuscularly, and 1 gr. (65 mg.) of codeine phosphate four-hourly may be used for the relief of headache. Morphine must on no account be given.

The operation, which should be performed only when all other methods of treatment have been tried and failed, has been carried out successfully on disturbed and noisy schizophrenic patients, thus making them more easily managed and rendering the nurses' task less irksome and difficult. In a limited number of cases such patients have been able to live outside hospital and in the care of relatives. In involutional and other long-standing depressive illnesses leucotomy has been successful, while experimental work on the value of the operation in antisocial mental defectives, post-encephalitics, etc., is still being carried out.

In the neuroses, such as obsessional and anxiety states—illnesses which can as completely incapacitate the individual as the psychoses—successful results have been reported. The tension and anxiety are relieved and the obsessional thinking, rumination, etc., although still present, are much less vivid and do not handicap the patient to the same extent as before operation. It is important before operation to inquire very fully into the patient's personality, as aggressiveness and other such traits causing antisocial conduct may become more pronounced after operation.

The intellectual capacity is said not to undergo any reduction. Obviously where the patient was previously doing a job for which a high degree of intelligence was not required the point is not important; but where such a high degree is required careful thought must be given as to the advisability of operation. The patient, however, may become less self-critical, more demanding, and hasty-tempered, with resulting conflict with his environment. The

mortality rate is low and usually death is due to haemorrhage, while a late complication may be the appearance of epileptic fits and status epilepticus.

Narco-analysis: Abreaction

It has long been recognized that an unpleasant traumatic experience is repressed from the conscious into the unconscious mind. The result of this repression leads in many cases to a gap in the memory, or fugue, which extends from a short time prior to the trauma to some time after it. The resultant loss of memory is a source of worry to the patient, as sometimes he wonders what happened during this period of amnesia, and he may think that he has committed a criminal act. Hypnosis and psychotherapy were formerly employed to try to re-establish this loss of memory, together with the unpleasant episode, and in many cases considerable time had to be spent before the psychiatrist was successful in bringing about a cure. During the war this type of hysterical reaction in which the patient went through a harrowing experience was common, and as it was necessary to try to restore the memory rapidly, sodium amytal, given intravenously, was first used. A dose of $7\frac{1}{2}$ gr. (0.5 g.) in 5 ml. of water is given slowly at the rate of about 1 gr. (65 mg.) per minute, and when the patient has received about 5 gr. (0.32 g.) he becomes relaxed and in a state resembling that of drunkenness, in which he is garrulous and talkative. The patient's conversation is then led from the last thing he recollects before the incident until the actual incident itself is recalled and re-enacted. In many cases several sessions are necessary before the full incident is recounted, and during these sessions the patient relives the experience and a terrific amount of emotion is released. When it is considered that the patient has talked sufficiently at that session the injection of sodium amytal is completed, after which he sleeps for several hours. It might be argued that it is unwise to restore an unpleasant incident which is upsetting to the patient, but the loss of memory is productive of much more worry to him than a knowledge of the incident, which can be explained to him and be accepted in a reasonable light. This abreaction, or getting rid of pent-up emotion, has also been called "mental catharsis" or "emotional diarrhoea."

Various other drugs have been employed for this purpose—namely, thiopentone, hexobarbitone, and ether. The last-named is now more commonly used than sodium amytal to produce abreaction. This form of treatment is also of value in peacetime in hysterical loss of memory and acute anxiety states where obviously some traumatic incident has been repressed.

Psychological Methods of Treatment

I do not propose to discuss at length the various techniques of psychological treatment, as the specialized forms such as psycho-analysis should be left to those specially trained in this type of treatment, while hypnosis, suggestion, and persuasion are constantly used as adjuncts to physical methods of treatment or by themselves.

The importance of suggestion is seen when a patient is admitted to hospital. When he enters the ward he should be made to feel the business-like atmosphere and air of confidence among the medical and nursing staff, rendering him hopeful about the outcome of his illness. This suggestion plays an important part in the whole hospital atmosphere, while the giving of medicines, even though they may be only placebos, can help in this way. Psychotherapy, such as detailed history-taking, the talking over of difficulties, discussion of home and other worries, must be used in every case. Group psychotherapy, where several patients meet and discuss their symptoms and difficulties collectively, is also of value.

Patients enact situations which they find difficult and which they are ordinarily unable to face; this technique is called psychodrama. These methods of treatment allow several patients to receive treatment at the same time and help to develop team spirit also. In dealing with the psychological approach to the patient I should like to mention certain aspects which have been evolved as a result of our war experiences and which can be carried usefully into civilian life. At the outbreak of war men were called up for the Army and if medically fit were sent into various branches irrespective of their training in civilian life or degree of intelligence. As a result it was found that men who possibly were labourers and were dull intellectually were sent to workshops where skilled engineers were required, while skilled engineers were likely to find themselves doing labouring jobs in the Pioneer Corps. The result was that the man who had had no skilled training and was unable to do his job became anxious and worried about it and broke down, while the skilled man became "browned-off" and bored with the dull monotony of his job and also broke down because of the lack of opportunity for him to use his skill. This led psychiatrists and psychologists, with the co-operation of the appropriate Service authorities, to devise selection in the placing of recruits into jobs more in keeping with their knowledge and capabilities. When a man had no skilled trade or profession in civilian life he was tested by the psychologist from both the intellectual and the vocational point of view so that he might be trained along the lines for which he showed some natural aptitude or bent. In this way recruits with a tendency to artistic work might be employed in cartography or draughtsmanship, while no time would be wasted in training an intellectually poor man with little or no natural aptitude when he was obviously suited only for menial and labouring jobs. This personal selection proved of great value in preventing unnecessary breakdowns among Army personnel, and is now being used in civilian life in industry. It is important that the right job should be found for each type of person wherever possible. In addition, it was observed during the war that some men were able to shoulder responsibility up to a certain degree, but when promoted above this point were unable to cope with the added responsibility, and broke down if not allowed to revert to their previous rank. In civilian life the same thing applies: some people are able to rise only to a certain level, and if promotion means added responsibility to which they cannot adapt themselves they must be content, if they wish to lead normal useful and happy lives, with a lower income level than the man who can accept that responsibility. This point is dealt with in a little more detail later on.

Rehabilitation and Occupational Therapy

The treatment of the neurotic differs from that of the physically ill patient in that the former, except when undergoing special treatment, is not confined to bed and his day must be planned in some useful way for him if he is to be prevented from becoming bored and brooding over his troubles. For this purpose various adjuncts to the treatment already mentioned are provided in a neurosis centre. Physical training, varying from light to full, should be given daily to those who are physically fit for it. In many cases the neurotic has a poor posture, and the correction of this by physical training helps in restoring confidence. Occupational therapy must also be provided, and this can be divided into recreational, diversional, and vocational. The first consists in providing reasonable recreational facilities in the form of indoor and outdoor games. In the playing of games it is wise to have inter-ward competitions, which provide healthy rivalry and stimulate team spirit.

Concerts, entertainments, and discussion groups are held, while recitals by well-known instrumentalists, who at the same time give talks about the instruments and the history of music, help to stimulate the patients' interest. Lecture discussions are held every week, all the lecturers being authorities on their subjects. Politics, geography, history, and other topics are discussed.

Diversional occupation consists in the making of various articles in the workshops. Among the types of occupation are rug-making, leather work, perspex work, making soft toys, carpentry, and gardening. The patients are allowed to choose the kind of work they wish to do, and when an article is completed they are allowed to purchase it at cost price. The accomplishment of making an article brings with it a sense of pride and helps to restore the loss of confidence from which most neurotics suffer. Lastly, the vocational type of occupation provides a means by which a patient who has no trade to go back to can be trained—for instance, in gardening or carpentry—and the foundation laid for him to begin a more thorough training that will help to rehabilitate him in the outside world. Patients are not dragged into working, but are encouraged to do so, and they usually respond well.

It is important that neurotic patients should be allowed out of hospital to visit their homes, local cinema, etc., so that when the time comes to leave hospital the task of readaptation to social life will not be so difficult.

Industrial Neurosis Unit

An experiment that is being carried out at Sutton consists in the development of an industrial neurosis unit. One hundred beds for both sexes are being set aside to which neurotics who are misfits in industry can be admitted. For some considerable time it has been known that men and women go to employment exchanges almost weekly asking for new jobs as they are unable to cope with their present ones. Jobs are changed at very frequent intervals and for trifling reasons—namely, that the work is too noisy, the conditions under which they work are too hot or too cold, or they cannot tolerate the foreman. These people are to be referred to a psychiatric out-patient clinic for an opinion. If there is a psychiatric condition which requires treatment this will be dealt with by out-patient attendance if possible; otherwise the patients will be admitted to the industrial unit.

It is hoped that it will be possible to treat and "vet" such patients in the course of a few weeks and that a maximum stay of six weeks in hospital will be required. The patient will be tested by a psychologist to assess intelligence and to find out what his natural aptitudes are. A social worker will investigate his home conditions and attempt to straighten out any difficulties, while appropriate psychiatric treatment will be given for his condition.

Additional workshops are being supplied for the unit, and it is hoped to provide for hairdressing, tailoring, secretarial work, bricklaying, plastering, and interior decorating. These shops will be staffed by skilled instructors, each of whom can teach about 10 patients at any one time. It is also hoped to establish a liaison with local firms where hospital patients may be sent to work in an unpaid capacity for a few hours each day. This will help in vocational selection. A Government training centre will provide 20 vacancies a week for patients who are found to be suitable for teaching a particular trade, while a full-time disablement resettlement officer of the Ministry of Labour will be attached to the unit to help in placing the patients after discharge and to send reports to the patient's local employment exchange. After-care will in most cases be of

great importance, and a social worker will cover both the patient's home and employment after discharge.

This, briefly, is an outline of the scheme, and it is hoped that many patients who formerly helped to swell the ranks of the unemployed will be returned to work either in the open market or in sheltered employment.

Conclusion

There is no doubt that psychiatry is fast becoming, or has become, an important branch of social medicine. Adequate housing and education, the teaching of the individual how to enjoy his leisure time without becoming bored, and financial security are all important factors in promoting mental health and in preventing relapse of those who have recovered from mental ill-health. The removal of public prejudice against mental disease, and an attempt to make everyone appreciate that psychiatry is a scientific subject, are of paramount importance in the promotion of mental hygiene.

PENICILLIN IN THE TREATMENT OF DIPHTHERIA

BY

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Penicillin Sensitivity of *Carynebacterium diphtheriae*

In 1929 Fleming reported that a slightly purified extract of a broth culture of *Penicillium notatum* was active against the pyogenic cocci and rather less so against *Corynebacterium diphtheriae*. This observation was confirmed by Clutterbuck *et al.* (1932) and by Chain *et al.* (1940). Young and Mood (1945) tested six strains for penicillin sensitivity and found all to be inhibited by concentrations between 0.004 and 0.06 unit per ml. In contrast to this Ercoli, Lewis, and Moench (1945) found that over 1 unit per ml. of penicillin was required to inhibit growth. Long (1946b) tested thirty strains and obtained sensitivities between 0.02 and 0.004 unit per ml. It is probable that the size of the inoculum used is an important factor in accounting for these differences, though even if an organism is resistant enough to require over 1 unit of penicillin per ml. to inhibit growth the possibility of successful treatment is not excluded.

Experimental Work on Treatment in Guinea-pigs

Reports on the treatment of experimental diphtheria in guinea-pigs are conflicting, Young and Mood (1945) claiming that infection could be prevented by extremely small amounts of penicillin mixed with the inoculum, and cured by larger doses given as long as 23 hours after inoculation with a larger dose of culture. Ercoli, Lewis, and Moench (1945), on the other hand, state that penicillin had only a negligible action on the course of an infection following a small inoculum.

It would appear that there is not sufficient evidence on which to judge the effect of penicillin on artificially induced diphtheria in the guinea-pig; but even if the evidence were conclusive it is doubtful whether it would be safe to argue from guinea-pig to man. The degree of susceptibility and the lesion resulting from injection of culture in the guinea-pig are not comparable to the naturally occurring disease in man. Further, diphtheria in man is commonly complicated by secondary infection with haemolytic streptococci, Vincent's organisms, and mixed

anaerobes. All these organisms are markedly penicillin-sensitive and are almost invariably present in the disease, though the haemolytic streptococcus is less common than the others.

Penicillin-treated Cases in the Literature

Symons (1945) reported the case of a boy of 13 years who received antitoxin and sulphonamides on the second day of the disease. One day later, as a result of the development of bull-neck and spreading of the membrane, penicillin was administered, 24,000 units being given three-hourly. This was followed by the membrane "separating, disintegrating, and almost disappearing within 24 hours." *C. diphtheriae gravis* and haemolytic streptococci were obtained from swabs before treatment.

Archer (1945) describes the dramatic improvement in the local condition of a patient with "mixed K.L.B., haemolytic streptococci, and Vincent's infection." Diphtheria antitoxin and "antistreptococcal serum" had been given previously without effect. Christie and Preston (1946) refer to two patients both with mixed *C. diphtheriae intermedius* and haemolytic streptococcal infections. Case 1, aged 15 years, had severe pharyngeal diphtheria with a bull-neck. The day of the disease is not given, nor is the state of activity of the membrane. He was treated with antitoxin and a sulphonamide on admission; three days later a petechial rash appeared, and systemic penicillin (100,000 units a day) with an hourly throat spray (500 units per ml.) was started. The throat had almost completely cleared in another two days. Case 2, aged 17, had severe pharyngeal diphtheria of "not more than three days' standing." On admission the patient was treated with antitoxin and penicillin as in the previous case. The membrane separated in two days, though the general condition remained unchanged. Death occurred from heart failure, preceded by immobility of the palate.

Dodds (1946) reported 13 cases treated with penicillin and antitoxin, and 13 controls treated with antitoxin alone. *C. diphtheriae gravis* is stated to have been present in a "high proportion" of these cases, though exact figures are not given; neither is the presence or absence of secondary infection noted. 200,000 units of penicillin were administered daily for two days, followed by 100,000 units daily for three to six days. The conclusions reached were that penicillin "appeared to have been in some degree beneficial in most cases treated," though it "seemed to have little effect on the rate of clearance of the membrane." Symons (1946) reported a further case from which virulent diphtheria bacilli were not isolated.

De, Chatterjee, and Ganguli (1947) describe the successful treatment of 27 Indian children alleged to be suffering from diphtheria, penicillin being administered by three-hourly injections of 10,000 units. Antitoxin was withheld, since the work was undertaken "to ascertain whether the drug can be used in the place of serum," "the risk being minimized by selecting early cases, under the assumption that the child can destroy and/or eliminate a certain amount of diphtheria toxin." Of the 27 cases treated 11 are described as bacteriologically negative; in the remainder the organisms appear to have been identified on morphology alone. In view of the unusually high fever (10 of the patients had temperatures between 102 and 104° F. (38.9 and 40° C.)) it is unfortunate that no indication is given of the presence or absence of secondary infection and, in particular, of haemolytic streptococci. Their cases are classified into four groups. Group I: early cases, bacteriologically positive. Group II: early cases, bacteriologically negative but clinically diagnosed as classical diphtheria. Group III: moderately severe cases, bacteriologically