A Lecture ON THE OPERATIVE TREATMENT OF INOPERABLE CANCER.

DELIVERED AT THE CANCER HOSPITAL, BROMPTON,

BY

CECIL ROWNTREE, F.R.C.S.,

ASSISTANT SURGEON TO THE CANCER HOSPITAL, AND ASSISTANT
SURGEON TO THE SEAMEN'S HOSPITAL, GREENWICH.

THE treatment of inoperable cancer is too vast a subject to permit me even to touch upon many aspects of the question. For example, I have no time to refer to any of those innumerable methods suggested for the cure of cancer that we have submitted to us at this hospital nearly every day. Those of you who are interested in the "cancer enthusiast" will find on this table, in the shape of pamphlets, books, letters, etc., unmistakable evidence of the energy and abandon with which the search for a cancer cure is prosecuted. In each of them is claimed the relief or cure of cancer, whatever its nature or position, whether operable or inoperable.

What is inoperable cancer? What does the word "inoperable" signify? It is generally applied to those cases in which the growth is so large or so fixed, or in which metastases are so widespread that no operation that is compatible with life offers any promise at all of eradicating the disease.

It follows that the application of the terms "operable" or "inoperable" must be largely dependent upon the personal equation of the surgeon—and he is often wrong; indeed, roughly speaking, he is wrong in about 50 per cent. of his cases. For that, taking all types of cancer, is about the proportion in which recurrence takes place after a radical operation has been performed.

Conversely, a case condemned as inoperable by one surgeon may be operated upon with complete success by another who is more enterprising or more lucky.

However, I am not now concerned with cases about the operability of which there can be any difference of opinion. Only too often one meets with cases where there can be no question of the possibility of carrying out any operation of a radical nature.

We have at our disposal two methods of treating cancer when it has reached this stage: first, by the application of one or several of those experimental cures for cancer to which I have already alluded. But we should be neglecting our patients did we not at the same time undertake one or other of the well-recognized palliative methods of treatment which are directed to the relief of symptoms rather than to the actual cure of the disease. These methods are, of course, very numerous, and include such procedures as the administration of drugs or the destruction of nerves to control pain, the use of belladonna to diminish mucous discharge, the application of x rays, radium, or diathermy to control ulceration, and so on. But what I want specially to draw your attention to to-day is the operative treatment of inoperable cancer, which perhaps sounds paradoxical. But there is no paradox, for it is our application of the word "inoperable" that is unfortunate when what we really mean is "incurable." It is a pity that the word has ever been permitted to be used in its usual application, for it inclines us to take it too literally and say, "I am afraid the case is inoperable—I can do nothing," and this in spite of the fact that such measures as gastrostomy, gastro-enterostomy, cystostomy, and so on, are perfectly familiar to all of us as palliative operations frequently carried out in so-called inoperable cancer. But these operations are life-saving measures performed merely for the purpose of dealing with one or more of the effects of cancer. They do not encroach upon, indeed they do not influence the disease itself. The kind of operation for which I want to plead is one deliberately undertaken with the sole object of removing the growth itself or as much of it as possible, in the hope of relieving much of the patient's discomfort, but with no expectation at all of permanently curing the disease. I believe that we are not active enough in the treatment of inoperable

cancer, and I am convinced that such operations have a far wider application than is generally accorded to them.

Cancer of the Tongue.

Ordinarily speaking, the life-history of a case of cancer of the tongue resolves itself into the history of the tongue itself—a history of ever-increasing pain and discomfort. So long as the growth is confined to the intrinsic muscles the discomfort is not great. There is some pain, a little difficulty with speech, some salivation; but so soon as the extrinsic muscles become involved—and in the majority of cases this is only a matter of weeks—the real suffering begins. Speech is more difficult, salivation is more profuse, and pain is aggravated by each attempt at speech or mastication or even swallowing. There is by this time a horribly offensive ulcer which is impossible to keep clean; and finally, worn out by pain and loss of sleep, and exhausted by septic poisoning, the patient falls an easy victim to bronchopneumonia, gangrene of the lung, or some similar affection. That is to say, some condition directly resulting from the offensive condition of the mouth.

Of 182 cases in which I ascertained the cause of death, in no less than 128 it was one of the above conditions. This teaches us, I think, that in cancer of the tongue, when not operated upon, most of the suffering and death itself are directly attributable to the local condition and to its septic concomitants.

Cancer of the Breast.

Dependent upon the position and nature of the growth and the size and shape of the breast, cases not operated upon ultimately reach a stage in which ulceration of the growth occurs, and the patient suffers first from the mechanical discomfort of the mass, and secondly is troubled by a copious discharge, usually most offensive. Finally, hæmorrhage and septic absorption complete the picture and terminate life, death resulting in large part from septic processes.

Cancer of the Uterus.

In cancer of the uterus we have the same story—sloughing and disintegration of the growth, with hæmorrhage, discharge, and septic absorption as the chief symptoms—symptoms almost entirely referable to secondary changes in the growth. And in a large percentage of the cases septic peritonitis, pelvic abscess, or ascending suppurative nephritis are the cause of death, rather than any considerable extension of the primary growth or multiplication of secondary deposits.

Duration of Life.

I need not multiply examples of types of cancer in which much of the suffering and many of the deaths largely or in part result from septic processes arising from the primary growth, but would compare with these such cases as periosteal sarcoma of bone, where ulceration is rare and the patients die of secondary growth. Or cases of carcinoma of the liver, where, although wasting may be extreme, the patient never gets into the dreadful condition found in uterine cancer, for example; because here there is no sloughing, and therefore none of the awful fetor and sepsis that accompany it.

In the former cases the patients have suffered and have died from sepsis and its concomitants rather than from cancer, and I am convinced that this is wrong and a reproach to modern surgery. Surely with all the methods now at our disposal such clinical histories and such deaths should not be possible. Few patients should be permitted to die of the primary growth alone; the number of secondary deposits ought to be in direct proportion to the excellence of our treatment, as they certainly are to the duration of the disease. I collected some figures which are of interest in this connexion; they are rough averages, but they serve to illustrate my point.

The average life of cases of cancer of the tongue, from first to last, when no surgical treatment is attempted, is fourteen months; the number of these cases in which metastases are found in internal organs is only 6 per cent.

The average total duration of cancer of the cervix uteri is twenty-one months. The percentage of secondary deposits in distant glands or internal organs is 15 to 20 per cent.

The total duration of cancer of the lip is twenty-four months, and the percentage of deposits in the lungs and elsewhere rises to 25 per cent.

While in cancer of the breast, with a total average life of three and a half years, the number of deposits is no less than 50 to 60 per cent.

It is very clear that with the increase in the average duration of life there is a corresponding rise in the number and complexity of the metastases; and this, I think, shows that a patient suffering from incurable cancer who dies with no secondary deposits, dies too soon by several months. I believe that life should and can be prolonged in many cases by palliative operations on the primary growth.

Cases are too few to enable me to give statistical results of palliative operations, but it is fair to draw deductions from cases in which ordinary operations have been carried out for disease which has recurred and ultimately killed the patient—that is to say, cases which, strictly speaking, were inoperable at the time of operation.

In cancer of the tongue, as already mentioned, the average life was fourteen months in cases not operated upon. In cases in which operation had been carried out, but where recurrence had killed the patient, it was seventeen months. A small gain, it may be said. But a far greater gain than is at first sight apparent, for no less than 44 per cent. of these cases remained absolutely free from any sign of recurrence within the month. Think what this means. Not only was life prolonged three months, but what a difference in that life—on the one hand, the intolerable misery of primary cancer within the month; on the other, the comparative comfort of secondary cancer in the glands or elsewhere.

In the case of the breast a much greater difference is found: Non-operated fatal cases, three and a half years; operated fatal cases, six years.

But mere prolongation of life is not my plea; it is increased comfort, or rather some diminution of the dreadful misery of inoperable cancer, that should be aimed at; and there are many types of cancer in addition to those already referred to that lend themselves to palliative operation. I may mention the excision of a large and painful sarcomatous testicle, even in face of irremovable abdominal metastases; the amputation of a limb rendered useless and unwieldy by inoperable periosteal sarcoma; the excision of a portion or the whole of the stomach in spite of the presence of infiltrated portal glands; the removal of the upper extremity when affected with the "brawny oedema" of breast cancer, or the performance of ovariectomy for cancer of the ovary even when wide abdominal metastasis indicates not far distant death.

Objections to Palliative Operations.

One of the criticisms levelled against these operations undertaken in cases in which death from the condition for which we operate must finally be inevitable, is the rather selfish one—that they are likely to lower the prestige of the art of surgery and of the surgeon who undertakes them.

This argument loses much of its force when it is remembered that the opinion of the general public as regards the surgical treatment of cancer could scarcely be less favourable. There is hardly a layman of my acquaintance who does not or who did not believe that "cancer always comes back after operation."

Even the most intelligent members of the general public will not realize that, generally speaking, it is only the unsuccessful cases that they hear about. Patients do not reveal the fact that they are suffering from or have been operated upon for cancer until concealment is no longer possible, with the result that the public hear little or nothing of the considerable proportion of cases—a proportion daily increasing and probably not less than 40 to 50 per cent.—in which early operation is followed by apparent cure. For this lack of knowledge—for which we ourselves are no doubt in part to blame—the public have to suffer. When they realize that every chronic ulcer and every painless swelling arising anywhere in the body of a person over the age of 35 years is much more likely to be cancer than anything else, and when they realize that in early and complete operation lies their only chance of cure, then the operative surgery of malignant disease will be able to

show far better results than a proportion of 40 per cent. of cures.

Another matter for consideration is the surgeon himself. No surgeon cares to be associated with unsuccessful cases, but, none the less, we all have to be. But these cases are not unsuccessful. We set out to do a certain thing, after explaining its exact objects and limitations to the patient or the patient's friends, and we do it. We offer relief from the most distressing of the symptoms during the last remaining months of life, and we obtain it. This is success, not failure; and it is rare, indeed, that the patient is not grateful for what has been done.

What other arguments are adduced against these incomplete operations? What are their disadvantages?

It has long been held—every textbook teaches—that incomplete operations are dangerous and should never be performed; yet, in dealing with so-called operable cases, we pay no attention to this belief, although we know full well that a large percentage of our cases will recur locally. That is to say, our operations will turn out to have been incomplete.

It is true that operation occasionally seems to cause widespread diffusion of cancer, possibly from mechanical interference with the tissues, just as generalized infection is sometimes met with after operations for surgical tuberculosis. But there is no clear evidence that this rapid diffusion of growth is more frequent after operation in so-called inoperable cases than it is after operation in the early cases, and I therefore think that it is not a matter of importance. It is also said that local recurrence takes place quickly after these partial operations, and that the last state of the patient is worse than if nothing had been done at all. Local recurrence takes place in a certain proportion of cases after any kind of operation; but even in these cases, when recurrence takes place comparatively early, I do not believe that the condition of the patient is as bad as it would have been by that time, supposing no operation had taken place at all; and no one can deny that in many cases local recurrence never takes place at all—the patient dying a merciful death from visceral deposits after several or even many months of comparative comfort.

Advantages of Palliative Operations.

The advantages to be gained by these procedures can best be illustrated by showing you some cases in which they have been carried out.

CASE I.

When I first saw this patient there was a large ulcerated growth in the lower and inner quadrant of the breast, and extensive involvement of the axillary glands. The growth, which is well shown in the photograph (see p. 779), was fixed to the sternum, and the case was obviously one in which radical operation could not be attempted, particularly as Dr. Knox was able to demonstrate the presence of a mass of secondary growth within the mediastinum. The patient was quite unable to carry out her duties, and I accordingly performed a limited operation six weeks ago. The patient looks and feels comparatively well, and she is, of course, very pleased with the result. Even should local recurrence take place to-morrow, I believe she would still think that the comfort of the last few weeks had been well worth the pain and discomfort of the operation. The advantages gained in this case, which may be taken as a type, are obvious. The patient is freed from the mechanical discomforts occasioned by the mere mass of the growth; she is relieved of the necessity of constantly dressing the ulcerated surface; she is free from offensive odour; she is no longer being poisoned by septic absorption; and, for a little while at any rate, she will be able to continue her occupation as a machinist. In this case we demonstrated a deposit in the mediastinum, probably arising in the mediastinal glands. Such deposits extend rather slowly, I believe, and therefore, although the duration of this patient's life is very definitely limited, yet I think that she has several months to live, and it seems possible that during those months she will have no local recurrence.

CASE II.

The next patient came to me over two and a half years ago from another hospital where an operation was thought to be inadvisable owing to the extent of the disease. There was a very large tumour which had broken down on the surface, and was adherent to the pectoral muscle and to the ribs. The ulcerated mass completely prevented the patient from following her occupation as a monthly nurse, and I accordingly operated upon her. The wound quickly healed, and she returned to her work, which she has done ever since without much difficulty. Five months ago I found evidence of recurrence in the ribs and sternum; but the skin is still intact, although

there is a considerable mass in the chest wall. This patient has had two years at least of complete relief, and considering the condition she was in before I operated upon her, I think the result is highly satisfactory.

CASE III.

This patient was admitted to the hospital last May with a pelvic tumour, and much free fluid in the abdomen, which was much distended. When I opened the peritoneum several quarts of slightly blood-stained fluid escaped, and I found a solid malignant tumour of each ovary with numerous secondary nodules scattered throughout the peritoneum, including one the size of a fist in the mesocolon. In spite of these secondary deposits I determined to relieve the woman of the two large ovarian masses. She made a good recovery, and even now—nine months afterwards—she gets about quite well, whereas she was previously completely incapacitated. There is no actual evidence of any recurrence of the ascites, but the patient states that she thinks her abdomen has been getting a little bigger lately.

CASE IV.

The next patient was admitted to the hospital for a recurrence in the axilla, following upon amputation of the breast many years ago. The arm was in the condition of brawny oedema, and the poor woman suffered such acute pain that my colleague Mr. Swan performed interscapulo-thoracic amputation—removal of the limb with the scapula and the outer half of the clavicle. She is now quite free from pain and very grateful for the relief that she has obtained, although she bitterly complains that she can still feel the fingers of the amputated limb. It is not often that cases present themselves in which this operation is feasible, but when they do I think there should be no hesitation in performing it, for although the mutilation is great, the relief conferred is worth it.

CASE V.

(Mr. Rowntree next showed a specimen of sarcoma of the uterus, in which he had performed a very incomplete operation with considerable benefit.) The patient was admitted under the care of Mr. Ryall with intestinal obstruction and a large fixed pelvic tumour. In Mr. Ryall's absence I opened the abdomen and found a huge malignant growth of the body of the uterus, which had become cystic and was suppurating. The mass was adherent to and was obstructing the pelvic colon, and during manipulation the suppurating cavity burst and free bleeding took place. There seemed to be nothing to do but to attempt to remove the tumour as far as possible, and this I did, but had to leave large masses of growth which were infiltrating the pelvic cellular tissues. The patient was very ill for two or three weeks, but ultimately left the hospital soundly healed, with the prospect of some weeks at least of comparative comfort. I have not been able to ascertain the ultimate fate of this patient.

The tumour is very interesting, for it proved to be a small spindle-cell sarcoma. A good deal of it has been cut away in order to display the curious lobulated arrangement of the growth within the uterine cavity. Slender outrunners of the tumour have penetrated the large veins in the manner so typical of this form of sarcoma.

Palliative Operations on Secondary Deposits.

It does not always happen that it is the primary growth that causes the most suffering, and very occasionally the removal of secondary deposits gives much relief although the primary growth cannot be interfered with.

Last summer a patient was admitted to the chronic wards, under the care of Mr. W. Ernest Miles, with a diagnosis of inoperable abdominal carcinoma. It was found that there was a large pelvic tumour with much free fluid. As Mr. Miles was away, I opened the abdomen, and discovered a large solid tumour springing from each ovary. I recognized that they were probably of metastatic origin, and, after removing them, explored the abdomen for the primary growth. Rather to my surprise—for there had been no gastric symptoms—I found a large mass involving the greater curvature of the stomach, and so extensive as to be quite irremovable.

The patient made a good recovery and left the hospital very much relieved, to die three months later of the stomach condition.

Selection of Cases for Palliative Operations.

It must not be supposed from what has gone before that such operations as I have described are to be recommended in each and every case, irrespective of the extent and nature of the disease. Far from it; for each case requires most careful consideration in the light of a full knowledge of the natural history of the particular type of cancer concerned.

Such knowledge is not at present to be got from textbooks. It is only to be obtained, I believe, by constant observation of the disease in all its stages in some institution such as this, and by constant attendance in the post-mortem room. Experience so gained is of the greatest possible value when attempting to form an estimate of the probable routes of extension of the disease, and of the probable duration of life.

Mr. Rowntree showed a patient with two large cutaneous masses in the axilla following upon amputation of both breasts some two years ago. It might be thought that such a condition

was suitable for a palliative operation, but experience proved that deposits of this particular kind grew very slowly, and took a long time to break down. Moreover, when ulceration occurred it was superficial, and occasions no especial suffering. But there was more than this. Dr. Knox's beautiful instantaneous radiogram showed that there was an irregularity in the outline of the liver pointing to a deposit there, and distinct evidence of a mass of secondary growth at the root of each lung.

These thoracic deposits would terminate the story long before the axillary masses had commenced to give very much trouble; and there was, therefore, no indication or justification for an operation of any kind.

A skiagram was shown of a patient who came with a large inoperable growth on the face which was about to ulcerate. The question of palliative operation was considered in order to relieve the patient of some of the discomfort that the inevitable breaking down of the growth would occasion. Dr. Knox took a skiagram, in which it was seen that each lung was studded with nodules of secondary growth, which must cause death within so short a time that an operation would serve no useful purpose.

These skiagrams, so far as I am aware, are among the first in which secondary deposits within the chest have been demonstrated, and the information that Dr. Knox is able to obtain for us is of the very greatest assistance in our work.

This is the evidence in favour of the performance of limited operations for the alleviation of incurable cases of cancer. I am aware that it is very fragmentary, and I believe that any one with larger experience would have been able to put a very much more convincing set of facts before you; but, so far as it goes, I think it shows, first of all the kind of cases in which a limited operation is desirable, and secondly, what benefit can be obtained by such an operation.

I hold the opinion very strongly indeed that at present we do not do enough for our cases of advanced cancer, and I am convinced that the immediate future holds out a good deal of promise as regards the palliation of this miserable condition. An important preliminary to this should, I think, consist in the banishment of the dreadful sense of hopelessness and finality that the present usage of the word "inoperable" creates.

It is perhaps hardly necessary to refer to the question of diagnosis; but it is important to make quite certain first of all that the case is cancer, and secondly, that it is

CASE I.

inoperable. Every method of examination and every means of diagnosis must be exhausted.

Soon after I began to be specially interested in cancer I made a necropsy upon a case that had been diagnosed and treated and allowed to die as inoperable cancer of the uterus. At the *post-mortem* examination I found the vagina greatly distended by a huge growth which was attached to the cervix uteri by the narrowest possible pedicle. If the patient had been examined under an anaesthetic the condition of affairs would have at once been obvious, and she could have been completely cured by the most simple operation.

Technique.

In connexion with the technique of these operations, there are several points of importance. First and foremost, it must be remembered that a radical operation is not being attempted, and that methods that would be adapted to a radical operation are quite out of place. In the case of the breast, for instance, there is no necessity for wide sacrifice of skin, no reason for extensive undermining of the flaps, and often no indication for removal of the pectoral muscles.

It suffices to remove the breast with all obvious growth as far as possible. The wound is then covered in with thick, healthy flaps, which will not be penetrated easily by any growth that may have been left behind in the chest wall. Difficulties with the flaps may, of course, arise when the growth is very large or when it is in an unusual position, but this is exceptional. In breast cases I lay great stress upon thickness of the flaps, as I am convinced it is a safeguard against efflorescence of the growth later in the disease.

The same rule holds good, where possible, in dealing with other sites. For instance, in amputating a leg for inoperable sarcoma of the tibia or lower end of the femur, the line of section should be just above the growth, not necessarily at the hip-joint, for obviously it would be absurd to perform such a serious and such a crippling operation as amputation at the hip-joint for a condition in which cure is absolutely out of the question. Again, in cancer of the tongue, a simple Whitehead operation—the mortality of which is very low—is all that is indicated in those cases where radical measures are not possible. I might multiply examples; but there is no object in doing so, so long as the main principle is remembered: that what one is aiming at is the removal of a maximum amount of disease with a minimum disturbance of healthy tissues.

In all these operations there are two dangers that must be carefully guarded against. One is septic infection of the wound, and the other infection of the wound with cancer cells. The danger of septic infection arises from the fact that ulceration is usually present. Organisms permeate not only the tissues of the growth itself, but are also present in the lymphatics draining the area. It therefore follows that even if infection from the surface be avoided, it may yet arise from the organisms in the deeper tissues. When the ulceration is of small extent the application of tincture of iodine, followed by a layer of collodion, will efficiently guard against any danger arising from this source. When the ulcer is more extensive it is perhaps wiser to go over the surface with the actual cautery immediately prior to the operation. In the later stages of the operation it is well, I think, to flush very thoroughly with warm saline solution, which mechanically removes any organisms lying in the wound. Antiseptics I never use for this purpose, because I believe that they do more harm than good by lowering the vitality of the tissues. The wound should be carefully dried before it is closed, and ample drainage should be provided for.

The danger of cancer infection is more difficult to guard against, for, as my senior colleague, Mr. Charles Ryall, has pointed out, cancer cells may easily be disseminated in a wound and give rise to little deposits of secondary growth, even in stitch holes or the openings for drainage tubes. Copious flushing of the wound and the avoidance of too much handling of the tissues are probably the best means we have of reducing this danger to a minimum.

The opening of the winter session at the Leeds School of Medicine on October 1st will be marked by the delivery of an address by Professor Sherrington, F.R.S., Holt Professor of Physiology at the University of Liverpool.

THE REACTION OF THE BLOOD SERUM AS AN AID TO THE DIAGNOSIS OF CANCER.

BY

W. D. STURROCK, M.A., M.D.(OXON.).

A PAPER published by Moore and Wilson⁶ in 1906 gives the results of their estimations of the alkalinity of the blood serum of cancer patients, as compared with that of healthy persons and of patients with other diseases.

The estimations determined the reactions (1) of the serum to phenolphthalein, (2) of the serum to dimethyl,* (3) of the inorganic salts of the serum to dimethyl. The phenolphthalein results were negative, but the dimethyl results indicated a definite increase in the alkalinity of the serum of cancer patients.

Moore and Wilson were led to this research by the hypothesis which Moore and his collaborators^{4,5} had suggested to explain results obtained in previous research on the amount of free HCl in the gastric juice of patients with cancer of any part of the body. They had found that the free HCl was as definitely reduced in cancer of other parts of the body as in cancer of the stomach,† and therefore concluded that the well-known reduction in this latter condition could not be due to local causes, but might, in common with the reduction in other cases be due to "a change in the concentration in hydrogen ions in the plasma and lymph."

It is at once evident that if a definite increase in the alkalinity of the serum can be detected in persons with cancer a valuable aid to diagnosis is secured, and the present paper represents an attempt to determine whether the reaction will lend itself to clinical work. West Watson¹² has published the results of a similar attempt, and his work certainly appears to justify the hope that diagnosis may be helped. I have, however, seen no further records of work on the subject. Moore and Wilson only touched incidentally on the possible clinical value of their work.

Moore and Wilson's second method—estimation of the reaction of the whole serum to dimethyl—appeared the most simple, and therefore, if applicable, the most desirable; the third method—estimation of the reaction of the inorganic salts of the serum—involves processes of evaporation and incineration, and is therefore, *ceteris paribus*, less well adapted to clinical purposes. It still remained, however, if the selected method proved inapplicable, and it must be mentioned that Moore and Wilson had themselves noted it as, perhaps, the more accurate.

It must be remembered that physical methods are at present of little value in determining the comparative reactions of complex physiological fluids such as the serums of different persons; serum is neither measurably alkaline nor measurably acid to such methods. Methods of colour titration, at the same time, have two noticeable drawbacks: (1) The estimations are purely comparative, and no attempt can be made to determine absolute values. The turning points of the different indicators have very different relations to true neutrality, and they are even more widely separated with physiological fluids than with solutions containing free acid or alkali; blood serum is acid to phenolphthalein and alkaline to dimethyl. (2) The colour changes (with blood serum) are so gradual that it is impossible to determine any definite point of change in an ordinary titration; all that appears possible is to mix samples of serum with samples of acid or alkali of different strengths, and determine what strength of acid or alkali is needed to turn the indicator employed.

The results given in this paper make no attempt to show the absolute reactions of the given serums, but merely to show that some serums are *more alkaline* to dimethyl than others.

Technique.—Any improvement in technique is obviously of definite value; the method here described is based on that of Moore and Wilson, but contains several modifications which, I believe, increase its clinical value. I examined many cases by Moore and Wilson's method, but found definite results so difficult to obtain that I was driven to try and alter the technique.

* Dimethyl-amido-azo-benzene.

† This work has been criticized by several writers, notably by Copeman and Hake,¹ to whom Moore⁷ has replied. The latter's work has also been supported by Morton Palmer,⁸ and others.