- ⁷ Stern, K., Goodman, H. S., and Berger, M., *Journal of Immunology*, 1961, 87, 189.
- ⁸ Race, R. R., and Sanger, R., *Blood Groups in Man*, 5th edn., Oxford, Blackwell Scientific Publications, 1968.
- ⁹ Woodrow, J. C., *Series Haematologica*, 1970, 3, 3.
- ¹⁰ Mollison, P. L., *Blood Transfusion in Clinical Medicine*, 4th. edn. Oxford, Blackwell Scientific Publications, 1967.
- ¹¹ Renkonen, K. O., Seppälä, M., and Timonen, S., *Journal of Medical Genetics*, 1968, 5, 123.
- ¹² Rochna, E., and Hughes-Jones, N. C., *Vox Sanguinis*, 1965, 10, 675.
- ¹³ Murray, S., *British Journal of Haematology*, 1957, 3, 143.
- ¹⁴ Renkonen, K. O., and Timonen, S., *Journal of Medical Genetics*, 1967, 4, 166.
- ¹⁵ Woodrow, J. C., and Donohoe, W. T. A., *British Medical Journal*, 1968, 4, 139.
- ¹⁶ Kleihauer, E., Braun, H., and Betke, K., *Klinische Wochenschrift*, 1957, 35, 637.
- ¹⁷ Jakobowicz, R., Crawford, J., Graydon, J. J., and Pinder, M., *British Journal of Haematology*, 1959, 5, 232.
- ¹⁸ Owen, R. D., Wood, H. R., Ford, A. G., Sturgeon, P., and Baldwin, L. G., *Proceedings of the National Academy of Science (Washington)*, 1954, 44, 420.
- ¹⁹ Mayeda, K., *American Journal of Human Genetics*, 1962, 14, 281.
- ²⁰ Nevanlinna, H. R., and Vainio, T., in *Proceedings of the Eighth Congress of the International Society of Blood Transfusion*, Tokyo, 1960., ed. L. Holland, p. 281. Basel, Karger, 1962.
- ²¹ Chown, B., *Vox Sanguinis*, 1968, 15, 249.
- ²² Woodrow, J. C., et al., *British Medical Journal*, 1971, 2, 610.
- ²³ Finn, R., *British Medical Journal*, 1960, 1, 797.
- ²⁴ Combined Study from centres in England and Baltimore, *British Medical Journal*, 1966, 2, 907 and *British Medical Journal*, 1971, 2, 607.
- ²⁵ Roberts, G. F., *Comparative Aspects of Haemolytic Disease of the Newborn*, London, Heinemann, 1957.
- ²⁶ Franks, D., *Annals of the New York Academy of Science*, 1962, 97, 235.
- ²⁷ *Cambridge Daily News*, 20 August 1966.
- ²⁸ Mackay, W. D., *British Journal of Cancer*, 1966, 20, 434.
- ²⁹ Mathe, G., *British Medical Journal*, 1969, 4, 7.
- ³⁰ Scott, J. S., *American Journal of Obstetrics and Gynecology*, 1962, 83, 185.
- ³¹ Scott, J. S., *Lancet*, 1968, 1, 865.
- ³² Azar, H. A., *Cancer*, 1962, 15, 66.
- ³³ Iliya, F. A., Williamson, S., and Azar, H. A., *Cancer*, 1967, 20, 144.
- ³⁴ Ben-Hur, N., Robinson, E., and Neuman, Z., *Lancet*, 1965, 1, 611.
- ³⁵ Bagshawe, K. D., Rawlins, G., Pike, M. C., and Lawler, D., *Lancet*, 1971, 1, 553.
- ³⁶ Lawler, S. D., Klouda, P. T., and Bagshawe, K. D., *Lancet*, 1971, 2, 834.

Clinical Problems

Rehabilitation of the Elderly Lower-limb Amputee

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Introduction

About 4,500 new patients are referred each year to the limb-fitting centres of England and Wales after lower-limb amputation and a further 500 are referred after amputation of an upper limb. The prosthetic fitting and subsequent training in most cases are managed on an outpatient basis.¹

Chilvers and Browse² have shown that in order to settle their social problems a high proportion of lower-limb amputees tend to occupy general surgical beds, which are not equipped for the length of stay needed to achieve limb fitting. When the Oxford Artificial Limb and Appliance Centre was opened in September 1968 it was proposed that amputees from the Oxford region whose social and medical background presented problems in prosthetic fitting and usage should be admitted to Mary Marlborough Lodge, the 18-bedded disabled living research unit in the Nuffield Orthopaedic Centre, to which the Artificial Limb and Appliance Centre is physically linked. Thus prosthetic fitting at the appliance centre can be integrated with the comprehensive rehabilitation programme organized in Mary Marlborough Lodge. Since 1968 this proposition has been implemented, and Mary Marlborough Lodge has been admitting about 100 amputees each year.

Patients have been admitted initially for assessment and training at the time of provision of their preliminary pylons and again, if indicated, at the time of issue of their definitive limbs. To evaluate the effect of such inpatient training, to clarify the indication for future admission, and to establish the types of problem being handled we decided to carry out a survey and follow-up on some of the amputee patients who had

been admitted to Mary Marlborough Lodge from September 1968 to December 1969 inclusive. The survey was limited to the 50 patients who during this time were admitted to the unit for fitting, issue, and mobility and independence training with primary rocker pylons after lower-limb amputation.

Patients

During the period under review 149 lower-limb amputees were referred to the appliance centre. Two-thirds of these patients were in the geriatric age group (70% were over 60 years old and 50% were over 70 years old), and nearly three-quarters had their amputation because of vascular insufficiency (Tables I and II).

TABLE I—Age Distribution of Patients admitted to Oxford Artificial Limb and Appliance Centre during September 1968 to December 1969

	Age in Years							Total
	<30	30—	40—	50—	60—	70—	≥80	
No. of patients	9	3	9	13	32	47	25	149

TABLE II—Reason for Amputation in the 149 Patients

Vascular insufficiency	82	Chronic infection	5
Vascular insufficiency with diabetes ..	28	Congenital deficiency	2
Trauma	9	Unknown	15
Malignancy	8		

Altogether 50 (33%) of these patients (36 males and 14 females) were admitted to the disabled living unit during the period under consideration. An analysis of the remaining 99 patients (66%) who were not admitted is given in Table III. Of the 50 patients reviewed 10 were double amputees admitted for the first fitting of the short rocker pylons, after the amputa-

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tion of the second leg (Table IV), and 40 were single amputees admitted for the primary fitting of a pylon. Eight of the 10 double amputees and 29 of the 40 single amputees were over 60 years of age.

TABLE III—Details of 99 Patients seen for First Time at Oxford Artificial Limb and Appliance Centre during September 1968 and December 1969 and Not Admitted to Mary Marlborough Lodge for Initial Fitting of Pylon and Walking Training

	No.
Not available for analysis (died before attending, transferred to other regions, unsuitable for limb fitting)	15
Double amputees:	
Died before limb fitting	4
Short rocker pylons issued and returned to other hospital for training	2
Unsuitable for limb fitting	3
Single amputees issued with pylon and referred to own hospital for walking training	75
Definitive limb not delivered	5
Definitive limb not ordered	11
Died within follow-up period	27
	43

TABLE IV—Details of 40 Single and 10 Double Amputees

	Single	Double	Total
Type of amputation			
Hind quarter	1	0	1
Above-knee	23	5	28
Gritti-Stokes	7	1	8
Through-knee	2	0	2
Below-knee	9	3	12
Syme's	1	0	0
Above-knee/below-knee	0	1	1
Time to follow-up			
18 months	4	1	5
19-24 months	19	3	22
Over 2 years	14	1	15
Died	3	5	8
Cause of amputation			
Vascular insufficiency	28	7	35
Vascular insufficiency and diabetes	6	3	9
Infection (chronic osteomyelitis)	2	0	2
Malignancy	3	0	3
Trauma	1	0	1

GENERAL STATE ON ADMISSION

In an assessment of the general condition of the patients at the time of admission to the disabled living unit only nine were classified as "good" and the remainder as "fair" or "poor."

Though physical and mental symptoms of a wide variety of diseases contributed to the diminished functional efficiency of some patients, symptoms relating to dysfunction of the cardiovascular system were the most frequently occurring and of the greatest importance in their effect on the rehabilitation of any amputee. Thus in patients with amputations for vascular conditions the efficiency of the cerebral circulation, the cardiac circulation, and the peripheral circulation to the contralateral limb were the most decisive factors in determining whether or not a patient made good use of his prosthesis.

A total of 38 patients (76%) had a history or clinical evidence of respiratory or cardiovascular disease, and there was clinical evidence of impairment of the circulation in the remaining leg in 24 of the 40 single amputees.

CONDITION OF STUMP ON ADMISSION

The stump itself was recorded as being "poor" in only seven patients, but a further 24 were recorded as being only "fair." Many conditions were recorded on admission to Mary Marlborough Lodge that affected the stump adversely, the commonest problem being that of delayed healing, with or without wound infection. But phantom pain, poor stump shape, persistent stump oedema, and flexion contractures at the joints proximal to the stump were all present in significant numbers (Table V).

TABLE V—Condition of Stump on Admission to Mary Marlborough Lodge likely to interfere with Limb Fitting and Walking Training

Delayed healing	14	Wound infection	5
Flexion contracture	12	Tenderness	4
Phantom pain	10	Stump too short	3
Poor stump shape	7	Haematoma	1
Ischaemic stump pain	6	Extensive scarring	1
Oedema	6		

Programme of Treatment

There are four main objectives in admitting patients to the disabled living unit immediately their pylon is ready: (a) to give the limb fitter the optimum conditions for fitting the appliance, (b) to give the patient his prosthetic training under conditions which can be varied to suit his individual needs and capabilities, (c) to review the patient clinically and functionally, and (d) to co-ordinate the patient's rehabilitation.

Initial admission is arranged as soon as the patient's condition allows and the referral is made. This is often three to four weeks postoperatively and follows an earlier outpatient attendance at the appliance centre for clinical examination and measurement for the prosthesis. During the first admission period, which usually lasts two weeks for single amputees and up to four weeks for double amputees, patients take delivery of their pylons and have a medical examination, a functional examination by occupational therapists, and a programme of exercise and walking training supervised by the physiotherapists.

Close collaboration between physiotherapist and limb fitter enables most patients to have three or four walking training sessions every day, even though modifications are being carried out to the pylon. Three or four short walking sessions have been found to be more suitable than two long ones, particularly for geriatric or debilitated patients or for patients with cardiovascular diseases. Walder³ clearly showed that in patients with peripheral vascular disease blood flow may stop completely during walking but may be increased after activity. Frequent rests are therefore essential for such patients, with a temporary break in walking training if exhaustion or discomfort is experienced. The advantages of inpatient walking training become particularly apparent in these circumstances. Time is not the critical factor which it is in the case of outpatients, when ambulance schedules must be met.

As the stump is shaped and strengthened by exercise with the pylon the pylon socket is modified or lined to compensate for its altered shape. Based on the combined reports of medical, nursing, and paramedical staff (including medical social workers) the activity potential of each patient is assessed, appropriate independence training given, and necessary equipment supplied or prescribed. This supplements the limb fitting and initial instruction already given by the medical officer and prosthetists at the appliance centre.

When the patients are discharged a summary of these reports and of the patients' achievements is sent to all those concerned with their medical and sociomedical care.

To enable patients to live at home with minimal inconvenience the equipment most frequently recommended is: (a) raised W.C. seats or appropriate commodes, (b) sheepskins to sit and lie on, (c) appropriate wheel-chairs, and (d) minor structural modifications to patient's homes—most commonly the installation of ramps and rails, particularly balance rails, grab rails in lavatory and bathroom, and extra bannister rails. Occasionally rehousing has been recommended when neither the prescription of equipment nor the alterations mentioned could counteract unsuitable home conditions. The location and accessibility of the lavatory, the availability of free floor space, and the presence of adequate downstairs sleeping accommodation, or easily negotiable stairs, have been important factors influencing such recommendations.

To ensure mobility outside the home patients with transport difficulties have been referred to the appliance centre for con-

sideration of their *capability* to drive and *eligibility* for Ministry assistance or for expert advice on the conversion of their own cars when their clinical condition has permitted. When the definitive limb is supplied further admission is arranged for final fitting and training in its use.

Failure to Complete Fitting and Walking Training

Walking training was either not started or stopped within a few days of admission on six occasions. Four patients had to be returned to the referring hospital without starting training and in two other instances the patient was unable to continue the training. Of the six whose rehabilitation was stopped two died within the follow-up period and three were still confined to wheel-chairs. The one "successful" patient within this group had a wound infection and learnt to walk well on a definitive artificial limb when the infection cleared.

Immediate Effect of Rehabilitation

Use of Prosthesis.—The general acceptance of the pylon was good. By the time of discharge the majority of patients were able to tolerate the appliance for most of the day, to put it on and take it off with little assistance, to walk a reasonable distance (20 to 50 yards; 18 to 45 metres) on the flat, manage a gentle slope, go up and down a few steps, and walk a short distance out of doors.

General Self-care and Independence.—Most patients at the time of discharge could manage their necessary activities of daily living (washing, dressing, toilet, and feeding) and the essential transfers on and off chair, bed, and toilet.

Delays in Limb Fitting and Walking Training

Eleven single amputees and four double amputees in this series were referred for walking training more than three months after amputation (Table VI). Delays in rehabilitation are frequently associated with poor results and it is therefore important to analyse the reasons for delays in referral. It is

TABLE VI—Time from Amputation to Admission to Mary Marlborough Lodge

	Single Amputation	Double Amputation	Total
Less than 4 weeks ..	5	1	6
4 to 6 weeks ..	7	1	8
6 weeks to 3 months ..	17	4	21
3 months to 6 months ..	3	2	5
Over 6 months ..	8	2	10
Total	40	10	50

TABLE VII—Reason for Delay over Three Months before Primary Limb Fitting and Walking Training

Single Amputees	
4 ..	Over 80 years and confused. No walking training achieved
7 ..	Operated on outside region. Contralateral hemiplegia
8 ..	General poor condition. Ipsilateral hemiplegia. Did not achieve walking training
21 ..	Further ipsilateral higher amputation before referral
30 ..	Ipsilateral hemiplegia two weeks after amputation
31 ..	Recurrent ipsilateral strokes. Confused on admission. No walking training achieved
35 ..	Traumatic amputation. Much skin grafting before referral
41 ..	Severely ill before amputation. Severe sacral pressure sores. Very poor stumps
48 ..	Acute cardiac failure postoperatively. Delayed wound healing and stump infection
50 ..	Malignancy. Postoperative radiotherapy
Double Amputees	
12 ..	Stormy postoperative course
36 ..	Delayed wound healing. Poor general condition. Phantom pain. Severe depression
42 ..	Aged 79. Poor general condition. Chronic bronchitis and emphysema
51 ..	Delays mainly due to industrial dispute

interesting to note that the delays were almost all associated with the general clinical status and the postoperative course of the patient (Table VII) and that there was a general tendency in the Oxford region to refer patients early to the appliance centre. We should now regard any period longer than four weeks postoperatively as representing an undue delay for limb fitting for the geriatric lower-limb amputee.

Condition at Follow-up

During the follow-up period the patients had attended the appliance centre as outpatients. Thirty single amputees and three double amputees had been fitted with "definitive artificial limbs" and some were readmitted to the disabled living unit for a further period of training. Eight patients had received only a pylon and one patient had a geriatric pylon. Eight patients had died. In only two patients had the decision to withhold definitive limbs been made and accepted.

A general assessment was therefore made of the overall level of activity of all the patients (Table VIII) and also an estimate of the maximum walking distance which they had achieved during the follow-up period.

TABLE VIII—Overall Status of the 50 Patients at Follow-up

Single Amputees (n = 10)	
Fitted with definitive limb used indoors and around the house ..	13
Fitted with definitive limb but minimal usage ..	8
Fitted with definitive limb and achieving good general use ..	5
Wheel-chair life only as a single amputee ..	5
Died ..	5
Became double amputee ..	4
Double Amputees (n = 10)	
Wheel-chair life only ..	4
Died ..	3
Fitted with definitive limbs but minimal use ..	2
Fitted with definitive limbs and achieving good use ..	1*

*A 45-year-old man with Buerger's disease.

"Minimal usage" of the prosthesis means that the patients wore the appliance for only part of the day or wore it only occasionally for assisted walking indoors with the aid of some suitable appliance—for example, when attending a hospital or day centre. The prosthesis was used only as equipment for exercise rather than as a substitute limb to increase the total functional activity of the patient.

"Reasonable usage" was considered to have been achieved by patients who were wearing their appliances in and around the house either all day or part of most days.

Those achieving "good general use" were able to walk more than 100 yards (91 metres), wore their artificial leg all day or for most of every day, and regularly went out of the house wearing and walking on their artificial leg.

It has been suggested that half of amputees die within two years and that half of the survivors lose the other leg during the following two years.⁴ Our survey was not quite so depressing, but fewer than half were leading active ambulant lives at follow-up, and the survivors clearly had a limited prognosis.

Wheel-chair Usage

There is much controversy about the issue and usage of wheel-chairs. Many clinicians and appliance medical officers regard the use of wheel-chairs as contraindicated in the early stages of rehabilitation after lower-limb amputation.

An elderly patient who has had a leg amputated owing to the severity of the disease of his peripheral vascular system has almost certainly a serious impairment of the circulation of the other leg. Clearly, then, the vascular status of this other leg must have an appreciable influence on the degree of activity attainable by such a patient. Though there is no available evidence to indicate the exact relation between the fitting and

use of the prosthesis in one limb and the onset of frank circulatory failure in the other limb it seems likely that such failure may be accelerated by undue activity. It is therefore essential to estimate the degree of activity which should be tolerated by the remaining leg and to regulate the rehabilitation activity of each patient accordingly.

The prescription of a wheel-chair for all geriatric amputees with peripheral vascular disease enables mobility to be maintained even when the condition of the contralateral limb restricts ambulation, and wheel-chair training should thus form an integral part of the rehabilitation training of such patients. Furthermore, most elderly patients have some additional locomotor or neurological condition which impairs their mobility or their balance or their ability to use sticks or walking aids. For the geriatric amputee the ability to walk again after lower-limb amputation is therefore by no means the inevitable consequence of prosthetic fitting. Without the availability of a wheel-chair most elderly amputees would never manage to go out of the house, and many others would restrict their moving around the house to the minimum.

This approach does not advocate active encouragement to resort to a wheel-chair life but a realistic approach to the most efficient means of achieving maximum independence and activity. Frequently the elderly amputee will be safer using a wheel-chair to reach the bathroom and the toilet and while dressing in the morning. The chair will also be used when going out of the house. And, finally, if provided with an appropriate wheel-chair with a suitable cushion the patient will always have available a chair of the right size and the right height which he can enter and leave independently; whereas once seated in many conventional armchairs he is often unable to get out without help.

In this survey all 10 double amputees and 23 of the 40 single amputees were issued with wheel-chairs. At the time of follow-up 26 (62%) of the 42 survivors were using a wheel-chair—17 the whole time (indoors and out of doors), 5 for part of the time indoors only, and 4 for part of the time out of doors only.

Mental Status

The mental status of any patient is an important factor in determining his rehabilitation potential. This factor is most often at risk in geriatric patients with cardiovascular insufficiency. Thus the forgetfulness of many patients with poor cerebral blood supply makes prosthetic instruction difficult, since they do not readily retain recently acquired facts.

Confusion, particularly in the early mornings, also occurs frequently in patients with cardiovascular disease and mitigates against successful prosthetic usage. Such confusion may be associated with hemiplegia or general arteriosclerosis. Since, however, this confusion may be intermittent or may improve as the patient's general condition improves it is essential to review at intervals those patients whose mental state immediately postoperatively has precluded successful prosthetic fitting and training.

It is important to differentiate between the confusion arising from a poor cerebral circulation and that arising from hypoglycaemia. A diabetic patient who has recently had a limb amputated may well be difficult to stabilize. Insulin or insulin-equivalent requirements will change as the stump heals and activity increases, and so will the composition and calorific value of the diet.

The psychological effects of pain, hospitalization, and amputation also contribute to the overall mental picture of the amputee, which is frequently one of depression. Such depression may be prevented to a large degree by adequate pre-operative and postoperative explanation and encouragement. When present, however, this condition needs rapid treatment and usually responds well to antidepressant medication, although skilled psychiatric help is sometimes necessary. Aversion to the prosthesis and dislike of self-image may also be

prevented by adequate psychological preparation before amputation and prosthetic fittings are undertaken.

In this study, seven patients were noticeably confused on admission to Mary Marlborough Lodge. At follow-up three of these had died and one was still confused. A further two patients had become confused.

Reactive depression was diagnosed in seven patients on admission. At follow-up two of these had died and five had greatly improved when seen at follow-up. Three other patients had become markedly depressed. Undue apprehension may be a symptom of depression and it was noted in eight patients on admission. Three patients were noted as lacking insight and one of these had become depressed at follow-up.

Psychological preparation for amputation is as important as physical preparation, and adequate treatment for reactive depression is essential as part of the total rehabilitation programme.⁵

Smoking

The relation between smoking and chronic bronchitis and vascular disease is now widely accepted.⁶ In this survey 39 (78%) of the amputees smoked regularly, and 30 (60%) had smoked more than 10 cigarettes a day for over 20 years.

Discussion

The rehabilitation needed by the elderly amputee differs greatly from that required by younger patients. These differences arise from four main causes: (a) the geriatric amputee is physically and intellectually less resilient and less efficient; (b) the geriatric amputee is almost invariably a lower-limb amputee with peripheral vascular insufficiency, and when the circulation of one lower limb becomes totally deficient that of the other one is usually tending to fail; (c) geriatric patients almost invariably suffer from multiple disorders, particularly of the cardiovascular and respiratory system; and (d) many of the geriatric patients present with social and domestic problems as well as clinical ones.

For these reasons it is not appropriate that lower-limb amputation in the geriatric patient should be followed by the automatic progression from pylon to definitive limb, which is customary with the younger amputee. Indeed, prosthetic fitting and usage plays only a part, and often a minor part in the total rehabilitation of the geriatric amputee, to which the approach must be multidisciplinary, gentle, and carefully monitored by clinical and social considerations. Although in Britain it is not customary to retain or admit patients to hospital for walking training after lower-limb amputation we feel that for the geriatric amputee such admission is essential.

During this survey we found that after a fortnight's stay in Mary Marlborough Lodge at the time of issue of their pylons, for independence and prosthetic training, most of the patients attained personal independence and reasonable mobility. Yet at follow-up few of the geriatric patients had substantially increased their range of achievements. Most of them were managing to live quietly at home, with a varying degree of assistance to maintain personal and domestic independence. Many of them made little use of the prostheses, and some did not use them at all.

For most of them their total degree of comfort was not simply a matter of the fit and mechanical performance of their artificial limbs but also of the way in which they had been trained to cope with a one-legged or legless existence, the amount and efficiency of the domestic and personal help they were receiving, the presence of essential equipment and minor structural alterations in their homes (and also the architectural layout), and their possession of appropriate aids to mobility (chair, crutch, stick, or frame) to enable them to move about inside and outside the house.

In short, the success of their lower-limb amputation as a treatment to provide a comfortable existence had depended on the accuracy of the initial assessment of their capabilities and the effectiveness with which the deficiencies in those capabilities had been supplemented. Admission to a rehabilitation unit geared to individual needs, at the time of issue of the preliminary walking pylon, enables such an assessment to be made and a realistic decision to be reached on the manner in which optimal mobility for each patient can be obtained.

The choice lies at present between wheel-chair life and the retention of the pylon (or a cosmetically acceptable development of the pylon) as the permanent prosthesis or the use of the pylon as a preliminary to the eventual use of a definitive limb. Not until this choice has been made by the combined decision of the medical and paramedical staff concerned in his care and its rationale has been demonstrated to the patient by his own performance can appropriate independence training and domestic reorganization be finalized. Such a decision, taken early in amputee life and subject to repeated review, would go a long way towards correcting the present concept of the geriatric amputee as an elderly patient to whom a prosthesis needs to be fitted and substituting that of an elderly patient whose potentially serious disability may be mitigated by a judicious combination of method training, prosthetic fitting, and the supply of suitable equipment.

Conclusions

From our experience during this survey and in the past three years we believe that the total problem of the geriatric amputee could be improved by: (1) better appreciation and application of preoperative and early postoperative physiotherapy to prepare the geriatric patient physically for amputation by strengthening muscles of which extra exertion will be required, in the stump, contralateral leg, and arms, and by prevention of flexion contractures; (2) more comprehensive psychological preparation for the mental trauma to which amputation gives rise; (3) better integration of prosthetic fitting and training with the total rehabilitation of the patient by his admission to an appropriate unit at the time of issue of the pylon for comprehensive assessment and walking and independence training; (4) better liaison between such a unit and the welfare services

responsible for patient care in the home, so that suitable social and domestic support will be forthcoming immediately he leaves hospital; and (5) greater readiness on the part of hospitals and limb centres to provide appropriate wheel-chairs and walking aids to geriatric amputees before discharge.

Amputation is frequently dismissed by surgeons as evidence of the failure of measures to maintain and improve the peripheral circulation, and this negative approach is often communicated to patients. The realization that amputation will herald the end of persistent pain or terminate a series of surgical procedures can only be impressed on a patient by careful and repeated explanation and will enable him to view the procedure in its true perspective. He will understand that as a part of a highly individualized rehabilitation programme amputation will help to ensure a limited but effective mobility, independence for all normal activities of daily living, and the ability to live at home in reasonable comfort, independence, and dignity.

This survey could not have been carried out without the unfailing and unstinted help of the staff of the Oxford Artificial Limb and Appliance Centre. Mr. G. R. Parry F.R.C.S., medical officer, has taught us much about the care of stumps and the technicalities of limb fitting. Mr. W. Francis, the manager, and his staff have reduced the problems of the administration and documenting aspects of the study to a minimum. We have been greatly helped and impressed by the interest and co-operation of the limb fitters, and our own staff of physiotherapists, occupational therapists, and nurses have continued to render exceptional service, often in very difficult circumstances. We are also indebted to the surgeons in the region who have all followed our experiment in rehabilitation with interest and encouragement. But above all we have been encouraged by the remarkable achievements of the patients when put into a situation of positive encouragement and active rehabilitation.

References

- ¹ Working Party of British Medical Association's Planning Unit, *Aids for the Disabled* (Report No. 2). London, British Medical Association, 1968.
- ² Chilvers, A. S., and Browne, N. L., *Lancet*, 1971, 2, 1192.
- ³ Walder, D. N., *British Medical Journal*, 1958, 1, 255.
- ⁴ Brodie, I. A. O. D., *British Journal of Hospital Medicine*, 1970, 4, 596.
- ⁵ Parkes, C. M., in *Proceedings of a Symposium on Pain and Disablement 1970*, ed. W. H. Bradley. London, National Fund for Research into Crippling Diseases, 1971.
- ⁶ Royal College of Physicians, *Smoking and Health Now*. London, R.C.P., 1971.

Clinical Endocrinology

The Hypothalamus

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Knowledge of the role of the hypothalamus has accumulated rapidly during the last two decades. Thus it is now apparent that this small area of the brain is an integrative centre for the neural control of pituitary function, temperature regulation, and food and water satiety, as well as taking part in the control of the cardiovascular system.

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Anatomy

The anatomical boundaries of the hypothalamus are not well defined, but anteriorly and below lies the optic chiasma and posteriorly its limits are the mammillary bodies and interpeduncular fossa. Laterally are the internal capsule and inferior part of the thalamus. Superiorly is the third ventricle; the lateral walls of the lower part of the ventricle form part of the hypothalamic area. Below, the hypothalamus extends downwards to join the pituitary stalk.

Embryologically, the hypothalamus, pituitary stalk, and posterior lobe of the pituitary are derived from an outgrowth