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REPORT OF THE COUNCIL FOR THE YEAR ENDED 31 MARCH 2000

The Council submits its report together with the audited financial statements for the year ended 31 March 2000.

Principal activity
The company uses the multidisciplinary approach of medicine, engineering and science to identify needs of disabled people and hospital patients not being met elsewhere and to provide solutions.

Council's responsibilities in respect of the accounts
Company law requires the Council to prepare accounts for each financial year which give a true and fair view of the state of affairs of the company and of the surplus or deficit of the company for that period. In preparing those accounts, the Council is required to:

—select suitable accounting policies and then apply them consistently

—make judgements and estimates that are reasonable and prudent

—follow applicable accounting standards, subject to any material departures disclosed and explained in the accounts

—prepare the accounts on the going concern basis unless it is inappropriate to presume that the company will continue in business.

The Council is responsible for keeping proper accounting records which disclose with reasonable accuracy at any time the financial position of the company and to enable it to ensure that the accounts comply with the Companies Act 1985. It is also responsible for safeguarding the assets of the company and hence for taking reasonable steps for the prevention and detection of fraud and other irregularities.

Auditors
R. S. Porter & Co. have expressed their willingness to continue in office and a resolution to re-appoint them will be proposed at the annual general meeting.

By order of the Council

J. A. Bursey
Honorary Secretary

15 May 2000

REPORT OF THE AUDITORS TO THE MEMBERS

We have audited the accounts on pages 32 to 34 which have been prepared under the historical cost convention and the accounting policies set out on page 31.

Respective responsibilities of the Council and Auditors
As described on this page the Council is responsible for the preparation of accounts. It is our responsibility to form an independent opinion, based on our audit, on those accounts and to report our opinion to you.

Basis of opinion
We conducted our audit in accordance with Auditing Standards issued by the Auditing Practices Board. An audit includes examination, on a test basis, of evidence relevant to the amounts and disclosures in the accounts. It also includes an assessment of the significant estimates and judgements made by the Council in the preparation of the accounts, and of whether the accounting policies are appropriate to the company's circumstances, consistently applied and adequately disclosed.

We planned and performed our audit so as to obtain all the information and explanations which we considered necessary in order to provide us with sufficient evidence to give reasonable assurance that the accounts are free from material misstatement, whether caused by fraud or other irregularity or error. In forming our opinion we also evaluated the overall adequacy of the presentation of information in the accounts.

Opinion
In our opinion the accounts give a true and fair view of the state of the company's affairs as at 31 March 2000 and of its surplus for the year then ended and have been properly prepared in accordance with the provisions of the Companies Act 1985 applicable to small companies.

R. S. Porter & Co.
Chartered Accountants and Registered Auditors
77/81 Alma Road
Clifton
Bristol BS8 2DP

15 May 2000

STATEMENT OF ACCOUNTING POLICIES

This statement of accounting policies forms part of the accounts.

(a) *Accounting convention*
The accounts have been prepared in accordance with the historical cost basis of accounting and in accordance with Statement of Recommended Practice No. 2 "Accounting by Charities".

(b) *Taxation*
No provision for taxation, deferred or otherwise, has been provided in these accounts as the Institute is a registered charity (registered number 256335) and is therefore exempt from taxation (other than Value Added Tax) under Section 505 of the Income and Corporation Taxes Act, 1988.

(c) *Assets received as donations*
No monetary value has been incorporated in the accounts in respect of assets donated to the Institute, other than those comprising cash and securities.

(d) *Cash flow statement*
No cash flow statement has been prepared as it is considered that no material benefit would be derived from such a statement.

(e) *Sponsored research*
Income from sponsored research is included only to the extent of direct expenditure incurred during the year and overheads relevant to that year.

(f) *Replacement of fixed assets*
Land and buildings are shown in the Balance Sheet at a written-down value and the original cost to the Institute is shown in the Notes to the Accounts. Other fixed assets are excluded from the Balance Sheet and their replacement is met from general income or specific grants made for the purpose of replacement.

(g) *Investments*
Dividends and interest from investments are credited to income on receipt and include the associated income tax credits.

Investments are shown in the Balance Sheet at the mid-market price quoted by the London Stock Exchange. Gains and losses on the revaluation and realisation of investments are credited to the Investment Fund in the Statement of Financial Activities.

(h) *Reserves*
The Council of the Institute exercises its discretion in the creation of reserves to meet future expenditure and in the utilisation of those reserves. The annual surplus on the Statement of Financial Activities transferred to the Accumulated fund is shown after making transfers to and from reserves.

(i) *Stocks*
No account is taken of stocks held by the Institute as these are immaterial.

STATEMENT OF FINANCIAL ACTIVITIES
Year Ended 31 March 2000

INCOME AND EXPENDITURE	Note	Unrestricted Funds £	Restricted Funds £	Reserve Funds £	Total Funds 2000 £	*Total Funds 1999 £*
INCOMING RESOURCES						
Donations		**159,245**			**159,245**	*153,855*
BBC 'Lifeline' appeal					**0**	*19,927*
Grants for sponsored research		**5,006**	**115,678**		**120,684**	*107,962*
Subscriptions		**362**			**362**	*372*
Interest	4	**54,409**			**54,409**	*53,814*
Consultancies, sales and royalties		**45,305**			**45,305**	*56,769*
Total Incoming Resources		**264,327**	**115,678**	**0**	**380,005**	*£392,699*
RESOURCES EXPENDED						
Direct expenditure on general activities:						
Salaries and wages	5	**179,065**			**179,065**	*157,653*
Materials and equipment		**58,608**			**58,608**	*39.395*
Direct expenditure on sponsored research:						
Salaries and wages			**87,874**		**87,874**	*98,611*
Materials and equipment			**12,811**		**12,811**	*6,227*
Other			**3,111**		**3,111**	*3,124*
Indirect expenses:						
Rent	6	**180**			**180**	*180*
Premises		**2374**			**2374**	*4,509*
Administration, exhibitions and professional fees	7	**12,442**			**12,442**	*20,300*
Travelling and conferences		**4.212**			**4,212**	*2,266*
Total Resources Expended		**256,881**	**103,796**	**0**	**360,677**	*£332,265*
NET INCOMING (OUTGOING) RESOURCES For the year from continuing operations		**7,446**	**11,882**	**0**	**19,328**	*60,434*
Gains / (Losses) on Investments						
Realised						
Write-back previous years' unrealised gains						
Unrealised		**10,491**			**10,491**	*(4000)*
Transfer to Reserve for short-term appointments		**(29,600)**		**29,600**		
Net Movement in Funds		**(11,663)**	**11,882**	**29,600**	**28,819**	*56,434*
BALANCE BROUGHT FORWARD AT 31 03 1999		**232,420**	**(11,882)**	**756,300**	**976,838**	*920,404*
BALANCE CARRIED FORWARD AT 31 03 2000		**£220,757**	**0**	**£785,900**	**£1,006,657**	*£976,838*

The notes on page 34 form part of these accounts

BALANCE SHEET
31 March 2000

	Note	Unrestricted Funds £	Restricted Funds £	Reserve Funds £	Total Funds 2000 £	*Total Funds 1999* £
FIXED ASSETS						
Quoted Investments	9	**0**	**0**	**535,824**	**535,824**	*325,333*
		0	**0**	**535,824**	**535,824**	*325,333*
Current Assets:						
Debtors Sundry		**47,965**		**0**	**47,965**	*1,795*
Pre-payments		**227**		**0**	**227**	*186*
Accrued income		**0**		**0**	**0**	*36,721*
University of Bath	10	**41,639**		**0**	**41,639**	*84,259*
Money market deposits		**150,859**		**250,076**	**400,935**	*570,508*
Bank balances		**215**		**0**	**215**	*204*
		240,905	**0**	**250,076**	**490,981**	*693,673*
Current Liabilities:						
Creditors Accruals		**(20,148)**	**0**	**250,076**	**(20,148)**	*(42,168)*
Net current assets		**£220,757**	**0**	**£250,076**	**£470,833**	*651,505*
Total assets, *less* current liabilities		**£220,757**	**0**	**£785,900**	**£1,006,657**	*£976,838*
Represented by:						
Accumulated fund		**220,757**			**220,757**	*220,538*
Reserve for short-term appointments	11			**785,900**	**785,900**	*756,300*
		£220,757	**0**	**£785,900**	**£1,006,657**	*£976,838*

The notes on page 34 form an integral part of these accounts.

P. LAWES *Chairman*
D. T. PROTHEROE *Vice-Chairman*

15 May 2000

NOTES TO THE ACCOUNTS
Year Ended 31 March 2000

1. **LIMITATION BY GUARANTEE**
The Company is limited by guarantee and as such has no share capital.

2. **CHARITABLE STATUS**
The Company is a registered charity (no. 256335).

3. **COUNCIL**
No remuneration is payable to the members of the Council of the Institute.

4. **INTEREST**

	£
Quoted Investments	19,673
University of Bath	4,308
C.O.I.F	30,346
Abbey National	82
	54,409

5. **EMPLOYEES**
The average number of employees during the year was as follows:

2000	*1999*
14	*14*

No employee earns more than £40,000 per year

6. **LEASEHOLD PROPERTY AND FIXED ASSETS**
A lease of the property at the Medical Sciences Centre, was entered into on 26 May 1995.
By the terms of the lease, the annual rent is set at £180. The lease expires on 28 September 2067.

The other fixed assets of the Company have been written down to a nil value in the accounts.

7. **AUDIT FEES**
Audit fees of £294.00 are included under the heading of Administration, exhibitions and professional fees.

8. **DIRECTORS AND OFFICERS LIABILITY INSURANCE**
The Institute has effected directors' and officers' liability insurance cover. The annual premium is £472.50.

9. **QUOTED INVESTMENTS**

	£
Value @ 31/03/1999	325,333
Purchased in Year	200,000
Unrealised Gains/(Losses)	10,491
Value @ 31/03/2000	535,824

The investments are shown in the Balance Sheet at market value.

10. **UNIVERSITY OF BATH**
The University of Bath administers the financial affairs of the Company. The balance on the current account with the University attracts interest at the current market rate, as determined by the average rate obtained by the University on its deposits and investments.

11. **RESERVE FOR SHORT-TERM APPOINTMENTS**
The Institute has assigned funds for short-term engineering appointments for specific projects.

Funds for short-term engineering appointments	£	£
Graduate Engineer in post: 3 years	112,700	
Graduate Engineer in post: 2 years and replacement	84,500	
Graduate Engineer in post: 2 years and replacement	84,500	
Graduate Electrical Engineer in post: 1 year and replacement	96,000	
Graduate Electrical Engineer in post: 2 years and replacement	77,700	
Workshop Technician in post: 3 years	77,300	
Workshop Technician in post: 3 years	74,000	
Electronics Technician in post: 2 years and replacement	66,200	
Production Technician in post: 1 year, replacement and costs	63,100	
Occupational Therapist (part-time): 1 year and replacement	49,900	
		785,900
Balance on reserve: 31/03/1999		£756,300
Transfer from Income and Expenditure Account		29,600
Balance on reserve: 31/03/2000		£785.900

Estimate of Future Income and Expenditure

Introduction to Table

The estimates in this table are for three years with a tentative projection to the fourth year. An annual rate of inflation of 3% is assumed. Please refer to the Director's Report under 'Planning' for a further discussion of the implications.

	1999/2000		2000/2001		2001/2002		(2002/2003)	
	Income	Expenditure	Income	Expenditure	Income	Expenditure	Income	Expenditure
	£	£	£	£	£	£	£	£
Estimated Income								
Subscriptions, Sales, Consultancies, Royalties	55,000		55,000		55,000		(55,000)	
Donations from regular sponsors (see Note 1)	140,000		145,000		150,000		(150,000)	
Interest	50,000		50,000		50,000		(50,000)	
Estimated Effective Expenditure & Offsetting Support (see Note 2)								
Salary commitment for staff working at BIME								
(a) Director (part-time) and 2 permanent engineers		85,200		87,800		90,400		(90,400)
Salary support provided by direct employment and project grants from the Health Authority and DH	67,400		69,400		71,500		(41,000)	
(b) Short-term appointments of 6 engineers and 1 physicist		166,400		171,400		176,500		(76,000)
Salary support provided by project grants	53,300		54,900		56,500			
(c) 5.5 Technicians and Therapists		107,700		110,900		114,200		(57,000)
Salary support provided by direct employment and project grants	22,800		23,500		24,200		(11,000)	
(d) Secretarial		13,800		14,200		14,600		(14,600)
Salary support provided by direct employment and project grants	7,000		7,200		7,400			
(e) Cleaning		2,200		2,300		2,400		(2,600)
Salary support from DH grants	1,100		1,200		1,200			
Materials & Equipment		50,000		50,000		50,000		(50,000)
Support from DH grants	3,000		3,000		3,000			
Premises		4,500		4,500		4,500		(4,500)
Administration, exhibitions etc		20,000		20,000		20,000		(20,000)
Support from DH grants	10,000		10,000		10,000			
Travelling		2,000		2,000		2,000		(2,000)
Support from DH grants	1,000		1,000		1,000			
Fees and Service charges		200		200		200		(200)
	£410,600	£452,000	£420,200	£463,300	£429,800	£474,800	(£307,000)	(£317,300)
Balance on year	–£41,400		–£43,100		–£45,000		(£10,300)	

Notes

1. The estimates of donations from regular sponsors have been based on promised support and experience of the level recently received. They represent target figures for donated income which we hope our sponsors will provide.

2. The effective expenditure is the cost of running the Institute. Some of the staff working at the Institute are employees of other organisations (Royal United Hospital NHS Trust, University of Bath) and their salary costs are not recorded in the Annual Accounts. The offsetting support under 'income' includes this salary contribution and also the salary contribution provided by the DH grants. Not included in this table is an estimate of the cost of the administrative support provided by the University.

BATH INSTITUTE OF MEDICAL ENGINEERING LIMITED

DONATIONS RECEIVED
Year Ended 31 March 2000

Under £200 : 32 donors

The following were exceptionally generous in their donations:

The Headley Trust
The Southern Trust
Charity of Henry Smith (Kensington Estate)
The Childwick Trust
Emmandjay Trust
Sir Samuel Scott of Yews Trust
Glaxo Wellcome Plc
Nationwide Foundation
The H.B. Allen Charitable Trust
W.A. Cadbury Charitable Trust
The Dunhill Medical Trust
Edwin George Robinson Charitable Trust
The Underwood Trust
Jenour Foundation
Pilkington Charitable Trusts
J. Rothschild Assurance Foundation
Remedi
Lazard Brothers & Co. Ltd.
The Dowager Countess Eleanor Peel Trust
Mary Webb Trust
In memory of Mr. Ken Lloyd Williams
The Inverforth Charitable Trust
The Friarsgate Trust
Sir James Reckitt Charity
The Astor Foundation
Paul Balint Charitable Trust
The Mason Bibby 1981 Trust
The Enid Blyton Trust for Children
Mr. R.N. Cadbury
Cooper Charitable Trust
The D'Oyly Carte Charitable Trust
The Freemasons' Grand Charity
R.J. Harris Charitable Trust
Lady Hind Trust
The Jane Hodge Foundation
Lazard Brothers & Co. Ltd.
Oakley Charitable Trust
P.F. Charitable Trust
John Pryor Charitable Trust
Rotork Plc
Charles & Elsie Sykes Trust
Dame Violet Wills Will Trust
BBC Children in Need Appeal
G.M. Morrison Charitable Trust
Norman Family Charitable Trust
C. Rowbotham Charitable Trust
Mrs. R.A. Brinton
Bath Area Medical Research Trust
Col. W.W. Pilkington Will Trust
The Arnold Foundation
Mrs. A.L.K. Cadbury
The Richard Cadbury Charitable Trust
CGU Plc
The A.M. Fenton Trust
Doris Field Charitable Trust
The Good Neighbours Trust
Leigh Day
NatWest Staff Samaritan Fund
Mr. & Mrs. J.A. Pye's Charitable Settlement
Rugby Football Union Charitable Fund
N. Smith Charitable Settlement
Smiths Industries Plc
Sir Jules Thorn Charitable Trust
Ti Group Plc
Waitrose Ltd.
Bath Fosseway Townswomen's Guild
Benham Charitable Settlement
Henderson Administration Ltd.
IMI Plc
The Ravensdale Trust
Mars U.K. Ltd.
Singer & Friedlander Ltd.
Mr. P.G. Davis
Dr. J.D. Garnish
Herman Miller Ltd.
Imperial Tobacco Ltd.
B.G. Foundation
Miss J.M. Bisgood
British Alcan Aluminium Plc
Fenwick Ltd.
Robert Fleming Holdings Ltd.
HSBC Bank Plc
Mr. N.R. Lacey
Lewis Family Charitable Trust
Midland Bank Plc
Rolls-Royce Plc
Worshipful Co. of Scientific Instrument Makers
Andrew Anderson Trust
The Edward Bibby Fund
Bertie Black Foundation
The Fitton Trust
Robert Hickson-Collis Charitable Trust
The Higgs Charitable Trust
Wessex Water Plc

One Donor wished to remain anonymous

Director's Report

Introduction

In October we were very sad to learn of the death of Mr Kenneth Lloyd Williams. He was a leading founder of the Institute in 1968 and was actively involved in supporting its work right up to the time of his death, by both serving on Committees and personally encouraging the staff employed by BIME through many visits to the laboratories and workshops discussing new ideas and reviewing the progress of ongoing projects. Ken was a Council member from the beginning, serving first as Vice Chairman from 1968 to 1988 and then as Chairman from 1988 to 1997. He was the first Chairman of the Projects Committee from 1968 to 1977 and served on the Committee since then. He felt most at home on the Projects Committee, where he relished contributing ideas and evaluating proposals for new projects to assist with disability problems or to develop novel surgical instruments. In the 1980's the Institute outgrew its buildings at St Martin's Hospital and also lost contact with many collaborating clinicians because of the move of many acute services to the Royal United Hospital in Bath. Ken was a prime mover in persuading the Health Authority to financially support the scheme to move to newly-built premises at the Royal United Hospital in 1987, which we now occupy. We shall all miss Ken's warm enthusiastic support and extend our sympathies to his wife, Frances, and family. A friend and colleague for many years, Mr Theo Schofield, paid tribute to Ken at his memorial service and has kindly given us permission to reproduce an extract of his address just before this report.

Following last year's celebration of our 30th anniversary with the BBC Lifeline Appeal, and the generous response of our sponsors, we were able to employ a much-needed electrical engineer and to extend the contracts of two other members of the staff team. As a result we have had a most encouraging year in working on and seeing through to completion

a large number of projects leading to assistive devices for disabled people and in making available our "non-commercial" devices to an increasing number of users through our Production Workshop, via marketing companies and direct sales. The number of our projects being used is the best indicator of our success and we continue to seek new outlets for the devices we have developed. This year, with the generous purchase of a van by one of our sponsors, the Emmandjay Trust, we have been able to increase the number of exhibitions and demonstrations we have been able to attend. We also make our products known by our Internet Website and through our entries in the Disabled Livings Foundation lists. Both these sources of information for potential users have been used by enquirers seeking what help we can provide.

In this report the financial and forward planning aspects are presented first, followed by a description of our projects for disabled people undertaken during the year and the work of our production unit, finishing with a review of more general matters.

Finance and Planning

At the start of each year an estimate is made of the donations required to maintain our engineering commitment to the programme of aids development put to us through our Projects Committee, who first research the various needs and ideas brought to the Institute. Again, we have been supported most generously by our sponsors at a time when the Chancellor has begun to tax the available funds of many of them. May I express our warm thanks to our many donors listed on the last page of this Report, who have responded so generously. Last year was our 30th anniversary celebration which, together with the BBC Lifeline appeal, raised the donation level considerably and enabled us to increase our staff commitment to projects for disabled people as mentioned above. Naturally our donated income this year is somewhat less as the accounts show, but still more than in any previous

year and this generous support will allow us to sustain our increased commitment which we took on last year.

In January we welcomed Mr Christopher Gibbs to strengthen our electronics team. He has a physics degree from Oxford University and an MSc in biomedical engineering from the University of Aberdeen, together with two years training experience in hospitals in Newcastle and Sunderland. In January, we also welcomed back Mrs Karen Hagan after her maternity leave following the birth of her daughter. With the growth of work going through the Production Unit, we also welcomed, in October, Mrs Julie Matthews to assist in this area as a part-time secretary.

In order to assess the income and expenditure required to maintain the Institute's work over the short term, an estimate has been made of the income and expenditure levels over a three year period. This has proved most useful in showing our sponsors and members how we propose to use the income already received, and illustrates our need for a regular level of donation income to match the trend of inflation. The three-year estimate prepared for this year's report, summarised as a table, together with a fourth year projection, is given on page xx.

As in last year's estimates, the table indicates the total staff commitment to the work of the Institute and the effective cost involved. This is done because some of those working at the Institute are employees of other organisations (mainly the Royal United Hospital Trust) whose salary costs are not shown in the Annual Accounts. In addition, some of the staff employed by the Institute are partially or wholly funded by project grants from the Department of Health. This support is also shown in the table separately from that provided by our donors. Not shown are the costs of the considerable administrative assistance provided by the University of Bath, to which the Institute is greatly indebted.

As the accounts show, the major source of income for the Institute's projects are the donations it receives from its sponsors. The figures for anticipated income from both donations and grants shown in the table are estimates. The projected grant income is based on the current indications of likely funding from Government grant-awarding bodies. The figures for anticipated donations have been estimated from promises received for the future and from anticipated donations from regular contributors, with an allowance for some increase each year. The estimated figures are not assured but represent targets for income which we hope our sponsors will provide. Obviously, although the estimated income and expenditure should be fairly accurate for the current financial year, the accuracy will decrease with time and be very approximate for 2003/2004. A figure of three per cent per year has been assumed for the effect of inflation on both salary and non-salary costs. An allowance for the incremental scales has also been made for the salary costs.

The future course and requirements of the Institute have been shown in the table in terms of staff commitments, rather than the individual project requirements, as this can be presented more clearly. It reflects the Institute's policy of keeping together a viable basic engineering team supplemented by short-term appointments, when our income allows, related to individual projects and where extra help is required. Because much of our income comes from individual gifts with no promise of repetition it has been considered prudent to hold a reserve equivalent to one year's support for both the permanent engineering team and the normal running costs of the Institute to complete our project programme, and to assign any excess over this sum to fund the short-term appointments. Thus, together with the part-time occupational therapy post, we now have ten engineers and technicians budgeted for short-term appointments. These commitments are detailed under note 9 in the Accounts and leave an uncommitted reserve of approximately one year's running costs.

All the staff are involved in a number of long and short-term projects. The long-term projects are individually assessed for staff and other funding. Donations given for specific projects are earmarked and recorded separately in the Accounts. Many of the short-term projects are more difficult to assess in detail and are fitted in as the programme permits. The engineering and technical staff are fully involved in the design and production of prototype aids, instruments and devices for sick and disabled people, either at home or in hospital. The table therefore gives an accurate indication of the personnel and engineering effort continuously employed on such projects. It can be seen from the table that more than half of the Institute's projects are funded by donations, and the remainder by direct employment (Royal United Hospital), and project grants from the Department of Health (DH) and other grant-giving bodies.

Projects

Every member of the engineering team contributes to this report, particularly in the descriptions which follow of the projects they are involved in. We are working on a large number of projects of different scale and type. Where possible these have been grouped under section headings. Projects described are those which have been completed during the year, those started during the year, and the state of development of some longer-term projects. The length of the description in this report should not be taken as a guide to the time commitment of the engineering team to the project. Some of our shorter projects require considerable explanation of their aims, while some projects, where there has been a major time commitment, are quite straightforward, with little background explanation required. For each project, the stage of progress in making the aid or device generally available is indicated; this may be by collaboration with a manufacturer for production of the

aid, by small scale production by BIME, or by work commissioned by manufacturers or the DH to solve specific problems concerning an aid or hospital device or to improve its design.

In all our work on equipment development, we are grateful to the great range of collaborators who help us through the development process to produce aids to help with the problems of a large number of disabled people. Our collaborators include many disabled people and patients, and individual members of many professions: medical, engineering, therapy, nursing, industry and teaching of the handicapped.

Equipment for Children

A number of projects for children have been completed over the year and several others have been started. Some of these are reported under "Individual Equipment".

1. *Car Swivel Seat*

A problem that is common for parents of disabled children and disabled parents is the difficulty they experience when lifting their child into a car seat. This is a problem when handling children of all ages although it becomes more difficult to lift the child the heavier and taller they become.

To get a child into the seat the parent has to lift the child over the car seat and somehow negotiate the body position around the door edge and swing them into place. This becomes very difficult to do and a potential cause of back problems.

Currently there are a few products available to overcome the lifting of a child into the child seat; one solution is to use a rotating front car seat commercially available to provide the turning of the child safety seat. This becomes a problem when a child can potentially obstruct the driver; also the device is not transferable to school buses or taxis, which is a common form of daily transport for the children.

There are strict guidelines to follow in terms of safety legislation from the European Union and still many forms of disabled child seating does not conform to these standards.

The Institute has been involved with designing a swivel seat attachment for a number of years. Recently we have established links with a large car-seat manufacturer and we hope to collaborate on the design of a swivel base that will attach to a range of their seats which includes seating for disabled children. This approach will produce a swivel base with expertise input from both the Institute and manufacturer involved.

2. *Bicycles for Children with Restricted Growth*

These projects are described later in this Report under "Restricted Growth Association Projects".

3. *Potty Seat for Children with Brittle Bone Disease*

Handling children with Brittle Bone Disease is always a tricky operation because their bones are like chalk and can easily be broken. The Institute has been involved in a project to develop a device to enable children with the condition to be transferred on and off the toilet as safely as possible. A special potty seat has been developed which is very supportive when the child is using it. When ready for transfer, the chair allows the child to be laid down to a supine position with the side supports out of the way. From this position it is much easier and far less risky to pick up the child. The seat has been developed in conjunction with the national Occupational Therapist of the Brittle Bone Society (BBS) based at Great Ormond Street Children's Hospital. She has taken the prototype seat all over the UK to see how children and their carers respond. The seat has been a great success and the Institute is currently carrying out a production development exercise with the aim of constructing batches of the device for issue through the BBS to help as many

children as possible. We are very grateful to the J Rothschild Assurance Foundation ~~and~~ the ~~Denis~~ Dorris Field Charitable Trust for supporting this work.

4. *Compliant Seating*

The Institute has developed a compliant seating system, in conjunction with Great Ormond Street Children's Hospital, for children who have whole body extensor spasms. The devices have been very successful for this client group and their use has been explored for helping adults with similar problems. Prototype devices have been in use with local clients for many months and have been very successful. We are very grateful to the Dowager Countess Eleanor Peel Trust for supporting this work.

5. Toilet Support Handles

Children with restricted growth can be very unstable on toilet seats. Toilet support handles which attach to the seat have been developed to give stability. They are near the end of their development and are nearly ready for production development. They have been well received so far with requests coming in for evaluations from interested parents faster than we can respond.

The handles have been through two design iterations so far. The first set built was not adjustable and did not fit all the toilets. The second set was made adjustable, fitted many different toilets, and was evaluated very successfully. The third set, recently completed, will be evaluated by children in the South West region of the RGA.

6. Child's Bottom Wiper

The bottom wiper has been designed for children with restricted growth who have short arms and are unable to clean themselves after toileting. It is of a simple design that uses a plastic clip to hold the paper in place. The first prototype was evaluated and further

developed during the year. Two new prototypes have been produced for evaluation by children and their parents.

7. Wheelchair Football – Lever-operated

Electric wheelchairs provide a number of children with opportunities to explore their environments, increasing their interaction and social skills within the community. Currently there are a number of children who wish to take part in sports from their wheelchairs hoping to increasing their independence and opportunities within society. Football is currently not accessible from the wheelchair and many children have expressed the desire to play the game. The institute was approached early last year and asked to develop a device that would attach to an indoor/ outdoor electric wheelchair and allow a child to engage in a game of football with able bodied friends.

The project has been developed into a final one-off device that is being evaluated by the user. The device allows the child to push a football using a lever whilst a scoop area holds the ball in position allowing the ball to be dribbled and passed to friends.

Information from the user will provide valuable experience and feedback to guide the institute in developing a similar device for a larger market. It was featured on the BBC 'Children in need appeal' this year.

The product was featured at the 'Kid E Quip' exhibition in Bolton where it was extremely popular. Other work has emerged from the original referral and developments are occurring in other areas related to disabilities and sport. We are most grateful for the support of the BBC "Children in Need" charity for this project.

8. Wheelchair Hockey

Similarly to the wheelchair football a child in main stream school required a device that allowed her to play hockey with her friends. Unfortunately upper body strength and

control did not allow for the child to use a standard hockey stick. The therapist, teachers and designer involved thought it would be appropriate to develop a device that would attach to the wheelchair and allow control of the ball despite limited movement and upper body strength.

It was decided at an early stage to develop a system that would enable the user to easily activate a pushing mechanism to propel the hockey ball to friends.

An initial device has been tested with the individual but at present the Institute is awaiting the purchase of a new electric wheelchair for the user before any development work can continue.

9. Powered Football Assistant

Many people with limited upper body strength are isolated from wheelchair sporting/ leisure activities; often sports developed for the disabled rely on good upper body strength for them to take part. A few examples: Wheelchair Hockey, Tennis, Rugby, Volleyball etc.

There is a large need for products that can engage disabled people with lesser physical strength in sports activities increasing their participation and motivation in team events. The work that has been undertaken for this project is the development of a power assisted football attachment that will allow electric wheelchair users with disabilities such as, Cerebral Palsy, Muscular Dystrophy, Spina Bifida and Juvenile Rheumatoid Arthritis who have limited upper body strength the opportunity to play football.

The work compiled to date has been a comprehensive study into mobility issues. Currently a working prototype has been constructed and tested with children at Burton Hill School (A local special school in Malmesbury) who have provided valuable feedback throughout the development process.

The design consists of a mild steel tubular structure that clips into brackets that are permanently mounted to a wheelchair. The product has been designed so that it will fit a large proportion of wheelchairs found on the current market. The power which pushes the ball between players is provided by a compressed air supply which fits neatly onto the back of the wheelchair and provides 105 shots from one charge. The air is regulated to a lower pressure, this enters a spring return pneumatic cylinder which pushes the ball. The user controls the shot by activating a push switch that is accessible to people with less physical strength.

Although the product is in its early stages of development it shows great potential as a future product to assist disabled people in pursuing football as a sport from their wheelchairs. It is envisaged that modifications will be made to the initial design and a small batch will be made available for evaluation, this will undoubtedly highlight further issues to address in the design and development work.

Many thanks to all at Burton Hill school who have contributed to the testing and development of this device and to Jade Harrold the original child who requested she wanted to play football from her wheelchair.

10. *Scoot-along Children's Mobility Aid*

Many children with cerebral palsy find they can propel themselves around with their feet more easily than by using their hands. A small scoot-along aid has been developed by the Institute to help this group of children. A project has just started to extend this work to look at other means of providing foot propulsion for children with these disabilities. We are very grateful to Glaxo Welcome and the D'Oyly Carte Charitable Trust for supporting this project.

11. *Remote Control Buggy Handset*

One of the Institute's great successes is the small powered mobility aids that were developed a few years ago to help children with cerebral palsy to attain independent mobility at early age. As is described later many of these devices are now in use throughout the UK. To help the children to learn to use the device a remote control handset has been developed which enables the carer to take control if the child gets stuck. The radio control device also has a "dead man's handle" facility to improve safety when using the buggy out of doors. If the child loses control in a difficult situation the carer just has to let go of the handle and the buggy will stop in its tracks. The device has been very well received by carers, and it is planned to make it available through the production unit as soon as possible. We are very grateful to the Nationwide Foundation for supporting this work.

Department of Health - Equipment Evaluation Programme

Infusion Systems and Enteral Feeding Pumps

This is the twenty-first year that BIME has been funded to run a programme of evaluation of infusion pumps and enteral feeding pumps on behalf of the Medical Devices Agency. Funding for the project has been put on a firmer footing this year with the introduction of a three year rolling contract.

The year saw the retirement of Dr. David Protheroe, Consultant Anaesthetist at the Royal United Hospital who has acted as medical advisor to BIME's pump evaluation programme from the start. Dr. Protheroe retains his interest in the project and remains available as advisor at present but is gradually handing on this responsibility to Dr. Bob Marjot, Consultant Anaesthetist at the RUH. We are very grateful for Dr. Protheroe's past and ongoing assistance and look forward to a fruitful relationship with Dr. Marjot.

The review of BIME's pump evaluation procedures which was performed in 1999 by the funding body, the Medical Devices Agency, has drawn to a close. A few of the proposed modifications have been put in place and some procedural changes are intended for the Year 2000. These include improved project management and tracking procedures which are to be introduced to all MDA funded evaluation centres. Microsoft Project is being utilised as a project management tool.

A particular product of this review has been a major proposed revision of the "Indications for Use" categories used by BIME in the pump "Evaluation" publications. The proposed new categories are currently being discussed by users and manufacturers of infusion pumps. Any resulting changes should be implemented mid-2000. The preparation of this document occupied a major part of 1999.

The number of infusion pumps being introduced to the market continues to keep our two-woman evaluation team busy. A full scale review of volumetric and syringe pumps is underway, with testing completed on 3 of these devices. A further 23 devices remain to be tested. This review is proposed for publication in late 2000.

A full evaluation of the IVAC P7000 syringe pump has been published this year; also a review of current enteral pumps has been prepared and is shortly to be published, subject to final editing. A review of Ambulatory pumps will then be prepared; all testing on the 11 ambulatory devices has been completed. A plan for publishing interactive reports on the Web is currently under discussion.

Some work for the Medical Devices Agency's division concerned with Device Technology and Safety has been performed during the year. This work frequently results in negotiations with pump manufacturers and can bring forward specific improvements in device safety.

Software written in 1999 in the pump evaluation laboratory has been sold to Underwriter's Laboratories, to assist in establishing a pump testing facility in the UK. Underwriter's Laboratories has recently been certified as a Notified body and is involved with the CE marking of medical devices for the European Market. This project brought welcome additional funds to the Evaluation Laboratory.

Teresa Dunn has been co-opted onto several of the committees involved with the redrafting of the Device Bulletin on Infusion Systems, originally published by the MDA in 1995 and now to be re-published with up to date advice. A significant portion of this document is going to cover the requirements for adequate training of clinical staff in the use of Infusion devices. Many fatalities in which infusion devices are implicated are caused by user error. It is hoped that better training procedures and requirements will reduce these user errors, and thereby improve patient safety.

At present some of the tests, required by the Standard IEC 60601-2-24 and performed by BIME's pump testing laboratory, necessitate the presence of an operator during testing. It is hoped to automate aspects of this testing. The particular test in question is designed to measure the response of the infusion pump to the adverse scenario where a nurse has left a stopcock closed on the line which should deliver fluid/drug to the patient. This will involve replacing the manually operated 3-way stopcock with a PC controlled solenoid valve(s) and the automatic recording of test parameters, using a graphical interface in-house software package. The above project is to be undertaken by Ann Hill, a clinical engineer in the Evaluation Laboratory, who is studying part time for a M.Sc. in Clinical Engineering.

Equipment for Living

1. *Assistive Robots*

The Institute is designing a wheelchair-mounted robotic manipulator to assist users of electric wheelchair, who have limited use of their hands and arms. This is a major project for the Institute and this year has seen completion of the prototype and initial evaluations.

The early part of the year saw a lot of work bringing together all the component parts of the system. Software was written to allow the control of the motors and other functions of the arm. This low level software was then linked to the high level user interface software developed earlier in the project.

For the initial evaluations which took place in the second part of the year the manipulator was mounted onto a wheeled trolley, which could be wheeled up close to the user's current wheelchair. This allowed them to evaluate the basic use of the system without either needing modifications to their own wheelchair or requiring them to transfer into another chair. In the future it is intended to carry out longer term evaluations for which the manipulator will be mounted to the user's own wheelchair.

Five volunteers have evaluated the device, representing a range of disabilities and domestic circumstances. They were all very positive about the device and in particular found the user interface easy to use. The gripper was felt to be a big improvement on the gripper used on BIME's earlier trolley mounted robot. The one specific area which requires further work is on the effect the robot has on the overall width of the wheelchair. We had managed to keep the increase in width down to 125mm, but the users reported that even that slight increase might be a problem. We will be addressing this problem in two ways. Firstly a revised mounting point will be designed which will allow the robot to be

pulled in closer to the wheelchair when it is in its "Parked" position. Secondly we will ensure that it is possible for the manipulator to be easily removed from the wheelchair by a carer for situations when any increase in width is unacceptable. We are very grateful to the Southern Trust for their generous support of this project.

2. *Flat Pack Commode*

The Institute is developing a commode chair which folds flat for users when travelling. A prototype device has been extensively evaluated by users, with very positive feedback. We have regularly received enquiries from potential users as to how the project is going, whether it is available for sale or whether for loan. We are now building up a production prototype. This takes into account the comments of users, as well as the requirements of small batch production. Following user evaluation and other tests it is hoped to initially make the device available through in-house production.

3. *Sip Cup*

The sip cup allows someone with swallowing difficulties to receive only a limited volume of fluid each time they bring the cup to their lips. The current design is basically very successful and we have many potential users and therapists who would like to obtain one of the cups. Producing such cups would, however, be very difficult using our normal small volume production techniques. We are currently investigating the possible costs of having the cup injection moulded and, in parallel, investigating possible marketing companies.

4. *Standing Transfer Unit*

There are many people, particularly those in their later years, who are able to weight bear using their legs but who are very unsteady on their feet and who find

transferring between a bed, chair and toilet very tricky. The Institute has been involved in the development of a device that can assist with this operation.

The device is quite simple and combines the properties of support frames with turntable devices to give someone security while they move from sitting to standing, and to help with turning. The standing transfer unit is placed next to, say, a bed such that the user can place their feet on its base and pull themselves to a standing position. The carer can then rotate the base to align it with, say, a wheelchair. The user can then lower themselves in a controlled fashion into the chair. The device has the added advantage of assisting the carer without them overloading and damaging their back. The whole device folds down to a small flat unit that can easily be stored or can be carried around by a home visitor.

The device has completed development and the Institute is currently looking for a way to make the device available. We are very grateful to Mrs Janet Allam, Occupational Therapist, for bringing the problem to our attention and guiding the development.

5. *Mug Holder*

Carrying items around with you when using a wheelchair can be quite tricky. This applies particularly to drinks. During the year three prototypes have been built to evaluate the feasibility of different methods, including a gimballed platform. The most promising approach which is now being developed is an attached stand with a spring lid/seal that fits over the tope of the mug or glass being carried. It is fully adjustable and can securely hold pint glasses, champagne flutes and teacups.

6. *Saliva Pump*

There are a number of conditions which give poor control over saliva and therefore may lead to drooling. This can be both uncomfortable and socially unacceptable. The Institute is developing a hand held pump which may be used to drain saliva from the

mouth. Although initially aimed at sufferers from motor neurone disease the device is also seen as being appropriate for other disability groups. Evaluation of a batch of pumps last year indicated that for many users stronger suction may be required. A change in power supply should overcome this problem and the necessary redesign is currently under way.

7. *Bathing Assistant with Leg Lifter*

There are many bath seat systems on the market offering a variety of alternative functions yet despite this there are many problems associated with existing designs. Research suggests that many disabled people would like to have a bath seat that will assist them in and out of the bath independently, without the need for a second person lifting the legs over the bath side etc. Bathing is a very personal experience and with the development of a new seating system that will provide complete assistance in lifting a person from outside the bath into an ideal position low to the bath floor will be very well received.

The aim of this project is to provide a product that allows people to get in and out of the bath comfortably, confidently and independently. Currently the market has not addressed the issue of people lifting their legs independently when getting into the bath. This is therefore a good opportunity to develop a product.

A list of requirements the product must fulfil has been drawn up from market research and initial discussions have taken place at disabled living centres. A conceptual idea of a product has been taken to exhibitions where it has been very well received.

The project is in its early stages and a prototype test device has been constructed to test a person's response to lifting legs and tilting in space. The project will involve end users throughout the design stages and when the product has reached a working demonstration stage it will be developed for production.

8. *Bed Lifter*

Occupational therapists, and others are often required to raise beds and chairs to enable blocks to be put underneath to increase the height. Raising the bed, while inserting the blocks can cause manual handling problems such as damage to the therapist's back. The Institute has designed a simple jack to safely raise and support a bed. A production batch is currently being built up and it is hoped to make it available in the near future.

Mobility Equipment

1. *Wheelchair Baby Carrier*

Dealing with the transportation of babies and young children can cause problems to anyone but becomes particularly trying for someone using a wheelchair. The Institute has been involved in the design of an "add-on" device that can enable such users to carry their babies and toddlers around on their chair.

A successful device was initially developed which fitted onto a wheelchair and enabled a young baby to be carried around and for the parent to interact with the child. As the child grew it was found that this structure became less stable and an alternative solution was explored. The child was supported in a separate seat mounted on its own wheel at the front of the wheelchair. The wheel can castor so that manoeuvring the wheelchair is relatively easy for a carer. The whole frame also hinges up and down to enable the pusher to propel the chair over undulating terrain and keep all the wheels on the ground. This feature also enables the wheelchair and toddler carrier to negotiate kerbs. The device has been much refined with mudguards and rain hoods fitted following initial evaluations. It has also been designed in a folding form to enable it to be easily packed into a car. The current demonstrator prototype folds to an even more compact form and is constructed from aluminium to keep the weight of the folded unit as low as possible.

The Institute is currently exploring the possibility of marketing the device through an outside company to enable any parent who uses a wheelchair to benefit from the work. We are very grateful to Neil and Cathy Frogatt for their help and comments in testing and evaluating many of the prototypes of these devices, and Railtrack plc for their generous support of this project.

2. *Lever Operated Wheelchair*

Propelling a wheelchair by means of the normal rims requires a reasonable level of hand grip on the part of the user. For users with joint problems in their hands or weak gripping muscles this becomes impossible and can often lead to the need for a powered chair when the user is otherwise quite fit.

The Institute has designed a lever-operated propulsion system that is a bolt-on addition to a normal manual wheelchair. The device enables all the usual functions of forward and backward movement, steering and braking, to be carried out without the need for any grip. The user just needs to be able to push and pull. Several of these units have now been provided to local users, and potential marketing organisations are currently being explored in order to make the device available.

3. *Foot Operated Wheelchair*

Several years ago the Institute was involved in a survey of adult wheelchair users who had cerebral palsy. The survey was carried out on behalf of Scope and led to some interesting conclusions. One of the more surprising was that around 20% of the users found it a lot easier to propel themselves around using their feet. They would either drag themselves forward by pulling with their feet on the ground, or they would push with their feet and steer their chair backwards. Both these propulsion techniques were far from

satisfactory and the Institute has recently been involved in the design of a chair that can be propelled in a forward direction by pushing with the feet.

The chair uses two foot plates that the user pushes on with their feet. The plates in turn enable forward and reverse propulsion, as well as steering and braking. The initial prototypes proved the principle but required quite a lot of development. Users often could push much less strongly with one leg than the other and found the co-ordination required for steering to be very awkward. The chair has been modified to include a tiller-like device for steering and this has led to a marked improvement in use. One of the volunteers was able to independently propel himself out of doors for the first time using the prototype chair. Braking has also proved to be a little tricky and a brake mechanism has now been incorporated in the steering tiller so that the user just presses down on it to brake. The footrests also have had to include quite a lot of adjustment so that the chair could be set up for individual users.

The current prototype is performing very well and it is planned to construct one more chair that consolidates all the development that have taken place over the last year. It is hoped that this chair can markedly improve the mobility of people with cerebral palsy and give them much better and independent access to mobility out of the house. We are most grateful to Remedi for their support of this project.

4. *Lifter for People with Muscular Dystrophy*

A disturbing and ever present problem for people with Muscular Dystrophy is their tendency to fall because of their very weak leg muscles. Getting back to a standing position again is difficult even when a carer is there to help because of the weakness. In conjunction with the Muscular Dystrophy Group the Institute has designed a lifter specifically for ~~this~~ people with this problem. The lifter incorporates a platform onto which the user can shuffle

following a fall. By means of a simply operated switch the platform then rises to a height sufficient for the user to stand again. The device has undergone extensive evaluations with a group of local volunteers and these have been very encouraging. Further development of the control electronics is currently underway after which it is proposed to plan a small batch of the lifters for issue to users through the Regional Care Officers of the Muscular Dystrophy Group. We are very grateful to the Southern Trust for their support of this project.

5. *Omni-directional Wheelchair*

Wheelchair users often find it difficult to manoeuvre in a constricted space. This is particularly a problem in a domestic environment. The Institute is developing an omnidirectional wheelchair which will translate sideways and rotate on the spot, as well as the more normal functions of forward and reverse motion and turning to left or right.

A simple powered base has been built to investigate some of the issues and to demonstrate to potential users. Those who have seen the base have been impressed by its simplicity and effectiveness.

We have now started on the design of a functional wheelchair, incorporating the features of the omni-directional base. Amongst the issues which will need to be addressed in the design are to create an attractive integrated mechanical design of chair and base, electrical power and control systems and the optimum user interface design. We are most grateful to the Headley Trust for providing generous funding to enable us to progress this important project.

6. *Rural Mobility Equipment*

Most wheelchairs, crutches and other mobility aids are designed for an urban environment to which they are well suited. The situation for disabled people in a rural environment is often more difficult. We have started a rural mobility feasibility study.

A questionnaire has been distributed to members of the Disabled Drivers Association Countryside Access Group (DDACAG). Tim Adlam joined the CAG for a ramble along the Thames path near Maidenhead, followed by a civic reception with Dr Michael Bruton, the deputy mayor, who is also a member of the group. About 20 wheelchair and scooter users travelled the course, coping with level tarmac, gravel paths and a rutted and muddy riverbank footpath. During the day, the best methods of transport for disabled people in the countryside were discussed.

Following further discussion with members of the DDACAG and responses to a request for comments in 'Disability Now' magazine, potential projects were identified and it is hoped that work on these projects can start during the year.

7. *Thoracic Support*

Many wheelchair users require the support of their upper body to stop them leaning to one side and to help maintain a correct seating posture. Current designs on the market do not provide enough support in the thoracic region and often twist out of position. The need for a more efficient and supportive upper body system is required, one that is adaptable and reasonably cheap without going to the expense of purchasing a new seating system.

Initial evaluations have been completed using one prototype and it proved very successful. The concern the Institute has at present is with the styling of the product; it is a very functional device and requires further cosmetic design work. This is underway. We hope to make the product available later this year.

Smart House

The Alzheimer's Disease Society estimate that 670,000 people in the UK have dementia, with 180,000 new cases each year. Caring for a loved one with dementia is carried out with devotion by many thousands of people but there is no doubt that it puts an enormous strain on them. For people cared for in institutions, again their care is first rate but is carried out at a great cost to other individuals or to the State. The problem is increasing, as is the hope that one day some form of treatment will become available for many forms of dementia. In the meantime there is an important role for technology to try and maintain the quality of life of those with the condition and reduce some of the strain and anxiety of their carers.

Following the Institute's 30th anniversary television appeal last year we were approached by Dementia Voice, a local organisation working with carers and professionals supporting people with dementia. They had negotiated with Housing 21, a major housing association in the UK, to find premises that could be converted to a so-called "smart house" for people with dementia. The Institute was asked if we would like to join them on the project to provide the engineering and design support.

Smart houses are smart in the sense that they provide devices that can sense the activities of the occupants and automatically provide some action or support in response. The smart house for people with dementia was aimed at providing a kind of 24 hour carer who would provide guidance and assistance to the user by monitoring their activities and taking appropriate actions. For example the house could automatically keep a comfortable environment by adjusting heating and window opening. It could help guide someone to the toilet at night by turning the bathroom light on if it detected someone getting up, and then guiding them back to bed by using room lights once it detected the toilet being flushed.

A house is being provided by Housing 21 in Gloucester with the aim of setting up a demonstrator home with a wide range of assistive devices installed. We are providing engineering support for the project and designing a whole range of new support devices in conjunction with potential users and their carers. There are three project activities being run in parallel. Firstly a user survey is being carried out by our Occupational Therapist to prioritise those problem areas that cause particular concern. Secondly a series of assist devices are being developed from scratch, three important ones in the first year. And thirdly two more generic activities are being explored. One is to look at how communication can be effected with the occupant in a way that does not alarm them. This is important for providing reminders or encouragement. The other is to look at techniques of behaviour monitoring to provide indications of the occupant being distressed.

The project is an ambitious one but excellent progress has been made already and we look forward to a public launch of the smart house with a number of the devices up and running in the summer. The communication bus (a system of communication between the various installed devices) is installed and three specific devices are currently being developed and due to be completed in the first year. The first device is a locator system to enable a resident to find an object mislaid around the house. The second device is a bath monitor. One of the symptoms of dementia is short-term memory loss and if bath water is left running, flooding is caused. The monitor will not only monitor the water level but also close the taps at a certain level. The third device is a cooker monitor which will intervene if heated pans are forgotten.

We are very grateful to Professor Jane Gilliard of Dementia Voice and Teresa Parker of Housing 21 for their collaboration with this project. We are also grateful to

Gloucester Social Services, the Barnwood House Trust and other bodies for their funding of the initial phases of the work.

Restricted Growth Association (RGA) Projects

In 1996 BIME began a programme of work with the Restricted Growth Association (RGA). Following a survey of members of the RGA, a 'wish list' of projects was drawn up. Following the appointment of a design engineer for this work a number of projects have advanced. This year has been very productive. We have seen the bicycles completed and made available. Orders are flowing in and bicycles are being delivered. The other projects are nearing the end of their development phases and are approaching production development ready for sale at the 2000 RGA convention in Worthing.

The survey based method of assessing an area of potential need and generating projects from a questionnaire has been found to be very effective. The RGA has been very helpful with evaluations and publicity.

1. Reaching Sticks

Many people with restricted growth find that they cannot reach light switches, lift buttons, and clothes rails when they are out and about. When shopping or at home, reaching a high shelf can be a great challenge. We have developed two collapsible sticks that can be used to retrieve items otherwise out of reach. The ReachStick is a lightweight telescopic stick that can be stored in a pocket or handbag. It is of a simple design with a 'prodder' and hook on its end. The ShopStick is a larger more substantial stick that folds and features a noose type gripper at its end for retrieving many different objects from shelves.

The small ReachStick has completed its prototype evaluation. The evaluations carried out by RGA members from the South West region have been successful,

demonstrating the usefulness of this product. It is thought that it may have a wider application than just the restricted growth market. The wheelchair user and elderly markets are being considered as well.

The larger ShopStick is currently out for evaluation with RGA users. During the year, several different gripping mechanisms and materials have been tried - steel cable, nylon cord, and a number of different ratchet mechanisms. Problems were encountered with the steel cable. It gripped many different objects well, but because of the spiral wound nature of the cable it would not maintain an open horizontal loop in line with the stick. Alternatives tried were spring steel tape - this was too brittle, and a thin 'V' belt originally designed for a tumble drier. The 'V' belt has proved to be the most successful and will be used during the evaluations.

2. *LightStep*

The RGA survey showed that there was a need for a lightweight step that could be carried in a school bag or when shopping or when shopping to provide extra height needed for many activities.

During the year improvements to the initial prototype have been made. The weight of the step has been reduced and the operation of the leg locking mechanism has been made more reliable and simplified. The central hinge has been removed and the step shortened. A further evaluation is in progress with RGA users to validate the recent changes.

3. *BIME Bicycles*

The development of the bicycles has been completed and they are now in production and available to the public, as described under Production Unit.

4. *Toilet Support Handles and Child's Bottom Wiper*

The toilet support handles and bottom wiper for children with restricted growth have been described earlier under 'Projects for Children'.

Equipment for Developing Countries

The Institute has been approached by Primary Diagnostics, an organisation run by people with many years experience of working at the primary healthcare level in developing countries. They had identified several pieces of diagnostic equipment that they felt would markedly improve the ability of clinicians to make diagnoses in primitive field situations. Two items in particular were felt to be much needed: a field microscope that had sufficient power to enable malarial parasite damage to be seen and a haemoglobinometer to provide basic indications of levels of anaemia. Both these devices have been developed to an advanced stage.

1. *Microscope*

The microscope includes many features to enable it to be suitable for use in rural health clinics and also to keep the selling price as low as possible. The optical focus uses a simple rotation of the microscope tube and incorporates an anti-backlash spring to provide a steady image. The whole tube is attached via a bayonet fitting to allow it to be removed simply when the objective lens needs changing for a different magnification. The whole unit with the optical tube and the micromanipulator folds out of the way to enable effective cleaning of the instrument. This is particularly important with this microscope as it is likely to be used to examine faeces under low magnification and could easily become contaminated. The light source is one of the new generation of powerful white light emitting diodes fed by a power supply with similar features to that used by the haemoglobinometer described below.

The instrument has been tested in a hospital in the UK and also had field evaluations in the Far East. These tests have led to a number of further developments such as the improvement in the ease of cleaning. A small batch of the fully developed instruments has now just started field evaluations in several African countries.

Preliminary market investigations have shown that the potential market is larger than the Institute's production unit would normally consider. Consequently, as is discussed elsewhere, a manufacturer has been identified who can both manufacture the instruments and deal with the complications of exporting them to developing countries. It is hoped that such sales can be started very shortly.

This project has been a very satisfying one for the Institute to be involved with as the potential clinical benefits are very large. We are very grateful to Dr Roy Rickman, John Anning and Tim Watts from Primary Diagnostics Ltd for Involving us in the project and for guiding the way the products developed.

2. *Haemoglobinometer (BIME Anaemascan)*

In many developing countries anaemia is a major problem and is a common and important cause of morbidity in tropical climates. It has many causes such as blood loss, malnutrition, and a wide range of communicable diseases - notably malaria and hookworm and is a good general indicator of sickness and of the degree of urgency of the need for treatment. Anaemia is also very common in pregnant women, nursing mothers and young children in these countries. Primary healthcare in remote rural communities is often poor due to the lack of appropriate and affordable medical diagnostic tools. Rural health posts are often basic, with no electricity or proper water supply and treatment is often given without confirmed diagnosis which can be wasteful of drugs (that are usually in short supply and expensive) and may be dangerous. There exists a real need to produce a simple,

low-cost blood haemoglobin meter which can be used anywhere from any available power source including solar power in a rural health care environment. Currently available portable haemoglobin meters are either too heavy, too complicated, only use specific type of batteries (which are normally unobtainable) or, more usually, far too expensive. We have developed a robust and inexpensive instrument for the in vitro measurement of blood haemoglobin levels in a rural primary health care setting. The instrument is capable of operating from variable mains supplies and 12V sources such as car batteries and solar cells while charging it's own internal rechargeable batteries. It is accurate and simple to use requiring the absolute minimum of maintenance. The development prototype was initially evaluated at the Haematology Department of North Devon District Hospital. It was found to be easy to use and very accurate, if accurate blood samples are taken. Further work on incorporating the latest monochromatic light emitting diodes into the instrument is still to be completed. This should reduce the final price by eliminating a costly optical component. A number of instruments are currently under evaluation in developing countries with a further batch nearing completion for further testing. The African Medical and Research Foundation (AMREF) based in Nairobi, Kenya has tested one of the instruments and provided invaluable user feedback. A further batch of two instruments has been delivered to them for more exhaustive evaluation. Other instruments are currently in Tanzania and Uganda.

Vibrotec

The "Vibrotec" is a device designed to help screen diabetic patients for susceptibility of developing foot ulcers. It is being developed in collaboration with the Department of Vascular Medicine at the University of Exeter. Such a measuring device, if it is to be clinically tested and then made commercially available, must be able to be easily

set up and calibrated. We are currently developing the device to ensure that it meets these requirements, and also to provide a more robust power supply. It is intended to supply a batch of devices to Exeter for trial.

Ankylosing Spondylitis Measurement Device

Ankylosing Spondylitis is a rheumatic disease of the spine often suffered by young men. It leads to increasing stiffness of the spine, and may be treated by physiotherapy and anti-inflammatory drugs. The Institute is working with physiotherapists from The Royal National Hospital for Rheumatic diseases to develop a range of diagnostic tools. Two measuring jigs are now complete and the third device, for measuring cervical rotation, is currently under development. When the range of three devices is complete we will make them available to other hospitals.

Individual Equipment

Although BIME tries to concentrate on devices which benefit large numbers of people, we are often requested to help individuals with specific problems. As well as providing a service for these disabled people, such help also recognises the fact that solutions to one-off problems can turn out to have wider applications. The majority of the following projects, which have been undertaken this year, are for children.

1. *Switch Support System*

We have designed and manufactured several devices that offer mounting points for switches. The mountings have been tailored to suit specific individual requirements and attach to a range of furniture. One was designed to hold switches in an ideal location for a child to operate from a standing frame; this same device was adaptable to suit a wheelchair. A mounting for the communication device accompanied the switch mountings and was also transferable between the wheelchair tray and the standing frame.

2. *Trays*

We have designed and manufactured several trays for children this year offering activity surfaces, work areas and mountings for a range of tasks. They have been varied; some have been fairly simple but essential in assisting a child's development both in school and at home. Others have been more complex incorporating foldaway surfaces and in some cases mounting the trays to unconventional furniture.

3. *Multi-purpose Activity Tray*

A number of children with physical disabilities are integrated into main stream schools. Often these children need equipment designing that will improve their independence within the classroom environment. Children might suffer from spinal injury or muscular dystrophy and this can greatly limit their movement capabilities. The institute was asked to provide a surface that would fit with an existing wheelchair for the purpose of writing, drawing and reading.

Parents and therapist working with the Institute were concerned about the posture and comfort of the child when completing schoolwork. A multi-purpose tray has been designed that is removable and attractive in appearance. It has an in-built adjustable angled surface that enables the user to write and draw in comfort. It also has a removable book holder this holds paper and small books in an ideal position for the user. A drinks holder and pencil area were integrated into the design and the whole tray collapses into a flat surface if required and is easily removed and stored.

The development of such a device involved initial prototype testing as with any project development, this supported with concept drawings gave the user an insight into how the final device would look thus allowing for feedback at all stages of the design

process. Surface angles were tested etc until the desired functional requirements were achieved. The tray is now being used successfully.

3. *Body Protector*

A brain damaged young adult who moved around on his knees was having an increasing number of fits. He tended to fall flat on his face and was severely damaging his face and losing teeth. The Institute evolved a body protection system which provided foam supports on his chest and a foam padded head band. When he fell forward the foam supports hit the ground first and spared his face. The system has been designed to try and make it as unobtrusive as possible as he has to wear it all the time. Since using the device he has no longer damaged himself and has completely accepted wearing it.

4. Liquid Oxygen Bottle Carrier

A young girl was brought to our attention who was on 24 hour oxygen. To cope with the large oxygen need she had been supplied with a commercially available liquid oxygen supply device. The problem she faced was that although the supply system was designed to be body worn it was far too heavy for the child. Her mother had to go everywhere with her, including at school, to carry her liquid oxygen supply around. The Institute designed a small carrier for the device with very free wheeling castors and a handle. The device was conceptually exceedingly simple but has enabled the child to be much more independent. She can push her oxygen supply around and her parents are also spared the worry of her knocking the liquid oxygen supply over as the carrier has been designed to be very stable.

4. *Wrist Watch Toilet Alarm*

We have designed a one-off toilet alarm that attaches to the wrist; this product was intended for a child who had no means of verbally communicating to parents the need to go to the toilet.

A simple-to-push switch was incorporated into a plastic housing and connected to a buzzer. This when activated raised an alarm and informed parents that the toilet was needed. The noise had to be fairly loud yet not uncomfortable to the user when activated. A series of different coloured interchangeable straps were also made to accompany the watch.

Student Projects

The Institute has a particularly close working relationship with the engineering schools at our own University. Several projects have been run this year.

We are assisting a PhD student in Mechanical Engineering with her work exploring the use of computer manikins in the design of human interfaces and particularly the difficult interface presented by disabled people. It is hoped that a very useful design tool may evolve from her research. Two masters students, also working in mechanical engineering, are using a similar tool to look at two other projects. One is exploring the biomechanics of transferring from a seated position to standing, and looking at the impact of assistive devices. The other is developing a simple robot system to validate some of the findings of the PhD work, particularly in relation to balancing problems. In addition to assisting with these research projects the Institute is liaising with a team of 7 final year undergraduates with their major design project. The students are carrying out some feasibility work on solutions for the problem of taking a wheelchair onto rough ground. They are looking at possible solutions to the problem that would also be feasible from an economical point of view. It is hoped that if they come up with a feasible solution it can be

explored in more detail during the Institute's work on this project, as is described elsewhere.

The BIME Production Unit

Introduction

It is an important aim of BIME to make sure all successful designs are made available to whoever can benefit from them. The primary way of achieving this is for a design to be licensed to a manufacturer. For some disability equipment however the market is too small and specialised for a manufacturer to quickly get back his initial investment in the device. Several years ago the Institute started its own production unit to try and make sure these low market devices were still made available. The Institute, with agreement from some of its major sponsors, uses some of its charitable income to cover production development, tooling and promotion activity. In this way new products can be made available at cost as all the costs involved in getting the product to the market have already been covered. The Institute has to be very careful not to market devices that are in competition with other commercial products as they are obviously being supported by the Institute's charitable status. The production facility has been a great success with many thousands of disabled people benefiting from products that would otherwise not have been made available. Some are marketed directly from the Institute and others are sold through marketing companies.

This report summarises progress over the year for the BIME Production Unit. It highlights a few specific devices and outlines the current situation with regard to the development of the unit. We are most grateful to the Emmandjay Trust for their generous funding of the production unit technician. The accompanying table shows the range of devices currently being manufactured.

Products

Bottom wipers

Sales of the rigid wiper have continued at an excellent level although the folding version has reduced due to overstocking on the part of the marketing company.

Buggies

Sales of the buggies have continued satisfactorily and we feel we are now seeing the results of many months of hard work promoting the devices. The new accessories have been very well received, particularly the hand switch control unit, as many severely disabled children found the joystick control rather awkward. The work on the remote control units has been successful and we are now looking at incorporating them as purchasable accessories. We have also modified the head-support units for both buggies to make them stronger. It had been found that although a "do not push" notice had been attached to the back of the head-support some users did try to push the buggy at this point, and one unit had become damaged. The new design is much more substantial and can be pushed without fear of damage. The backs have also been modified to take a commercial upper body harness for those children who require extra upper body support.

Although sales have been satisfactory we have been concerned that the take up nationally has not matched what we were able to achieve locally. Consequently some discussion has taken place with two companies with a view to their including the buggies in their range of products. The discussions are at an early stage but may well enable more children to gain access to the units through increased awareness on the part of their carers. We have preferred not to go down this route in the past because there would be an inevitable increase in the price. However we feel on balance the improved marketing would increase the level of use.

We have long felt that the use of buggies is not just important for children in the UK. The use of powered mobility for children is much more common in North America than in this country. We have had some advice from our local business support organisation "Business West" about selling in the USA and they have given us details of ways of contacting possible companies there with a view to manufacturing the buggies under licence. Again this work is at an early stage but it is hoped that progress will be made during the year. We were also contacted by Jetro, an import organisation in Japan, to see if we would be interested in a similar arrangement in Japan. They have borrowed a buggy and paid for it to be shipped to Japan and to be displayed in several trade exhibitions in Japan and a number of companies have since contacted us, although no serious contacts have been made so far.

Bicycles for people with restricted growth

Both the infant and adult bicycles for people with restricted growth problems completed their development in the year and much effort was expended taking them both through production development, including the fabrication of welding and brazing rigs. Commercial bicycles were identified that contained many of the components needed (wheels, brakes, gears, etc) and frames were fabricated from steel tube.

A dynamic loading test rig was devised based on the British Standard for bicycle frames and test frames subjected to the loading procedure. No problems whatsoever occurred, with the frames tolerating loads well in excess of the ones required.

A small batch of both the adult and infant bicycles were constructed ready for the Restricted Growth association's annual convention in Hull. The Institute took an exhibition stand at the Convention to promote the bicycles and the other devices developed for such users. The bicycles were very well received and the initial batch quickly sold. A further

batch is currently under construction. We have also had initial discussions with a cycle manufacturer who markets a range of bicycles for disabled people, to see if they would be interested in manufacturing the bicycles under licence. It is hoped these discussions will lead to a successful outcome during the next year.

It was clear from discussions with the RGA that an intermediate bicycle would be useful for junior age children and it is planned to develop one ready for next year's convention.

Wheelchair exerciser

Feedback from both the units on trial and from those supplied to sports centres as part of our National Lottery agreement had indicated that the exercisers were functionally excellent but did have a long term bearing problem. The flywheel bearing housing was modified to take a more substantial bearing but the problem seemed to lie more with how the flywheel was suspended. Consequently the flywheel mounting was modified and the fibreglass housings adapted to accommodate it. This arrangement has proved to be very satisfactory. Tooling has mostly been completed for the new design and it is hoped to start marketing the device within a few weeks.

Swallowing Aid

Excessive drooling makes social contact difficult and special clothes are sometimes necessary. If someone can be encouraged to learn to swallow regularly they will be able to keep themselves dry without recourse to more invasive procedures. BIME has designed a device to assist in the accepted therapeutic practice of the use of body-worn swallow reminders. Clients are encouraged to swallow as the aid bleeps, in the hope that a swallowing reflex will develop. The aid has been redesigned this year to improve the

packaging and controls. A new digital is currently being designed to replace the current production unit.

Movement reminder

The Movement reminder has been selling quite well and the only problems that have occurred have been with people draining the batteries too low for the device to function correctly. The design has been modified to include a low battery warning alarm and all future devices manufactured will include this facility.

Hearing assessment unit

There has been a lot of interest in the hearing assessment unit, mostly arising from word of mouth recommendations from current users. The devices enable an assessment to be made of the hearing capabilities of babies and young children. Each device incorporates six electrically powered toys and we have experienced some difficulty in procuring these. Many modern electric toys have a variety of clever features whereas all we require is plenty of attractive movement. A supplier in Scotland has been very helpful although using them has required buying fairly large numbers of toys at a time. However orders for this expensive item keep coming in and hopefully are helping with early diagnosis of hearing problems in babies.

Chin support

The use of the name "HeadUp" for the chin support to underline the fact that it helps too keep the child's head more vertical rather than physically support it, has had to be dropped. A search of trademarks found it was already in use and the name has had to be changed to "ChinUp".

Other Restricted Growth Association Items

The Institute's programme of design and development of devices to help people with restricted growth problems is almost complete. The bicycles have now been productionised, as described above. Several other items that were developed following a user needs assessment exercise are in their final stages of development. Pre-production versions of several of these devices were exhibited at the 1999 RGA Convention in Hull and were well received. Rather than starting to market these other devices in "dribs and drabs" it is planned to complete tooling for them and have small batches of all of them ready for the 2000 convention.

Trace box and selection box

Both of these items have come back for further development before we include them in the range of saleable products again. They have both been effective devices but it is felt that both would benefit from further development. An additional electronics engineer has recently been employed at the Institute and he will be putting in some further work on these items.

Quality control and CE marking

All those devices currently being sold and requiring CE marking have now been through the process. The procedures for its implementing are now part of the general project procedures and although they have led to more work within the projects affected, they have led to a more systematic approach to quality control.

Outside contractors

The links with our main outside contractor for machined components have continued to be excellent. The company has shown a very flexible approach to dealing with our needs, and a willingness to help with prototype work as well when the workshop

loadings become excessive. An alternative plastic coating company has also been found who provides a much wider range of colours and an improvement in quality. The only major problem has occurred with getting tube bending done for tube sizes outside the scope of our own bender. We are using a car exhaust manufacturer for our bicycle frames!

Staffing and facilities

Most of the primary manufacture is now contracted out to local workshops and our local sheltered workshop has been very helpful with assembly work and with covering peaks in demand. As was reported last year they have been happy for one of their staff to come into BIME for a week or two at a time to cover these periods of more intense activity

Conclusions

The production work is a core part of BIME's activities now and enables us to demonstrate to our sponsors very directly the way their support can improve the quality of life for disabled people. We are confident that the more focused activity being undertaken on promotion and marketing work will increase the take up of successfully develop devices, and we continue to be very pleased with the way that the production activity integrates with our design and development work.

Promotion and Marketing Work

The promotions sub-committee has continued to co-ordinate the promotion and marketing activity. The personnel involved have changed from last year. Tim Adlam continues to be involved but only on a one day per week basis. His graphics expertise is being used to maintain the promotions materials and to keep our web site up to date. (www.bath.ac.uk/Centres/BIME). An increasing number of enquiries arise from people accessing our site. Jill Jepson, whose main role at BIME is to provide Occupational

Therapy advice to the design staff, is now working for 16 hours per week overseeing the promotions work.

Our entries in the Disabled Living Foundation's lists have been kept up to date and lead to many enquiries. During the year fifteen exhibitions have been attended. These were carefully chosen to target therapists and people with disabilities, and have resulted in an increased number of enquiries about our products.

A review of the Institute's promotions and marketing activities was carried out at the end of 1998. The review's report recommended the continuation of the work with two additional major recommendations for further action.

1. Much more effort should be put into trying to get marketing companies to include our products in their ranges.
2. More emphasis should be put on demonstrating devices to potential customers, particularly therapists.

Liaison with marketing companies is now included as an activity that the designer responsible for each project must incorporate in his/her programme. For products currently being sold or undergoing production development the Institute has enlisted the help of a technology transfer group working with several local universities. The organisation is known as Western Arc and has DTI support to improve the take up of products from Universities. They are currently involved in advising about several BIME products and have been very helpful.

For the second conclusion, as was mentioned above. Jill Jepson has been spending more time on promotions work with a particular aim of increasing the number of demonstrations to potential customers. When Jill gets a request for a demonstration she tries wherever possible to arrange for several local people to be involved. For example if a

request comes from an Occupational Therapy department for one of their clients Jill will try to encourage them to bring in other potential users and therapists. This approach has worked well and has meant that one visit can demonstrate the devices to several possible users. It has ensured that several people are made aware of the devices for future use and can introduce people to other related products. The approach has been particularly effective for promoting buggies with five demonstrations resulting in the sale of seven buggies.

A number of other promotional activities have continued throughout the year. In September we held an open day to publicise our work to local health services, social services and schools. It was generally felt to be a successful venture. Editorial in various publications available to therapists and people with disabilities continues to be an effective method of promoting the Institute's work and products, and during the year a number of articles have appeared both in national publications and the local press.

During the year a van was bought to help with the promotions work and with providing transport for the many tests and evaluations of evolving prototypes that the Institute carries out. We are very grateful to the Emmandjay Trust for providing the financial support for this acquisition. A Vauxhall Combo van has been purchased after much shopping around, and this has been decorated with the BIME logo to help with promotion. The van has made a tremendous difference to our transport problems. We no longer have to hire vehicles for demonstrations and exhibitions, or for evaluations of prototypes. This has both led to a marked reduction in the cost of hiring, and has prevented the damage to the staff's own vehicles that inevitably occurs when they are carrying around devices in their own cars. It has also had a therapeutic benefit. The staff are very proud of the Institute and there is something very appealing about driving around and advertising

BIME at the same time! The van even appeared on local television as part of the BBC's reporting of some work we did with support from the Children in Need appeal.

General

1. *Council*

At the AGM in October we were very pleased to learn that Dr N R Nutt had agreed to serve a further term of office and was re-elected. We also welcomed Mr R A Cross who was elected to Council. We said farewell to Mr W Crossland and expressed appreciation of his role as a Founder Governor of BIME and of his continued support and commitment over the years. The assistance and loyalty to the Institute for many years of all our Council members and officers is greatly appreciated.

2. *Projects Committee*

Under the Chairmanship of Dr A K Clarke, the Committee kept all the above projects under active review and contributed their individual experience and expertise in their different fields to the various projects. I would like to record the thanks of the Institute to the members of the Projects Committee for their valuable time and advice given to this work.

3. *Annual Lecture*

Our 31st Annual Lecture was presented in October by Professor Duncan Dowson of the School of Mechanical Engineering, University of Leeds. His subject was "Bio-Tribology – the lubrication, friction and wear of skin, hair, teeth, natural and replacement synovial joints". Professor Dowson gave us a fascinating lecture on the use of new materials and articulation technologies to advance the development and research of joint replacement. This has enormous importance in improving the quality and lifetime of replacement joints. The

lecture was greatly appreciated by the large audience and we are most grateful to Professor Dowson.

The Annual Lecture for the year 2000 will be given at the University of Bath on Friday 13th October by Professor Ian D Swain of the Department of Medical Physics and Bioengineering, Salisbury District Hospital and the Department of Engineering, University of Bournemouth. Professor Swain's field of interest is in the use of electrical stimulation to control leg and arm muscles to provide some function in the spinally injured and also in using the technique to improve walking after stroke. We can look forward to another most interesting lecture.

4. *Presentations and Publications*

The work of the Institute has been presented during the year at a number of meetings and through publications. Presentations in other countries are always funded by grants from professional engineering bodies, such as the Fellowship of Engineering, Academy of Engineering, Institutions of Electrical Engineers and Mechanical Engineers and the Royal Society.

Presentations

Adlam T, Jepson J, "The design of daily living aids for people with restricted growth in cooperation with a support group", Rehabilitation Engineering Society of North America Conference, Long Beach, United States, June 1999

Hagan S, Orpwood R, "Carer remote control for a children's mobility aid", Rehabilitation Engineering Society of North America Conference, Long Beach, United States, June 1999

Hillman M, "Assistive Robotics - the way forward", Best practice in electronic assistive technology (Institute of Physics and Engineering in Medicine), Birmingham, March 1999

Hillman M, Hagan K, Hagan S, Jepson J, "A wheelchair mounted assistive robot", Rehabilitation Engineering Society of North America Conference, Long Beach, United States, June 1999

Hillman M, Hagan K, Hagan S, Jepson J, Orpwood R, "A wheelchair mounted assistive robot", International Conference on Rehabilitation Robotics, Stanford, United States, July 1999

Hillman M, Hagan K, Hagan S, Jepson J, Orpwood R, Adlam T, "Design of a wheelchair mounted robot", Association for the Advancement of Assistive Technology in Europe Conference, Dusseldorf, Germany, November 1999

Hillman M, "Integration of a robotic device onto a powered wheelchair", Wheelchair Stability Meeting (Institute of Physics and Engineering in Medicine), York, March 2000

Orpwood R., "Designing disability equipment", Annual conference of the Restricted Growth Association, Hull, 1999

Publications

Adlam T A, Jepson J J & Orpwood, R, "The design of a bicycle and other daily living aids for people with restricted growth", Assistive Technology on the Threshold of a New Millenium, Assistive Technology Research Series, vol 6, 245-249, 1999

Dunn T, Goodman A, Hill A, "Syringe pumps IVAC P7000" Evaluation (DH/MDA) 383, 1-28, August 1999

Hagan S & Orpwood R, "The development of a Haemoglobinometer and Field Microscope for Primary Care use in Developing Countries", Proceedings of IEE Seminar on Appropriate Medical Technology for Developing Countries, 6/1-6/3, 2000

Hillman M R, Hagan K, Hagan S A, Jepson J, Orpwood R & Adlam T, "Design of a wheelchair mounted robot", Assistive Technology on the Threshold of a new Millennium, Assistive Technology Research Series, vol 6, 316-321, 1999

Orpwood R, "The responses of a cortical model to input pattern categories", British Neuroscience Association Abstracts, 15, 65, 1999

5. *Educational Activities*

The Institute can provide a very useful resource for schools and universities for students interested in a career in medical engineering. We receive many calls and letters each year asking for career advice or for help with student projects. This year has seen an increase in this trend with many students contacting us or visiting for a brief chat. Information has also been provided to assist many students with their design projects. The requests for support have come from all over the country and there is no doubt that the

Institute is well respected as an authority in the field. This work does of course use some of the Institute's resources but it is not large and it is felt that these activities are one way in which we can ensure that good quality students are attracted into medical engineering and given support to achieve their aims.

The background of these students can vary enormously, from those already committed to working in the field from an engineering or industrial design background, to those who are still making decisions and wish to have some guidance about what the field is all about. As well as students from a technical background we also receive many requests to show our work to undergraduate therapists as part of their training. Again it is felt this is an important part of the Institute's work, as identifying the needs of disabled people and appreciating that a technical solution could help often comes from therapists. It is important that they realise from their training the importance of communicating with organisations such as BIME in order for new products to be developed.

6. *Professional Training and Activities*

It is important to the professional development of members of staff that they are involved in activities relating to their profession outside of BIME. The main professional body representing medical engineers in the UK is the Institute of Physics and Engineering in Medicine (IPEM). Several members of staff are members of the Institute. This provides them with a means for communicating with other people in their field and for developing as engineers. IPEM runs a Continuing Professional Development (CPD) scheme and staff members participate in this. Dr Hillman is also chartered through the Institute of Mechanical Engineers (IMechE), and a member of their Medical Engineering Division Board. Several other members of staff are in the process of becoming chartered through the various engineering institutions. As with many other professionals involved with health

care there is a move for all engineering staff to be registered as clinical scientists if they are working directly with patients. The registration is currently not mandatory but will be shortly. Dr Hillman, Ms Dunn and Dr Orpwood are all registered.

The Institute is keen for its staff to continue training in post to improve their skills. Mrs Hagan is registered for a PhD at Bath University on her robotics work. Mr Gibbs is registering for the new Pre-membership Programme of Advanced Training and Responsibility (PATR) run by IPEM. Mrs Hill is following a clinical sciences masters course at the University of the West of England. And we should congratulate two of our staff who have just competed training courses very successfully. Mr Gibbs has completed his IPEM grade 'A' training scheme and achieved a merit for his diploma. Mr Taylor has just been awarded an MA in industrial design, where he was awarded a distinction.

Various members of staff are also involved in outside committee work or advisory bodies. Miss Dunn sits on the British Standards Institution Technical Committee considering Infusion pumps and controllers. Dr Hillman is secretary of the Engineering Group Board within IPEM which focuses particularly on the professional development of engineers within the organisation. Dr Orpwood is an advisor to the EU Telemate project which is examining training within the European Union for people working at the interface between engineering, clinical practice and administration. Mr Hagan is the Computer Users representative for the School of Postgraduate Medicine and Dr Orpwood also sits on the Executive Committee of the School. Dr Hillman and Dr Clift (from BIME's Council) organised the IMechE's 11th Biomedical Engineering Undergraduate Student Competition. Dr Hillman chaired the panel, with Dr Clift and Dr Clarke (who chairs BIME's Projects Committee) acting as judges. Dr Orpwood is a member of the International Editorial Board of the journal Medical Engineering and Physics and of the new journal Mathematical

Neuroscience. Dr Hillman is a member of the International Editorial Board of the journal Robotica. Dr Hillman was the external examiner for a PhD student at Portsmouth University for research on autonomous wheelchairs.

7. *Technology Transfer*

A crucial part of the Institute's aims and objectives is to make sure that all successful designs become available to the people who can benefit from them. Part of the work carried out to realise this aim is the activities carried out by the Institute's production unit. However the most effective way of getting new devices into the hands of users is to involve an outside manufacturer who can produce the new product or who could include the device in their product range and promote it along side them. This technology transfer work has been assisted during the year by a technology transfer organisation working with several of the local universities and funded by the DTI. The organisation, Western Arc, employs consultants who have been able to guide the Institute with several of its products, as described below.

Cryoprobe The Institute has long had an interest in freezing probes for surgery and has developed commercially successful devices that have benefited many patients. Through Western Arc a glossy leaflet promoting the Institute's expertise has been produced for sending around the 30 or so companies worldwide who are involved in cryoprobe manufacture. The aim is to seek agreements or contracts with such companies to use the Institute's expertise for possible new medical products.

Haemoglobinometer This device could have a significant market and an outside manufacturer is needed to produce them. A company has been identified who has much experience of exporting technical equipment to developing countries. Western Arc is also helping to explore possible markets for the device in primary care in the UK.

Microscope Again the same company mentioned above is keen to manufacture and market the microscope to the developing world. Possible other UK markets are also being explored.

BIME Buggy The success of the BIME Buggy has prompted us to see if a manufacturer or marketing company might be keen to take on this device. As we know that there is a lot of interest in pre-school mobility in other countries, particularly the USA, we are keen to identify a company selling internationally.

RGA bicycles Discussions with a UK bicycle manufacturer are underway.

Wheelchair baby carrier, lever propulsion system and standing transfer unit All these devices are at an early stage of exploration with possible manufacturers.

It is hoped that the support the Institute is receiving from Western Arc will enable more successfully developed products to be made available to potential users and realise an important objective of BIME. We are very grateful to Dr Colin Lucas from Western Arc for his assistance.

Conclusions

The Institute has had a most encouraging year in terms of projects completed, projects advanced, uptake of aids from the production unit and in the level of donated income with which we have been supported. With our increased commitment this year to providing the awareness of the help we can provide, we are particularly pleased to see the increasing number of our developed devices finding routes to members of the disabled community who need them and this feature I highlighted in the introduction to this report. We look forward next year to sustaining our increased commitment, following our 30th anniversary appeal, to both our equipment development work and in continuing to seek to reach disabled people and their carers whom we can assist. Our future work, of course, depends on the level of regular

giving to the Institute and whether this level keeps pace with increasing costs and project commitments. We are greatly indebted to our many sponsors who have supported us so generously and have enabled an effective engineering team to work on providing solutions to many problems encountered by ill and disabled people. We would appeal to our regular sponsors to please continue their support; and for other and new supporters of the Institute's aims and work to consider providing assistance for our work perhaps on a regular basis.

April 2000

Professor S C Lillicrap

Director