525

AN EVALUATION OF CERTAIN ASPECTS OF AN OCCUPATIONAL HEALTH SERVICE

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SUMMARY

This thesis has been concerned with obtaining evidence to explore the proposition that the provision of occupational health services as arranged at the present time represents a misallocation of resources.

The research has been undertaken within the occupational health service of a large Midlands food factory. As the research progressed it became evident that questions were being raised about the nature and scope of occupational health as well as the contribution, in combating danger at work, that occupational health services can make to the health and safety team.

These questions have been scrutinized in depth, as they are clearly important, and a resolution of the problem of the definition of occupational health has been proposed. I have taken the approach of attempting to identify specific objectives or benefits of occupational health activities so that it is possible to assess how far these objectives are being achieved.

I have looked at three aspects of occupational health; audiometry, physiotherapy and pre-employment medical examinations as these activities embody crucial concepts which are common to all activities in an occupational health programme. A three category classification of occupational health activities is proposed such that the three activities provide examples within each category. These are called personnel therapy, personnel input screening and personnel throughput screening.

I conclude that I have not shown audiometry to be cost-effective. My observations of the physiotherapy service lead me to support the suggestion that there is a decline in sickness absence rates due to physiotherapy in industry. With pre-employment medical examinations I have shown that the service is product safety oriented and that benefits are extremely difficult to identify. In regard to the three services studied, in the one factory investigated, and because of the immeasurability of certain activities, I find support for the proposition that the mix of occupational health services as provided at the present time represents a misallocation of resources.

KEY WORDS

Evaluation
Occupational
Health
Cost
Benefit

PREFACE

This thesis is the result of research involving a tripartite arrangement between the Interdisciplinary Higher Degrees Scheme, the Department of Safety and Hygiene and Cadbury Schweppes Limited.

The Interdisciplinary Higher Degrees Scheme (IHD Scheme) was established at the University of Aston in Birmingham in 1968 to develop a programme of broader postgraduate education by utilising an interdisciplinary approach to enquire into problems in an industrial context. The student spends between 30% and 70% of his time in industry and the remainder at University. The aim is to draw upon several disciplines, if necessary, in order to synthesize a research area which is of practical relevance to industry as well as retaining the academicism for registration for a higher degree. As this usually involves research in previously unexplored territory the student's first degree is not necessarily directly related to the research area. This may contribute in that over-specialisation or too narrow an approach is avoided.

The Department of Safety and Hygiene (formerly the Safety and Hygiene Group) was set up in 1971 following a joint initiative by local industry and members of the University of Aston in Birmingham. Its primary objective was to establish safety and hygiene as an academic discipline. The Department's research is oriented towards conceptualizing research areas within industry such that new knowledge will result in safer and healthier places of work.

There was thus opportunity and scope for the IHD Scheme and the Department of Safety and Hygiene to cooperate in applying the Department's research aims and drawing on the IHD Scheme's interdisciplinary approach.
Cadbury Schweppes Limited was approached and agreed that one of the research areas which satisfied the above criteria was in the evaluation of the company's occupational health service.
The research discussed in this thesis thus attempts to contribute to the growing field of safety and health at work.

CONTENTS

PAGE

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A supervisory committee was formed to oversee the project and this consisted of members of Aston University's Department of Safety and Hygiene, the Management Centre, the Interdisciplinary Higher Degrees (IHD) Scheme and representatives from Cadbury Schweppes where the project work was carried out.

Members of the Department of Safety and Hygiene who contributed by their comments and helpful suggestions include Professor G R C Atherley, Mr M R Phillips and Mr A R Hale as research coordinator.

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CHAPTER 1

Introduction

The question of organisation and administration of occupational health services within the context of the provision of medical care on a national level has been raised intermittently over many years. One of the central issues in the discussion has been the extent to which resources can be channelled so as to provide an overall service of maximum efficiency within the context of manpower and resource constraints (Department of Health and Social Security, 1976). This aspect of economic rationality was recognised after the introduction of a National Health Service especially when doubts began to be raised about questions of overlapping between the NHS and the health services already established in industry.

These doubts were crystallized in a statement by the then Prime Minister, Mr Attlee, on June 1, 1949 to the House of Commons announcing that the Government had been considering the relation between the NHS and the various health services then provided in industry and calling on medical manpower:

> "In order to secure that the country's limited medical resources are used to the best advantage and with due regard to economy,"

said Mr Attlee,

> "it is essential that these services should be organised in such a way as to ensure that there is no duplication or misdirection of effort. I have therefore appointed to advise the Government on this matter a Committee whose members are drawn from the industrial field, including

both the management and the trade union sides, and various branches of the medical profession."

The Prime Minister suggested to all branches of industry that in view of this inquiry substantial further development of industrial health services should so far as it is possible be postponed until the Committee's recommendations were available; (Hansard, 1949).

The Committee's terms of reference were:

"To examine the relationship (including any possibility of overlapping) between the preventive and curative health services provided for the population at large and the industrial health services which make a call on medical manpower (doctors, nurses, and auxiliary medical personnel); to consider what measures should be taken by the Government and the other parties concerned to ensure that such medical manpower is used to the best advantage; and to make recommendations" (Report of a Committee of Enquiry on industrial health services, 1951).

The Committee (sometimes known as the Dale Committee after its chairman Judge E T Dale) confined itself to indicating any matters to which they thought further inquiry might be rewarding, such as experimentation in the establishment of group occupational health services.

They concluded that whenever overlapping of medical services occurred between the industrial medical services and those provided for the population as a whole, it was admissible because:

"the general burden of evidence is that where the doctor or nurse is fully occupied at the factory the overlap in

> those matters is justified as benefitting productivity. Furthermore, the benefit to the patient in some cases may be considerable and there will be a lessening of the load on the NHS."

In considering diagnostic examinations where ill-health is suspected the Committee again saw the possibility of overlapping. They concluded, however, that:

> "within reasonable limits overlap may well be justified in the interests of the efficiency and welfare of the workers."

The Committee held twenty-seven meetings in all and, because of the postponement of further development of industrial health services until their recommendations were available, framed a brief report.

On the whole the inquiry left the Committee

> "with no doubt as to the essential importance of industrial health services from whatever angle the subject is considered"

They stressed the value of industrial health services in relation to the nation as a whole and emphasized that there would be a corresponding lessening of the demand on the NHS.

They recommended that industrial health services should be maintained and encouraged to expand with due regard to the demands of all other health services for medical manpower.

Since the publication of the Dale Committee's recommendations there has indeed been expansion and elaboration in the facilities provided for doctors and nurses working in industry.

Phillips (1976) has shown, using numerous sources, how the employment of doctors and nurses in industry has grown over the last 50 years. These numerical estimates and the sources used are shown in Appendix 1.

This growth has been achieved purely on a voluntary basis mainly by enlightened and socially conscious employers and principally those employing many people in large factories although group occupational health services (each dealing with a number of small factories) have proliferated to some extent; (Hill 1972). However, the majority of people at work are employed in relatively small factories and these have little or no access to medical supervision at work. For this and other reasons, such as the continuing rise in sickness and absence rates, many organisations including the Trades Union Congress (1965) and the British Employers Confederation (1965) have called for an expansion of medical supervision of employees at work into what has become known as a national occupational health service. There are various organisational ways in which this might be accomplished.

Sir Arthur Porritt in 1962 considered that there were three ways in which an occupational health service could be arranged:

(i) wholly absorbed in the National Health Service or,

(ii) partly private, but run in association with, and partly administered by the National Health Service, or

(iii) completely independent of the National Health Service.

There were arguments for and against all three courses.

The incorporation of existing services into the National Health Service would lessen professional isolation by bringing occupational health into the main stream of medical development. This course has since been advocated by the Royal College of Nursing (1968) and the Socialist Medical Association (1972) though it was concluded by Porritt that it was not practical at the time although it was probably the best solution in the long run. One difficulty would be that existing occupational health services have grown up as an integral part of their parent industry or company and are organised accordingly, both in terms of geography and structure. Employers would probably not look forward to medical services which they had created being taken over by the National Health Service. Porritt recommended that the second course should be followed, as suggested by the British Medical Association. Occupational Health services would then have a dual character, one part remaining private and consisting mainly of existing services and the other public administered by Area Health Boards.* As long as the private services maintained proper standards they would remain in private hands. Other companies could establish their own private services as long as the set standards were upheld. The public sector occupational health service would concentrate on the large number of smaller concerns and the few larger ones which needed a service but did not have one. The third course of action, that of complete independence of the National Health Service, was deprecated by Porritt, because of the danger that gross variations in standards might occur. The present day situation is that this third option has in practice been followed and the courses advocated in (i) and (ii) have not been followed.

Occupational health services of the time were allowed to develop or contract purely on the decisions of employers, and employees whenever they have been brought into the decision making process. The result has been to maintain a mainly privately organised occupational health service except for the establishment, in 1973,

* Area Health Boards were administrative committees responsible for the management of local health resources.

of a government medical advisory service known as the Employment Medical Advisory Service. The important feature of any major expansion of occupational health, whichever organisational course is followed, is that it would involve a relocation of the point of contact between doctor and patient from a home and family based service, as we have at present, to one based to a large extent upon the workplace. This course has been advocated by the TUC (1965), the BEC (1964), by medical practitioners organisations such as the British Medical Association (1941), the Medical Practitioners Union (1953), the Socialist Medical Association (1956) and the Society of Occupational Medicine (1972) and by the Labour Government when in opposition BMJ (1973).

The Office of Health Economics in 1971 supported this change as being a contribution to reducing sickness absence in industry:

> "A qualified health team on the spot with knowledge of working conditions may be expected to be better able than a general practitioner to relate the individual's state of health to the job he has to perform. The industrial doctor is in an excellent position to co-ordinate schemes for the supervision of sickness absence while medical advice to management may be expected to encourage good conditions of employment."

And on the question of duplication with the NHS:

> "But duplication need not take place and occupational health and general practice should complement each other rather than overlap. There should ideally be close contact between the occupational services and the health centre or group practice ..."

Despite all sections of the community's advocating some form of expansion, on a national scale, of occupational health services expansion has not occurred - why not?

It appears to me that there are factors which have contributed to this lack of direction:

1. There has been, and still is, a lack of a generally accepted definition of occupational health. Also lacking is a body of knowledge which delineates the field from those encroaching upon it such as that practised by safety advisers, occupational hygienists and loss control advisers.
2. It has been suggested that limited resources limit direction of change and the pace of medical organisation but no studies have been made which show whether change in one direction or another will benefit the community, nor whether the present pace is inappropriate.

In Chapter 2 I expand on the problems of defining occupational health and show how these might be resolved.

In Chapter 3 I deal with the techniques of allocating priorities in times of resource constraint and their relevance and application to occupational health.

In Chapter 4 I outline the occupational health activities at Cadbury Schweppes and the reasoning behind the selection of the particular activities for analysis. Chapters 5, 6 and 7 then describe the application of these techniques and the findings that emerge as a result of this research.

CHAPTER 2

Defining Occupational Health

In the introduction I have put forward two main reasons why expansion, in the sense of having a nationally organised, financed and coordinated occupational health service, has not occurred.

In this chapter I discuss the first of these, namely:

- that there has been, and still is, a lack of a generally accepted definition of occupational health and a body of knowledge which delineates the field from those encroaching upon it such as that practised by safety advisers, occupational hygienists and loss control advocates.

The most commonly stated definition is the statement of the aim of occupational health arrived at by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950, namely that:

"Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention among workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological equipment and, to summarize; the adaptation of work to man and of each man to his job."

This definition has the disadvantage in that it represents a global representation of the activities of occupational health and as such it is difficult to bring out specific objectives which can be interpreted, assessed, and perhaps measured. Another difficulty is that occupational health services have often been described as "industrial medical services", "medicine in industry" or "occupational medicine". The interpretation of these terms in the light of the above definition has not been the subject of widespread agreement.

The factors underlying this disagreement can perhaps be discerned by my describing the evolution of the impact which medical practitioners have made on health and safety at work.

2.1 Occupational health origins

Medical men initially began to become involved in factory conditions on a formal basis after the passage of the 1833 Factories Act

> "To Regulate the Labour of Children and Young Persons in the Mills and Factories of the United Kingdom."

A medical certificate was required, countersigned by an inspector or magistrate stating that the child had the ordinary strength and appearance of a child of nine.

This was required because, until 1837, there were no birth certificates. With the advent of birth registration in 1837, age certification by the surgeons was no longer necessary.

The most important feature of the 1833 Act was that a Factory Inspectorate was formed to administer its provisions, consisting initially of four inspectors. The factory inspectors tried to arrange as far as possible for one medical man in each district to perform the duty of certifying surgeon but there were no statutory back-up powers until 1844. In this year power was given to them to appoint a sufficient number of practising medical men to be certifying surgeons for the purposes of examining young persons, though it was still possible for certificates to be given by persons other than the certifying surgeon provided there was a counter-signature by a Justice of the Peace; (Hunter 1975).

The 1844 Act also required notice to be given to the certifying surgeon of any accident causing bodily injury which prevented the injured person from returning to work before 9 am the following morning. The surgeon upon receiving a notice was required to investigate the nature and cause of the bodily injury and within the next 24 hours to send a copy of his report to the District Inspector together with any other information about the accident. Certifying surgeons were also given, for the purposes of the accident investigation only, the same powers of authority, inspection and entry as factory inspectors.

The Factory Act of 1855 gave certifying surgeons new duties - to certify that young persons were not incapacitated for work by disease or bodily infirmity.

In 1868, the scope of medical practice in the occupational sphere was extended and formalized by the formation of the Association of Certifying Medical Officers of Great Britain and Ireland whose objects were:

1. The observation and collection of facts tending to promote the advance of sanitary science and the relief and prevention of disease inherent to the various processes of manufacture; and
2. the consolidation and improvement of the position of the certifying surgeon in relation to the Government and the public.

The use of the word 'relief' is perhaps the first time that the therapeutic nature of the medical practitioner's contribution to health and safety at work was recognised at a formal level. The Association was active for about ten years and later a number of its former members were active in the formation of the Association of Certifying Factory Surgeons in 1889. This was also the year in which Thomas Legge was appointed as the first Medical Inspector of Factories.

The certifying surgeon was required, according to Robert Baker the Inspector of Factories in 1868, to examine mills at monthly intervals in order to monitor the health of the worker in relation to dust, gases or the conditions of labour. The appointment of doctors as certifying surgeons continued and led gradually to a statutory medical service for factory workers, provided by some 1800 part-time certifying factory surgeons, later called Appointed Factory Doctors. They had three main functions: (1) the examination of young persons under the age of 18 for fitness for work when they first took up employment and at annual intervals; (2) periodic medical examinations of persons employed in certain dangerous trades; and (3) investigation and reporting on patients notified as suffering from any of the notifiable industrial diseases or who had been injured by exposure in a factory to a noxious substance. This Appointed Factory Doctor Service was abolished in 1972 and replaced by the Employment Medical Advisory Service. The EMAS has wider duties with less emphasis on routine statutory examinations. Its main function is to give advice to employers, trade unions and employees on medical problems connected with employment; (Schilling 1973).

2.2 Confusion over definitions

The practitioners of occupational health have, as the body of knowledge has developed, extended the scope of their discipline so much that today confusion is apparent about the very nature of occupational health practice especially in its interaction with related disciplines. Lloyd Davies (1973) wrote:

> "Maybe occupational medicine is an attitude and not a discipline ... If it is an attitude, is occupational medicine more than medical support to industrial hygiene, industrial nursing or personnel management?"

The primary medical and supportive role also has adherents:

> "Medical examination is the heart if not the soul of an occupational health service" (Shaw 1974).

Other authors, while recognising occupational health as a discipline, see it as:

> "a discipline in search of a mission" (Kerr 1973).

Forssman (1973) suggested that the progress of research in occupational health and safety changed the original ILO/WHO concept of occupational health. Occupational health was originally concerned mainly with occupational injuries and disease. Gradually, the definition has become broader and now covers all aspects of health in relation to work and the working environment.

In 1959 the International Labour Office saw an occupational health service as a service established in or near a place of employment for the purposes of:

(a) protecting the workers against any health hazard which may arise out of their work or the conditions in which it is carried out

(b) contributing towards the workers' physical and mental adjustment in particular by the adaptation of the work to the workers and their assignment to jobs for which they are suited; and

(c) contributing to the establishment and maintenance of the highest degree of physical and mental well being of the worker

This recommendation typifies most of the existing definitions of occupational health in that it emphasizes the preventive and environmental aspects. It is to be seen in the recommendations made by the TUC (1965) and the BEC (1965), now known as the Confederation of British Industries (CBI), in their joint agreement that occupational health services should

- provide immediate treatment for medical and surgical emergencies and minor illnesses which occur at work
- provide for "follow-up" treatment at the place of work, eliminating loss of production time
- collaborate with the worker's General Practitioner in supervision and treatment of the patient
- help persons returning from a period of absence through illness to settle back into the working routine
- examine applicants for employment and advise management on their fitness for particular jobs
- help management to avoid hazards to health and to maintain healthy working conditions
- save loss of production time and contribute to the more effective healthy employment of all

The TUC added that occupational health practice means making a close study of the risks to health that arise from the conditions of work as well as the condition of the worker. They suggested a two-pronged approach: (a) eliminating health hazards by preventive measures, and (b) ensuring physical fitness by examination and treatment.

When, however, the Robens Committee's Report on Safety and Health at Work was published in 1972 the definition of occupational health that was adopted was not that proposed by occupational health practitioners.

The Committee accepted the Department of Employment's definition of occupational health as being that which is concerned with the reactions of work people to their working conditions and with the prevention of ill-health arising from working conditions and circumstances. According to the Robens Committee, occupational health comprises two main elements - occupational medicine which is a specialised branch of preventive medicine concerned with the diagnosis and assessment of health hazards at work; and occupational hygiene which deals with the measurement and physical control of environmental hazards. The Committee saw occupational health as being involved in preventing ill health through control of the working environment and occupational medicine as being one specialised element in this work. They stressed that occupational health is a multidisciplinary subject requiring the skills of chemists and engineers as well as doctors.

It has been suggested by Schilling (1973) that this definition may be too narrow in that it omits another important element of occupational health care - to prevent a patient's illness or disability, which is not necessarily caused by work, from having adverse effects on his own, or on the public's, health and safety.

Examples of workpeople in this category are drivers of public vehicles, aircraft pilots, food handlers and hospital staff. This wider definition of occupational health is in accordance with the ILO/WHO concept of the influence of health on work capacity and safety, as well as the influence of work on health. The Robens Committee reasoned that by no means did all the work of works' medical officers fall within their definition of occupational medicine that is, with the diagnosis and assessment of work related health hazards:

> "At least part of their time is devoted to the treatment of individuals, that is to say to the sort of work undertaken by general practitioners in the NHS. The directors of the group industrial health services estimated that about one-third of the time of the group services was taken up by casualty work and treatment."

This view of the activities of industrial medical services has been expressed in the past by Taylor (1958) who stated that a large part of industrial medicine is neither more nor less than general practice conducted in the context of the factory or other workplace.

The World Health Organisation in its report on Environmental and Health Monitoring in Occupational Health in 1973 said that current practices in occupational health, even in the most highly industrialized countries, seldom meet the goals as outlined by the WHO. In many instances the major emphasis is said to be on the finding of cases of illness and providing the necessary medical care, and true preventive medicine plays only a minor role...

> "Indeed, it is the practice of general medicine in industry and not the practice of industrial medicine per se that

characterises today's efforts."

Undoubtedly many of the skills acquired in general practice are essential to the practice of occupational medicine but it is by no means clear whether the requirements of the work people are primarily an industrial general practice service or alternatively in the preventive environmental control area.

The Robens Committee recognised this problem (paragraph 367):

"It is difficult to establish how much time works medical officers spend on their various functions such as advice to senior management, medical examinations, individual employee problems, casualty treatment, research and so on..."

Some definitions of occupational health are very wide ranging involving not only prevention of occupational ill-health but also total health care of individual workers taking into account the effect of work on man and man on work. This approach heavily emphasises the contribution by medical practitioners and is recommended by the Socialist Medical Association (1972) and the Permanent Commission and International Association on Occupational Health (1969).

Some medical organisations argue that the provision of doctors in industry should come within the scope of the law; for example, the Society of Occupational Medicine (1972).

The Government in 1972 introduced legislation which enabled the Department of Employment Medical Advisers (including personnel of the former Medical branch of the Factory Inspectorate) to take over from the Appointed Factory Doctor Service and establish the EMAS, Department of Employment (1972).

This enactment followed the recommendations of a sub-committee of the Department of Employment's Industrial Health Advisory Committee in 1966 which reported that an inordinate amount of time was spent by AFDS in routine and mainly unnecessary medical examinations, (Ministry of Labour 1966).

The Committee favoured the establishment of a more integrated and expert service with a wider role in occupational health. The EMAS, as mentioned in an earlier paragraph, was to have as its major task the identification and control of industrial hazards to health and safety through epidemiological and technological investigation, decisions on safety standards and the provision of a consulting and rehabilitation service. However, Murray (1974) at that time medical adviser to the Trades Union Congress, thought that EMAS would perform a useful function but that it could not provide an occupational health service for the country as a whole.

This view has also been expressed in the British Medical Journal (1973) where doubts were expressed about:

> "...how 110 E.M.A.s are to provide a service for two-thirds of the employed population, while 600 full-time and perhaps 1500 part-time occupational physicians are at present providing occupational health services of some kind to the other one-third."

Robens recognised that the existence of EMAS should not impede further consideration on occupational health at the appropriate time but that they hoped:

> "that any reconsideration would be based less on a priori arguments than on careful analysis of what actually happens in practice in the field."

When the Robens proposals were published, medical practitioners' criticism centred around the definition of occupational medicine (British Medical Journal 1973).

> "Clearly occupational physicians and occupational health nurses have failed to be sufficiently explicit and convincing about what occupational medicine is"

The implication was that the work done by occupational physicians and nurses in relation to rehabilitation and resettlement at work, assessment of capacity for various types of work, health education, support of group mental health, investigation and control of sickness absence, and, because they are on the spot, the treatment of minor illness and accidents at work was not part of occupational health.

Yet even here there is disagreement as the article goes on to say that:

> "Occupational physicians and occupational health nurses spend up to 90% of their time in aiding the resettlement and rehabilitation of people who have been or are becoming sick or disabled..."

and in a later issue; Moore (1973) saw that this:

> "does appear to exaggerate the extent of this particular function"

and that:

> "it is an oversimplification to regard rehabilitation and resettlement as the major part of his work"

Lee (1973) has said that to distinguish between general medical care at work and occupational medicine it is necessary to ask the question 'Why is it done' rather than 'What is done' or 'Who does it'.

He illustrates this question by considering the medical examinations of senior executives. If the purpose of the examination is to monitor their general health to reassure them or send them for further treatment, if necessary, then there is no reason why the general practitioner should not be the examining doctor for the examinations are not part of occupational medicine. If, however, the purpose of the examination is to monitor the health of the executive to determine whether or not he should continue in his particular job; or, to use the health of the executives as an index to monitor stresses in the situation where they work, then in both instances this is the practice of occupational medicine. Lee is thus attempting to provide a "coherent intellectual framework for the speciality." He does this by building on Himsworth's (1970) conceptual model of scientific knowledge which departs fundamentally from the long-established analogy of a tree of knowledge. Himsworth's model is that of a vast globe of primitive ignorance around the periphery of which there is a whole series of problems prompting men to seek knowledge. From these different points of departure, so the explanation goes, men have begun to penetrate towards the centre. On the periphery are the specialisations and the penetration towards an unspecialised centre is the development of knowledge in that field.

Thus in medicine the penetration sequence is clinical on the periphery, pathological, physiological, biochemical and so on to the molecular level. As one proceeds towards the centre there is progressively more ground in common so that, in theory, towards the centre of the globe most phenomena can be explained in terms of molecular physics and chemistry.

Lee suggested that occupational medicine lies, like clinical medicine, on the surface of the globe, and is that part of medicine which is concerned with the problems which arise on the line of contact between medicine and industry. Man enters the interest of occupational medicine whenever he approaches or crosses that line of contact. He might cross the line of contact into medicine as the result of an accident at work or an occupational disease. There is even provision for passing from the industry sector to the medicine sector without crossing the line of contact but rather by outflanking it by passing through a non-occupational sector.

Lee also suggested that occupational medicine should concern itself not only with the people who cross the line of contact between medicine and industry but also with preventing people from crossing the line of contact. This is to be achieved, apparently, by relating the man, still in the industry sector, to his working environment and its physical, chemical, psychological, and microbiological components. The particular fields which come into play would include industrial toxicology, occupational hygiene, ergonomics and health physics. Such knowledge is used to improve methods of detecting early changes so that the working environment and the exposed population can be more adequately monitored to ensure that no harm comes to persons exposed to that environment. It is when these objectives are being met that Lee suggests that the problems met are entirely those of occupational medicine.

2.3 A possible resolution

As so stated, Lee's formulation of the scope of occupational medicine is an attempt at formalising in a scientific guise the occupational health practitioners' claim to be responsible for all man/health interactions in industry. This is not to say that occupational health practitioners should not specify the discipline of occupational medicine; rather it should be done with a realistic idea of what can be achieved in a practice which is part of a health and safety team, having regard to the vast amount of knowledge required in the control of danger at work. This includes engineering aspects of safety such as noise, ventilation, electrical and machinery safety as well as the prevention of fire and explosion. A detailed knowledge of the law is required especially since the Health and Safety at Work etc. Act 1974 came into force. An essential element concerns human safety, human behaviour and management. All these subject areas are integrated within the study of the dangers found at work and the methods of prevention and control. In the very recent past the discipline of safety professionalism received a low priority both in industry and the academic world. Medical practitioners with an apparently established core discipline, and a relatively long history of involvement in health care at work, (see section 2.1) have naturally embraced health and safety at work as a field of medicine. However, the explosion in knowledge that has occurred and the recent unification of part of that knowledge into the discipline of safety professionalism means that medical practitioners must redefine those aspects of occupational medicine which fall into their sphere as a result of their medical training and expertise as well as practice.

If occupational health practitioners continue to lay claim to the whole field of safety and health at work they risk only a superficial and partial success in that very soon safety professionals at degree and postgraduate level will emerge from the universities and will compete whenever the fields overlap. In order to survive this competition occupational health practitioners after initial medical training have been able to obtain a Diploma in Industrial Health after a relatively short period of study or an MSc after a year's study at the London School of Hygiene and Tropical Medicine. There is also a proposal for specialist registration for doctors working in occupational health.

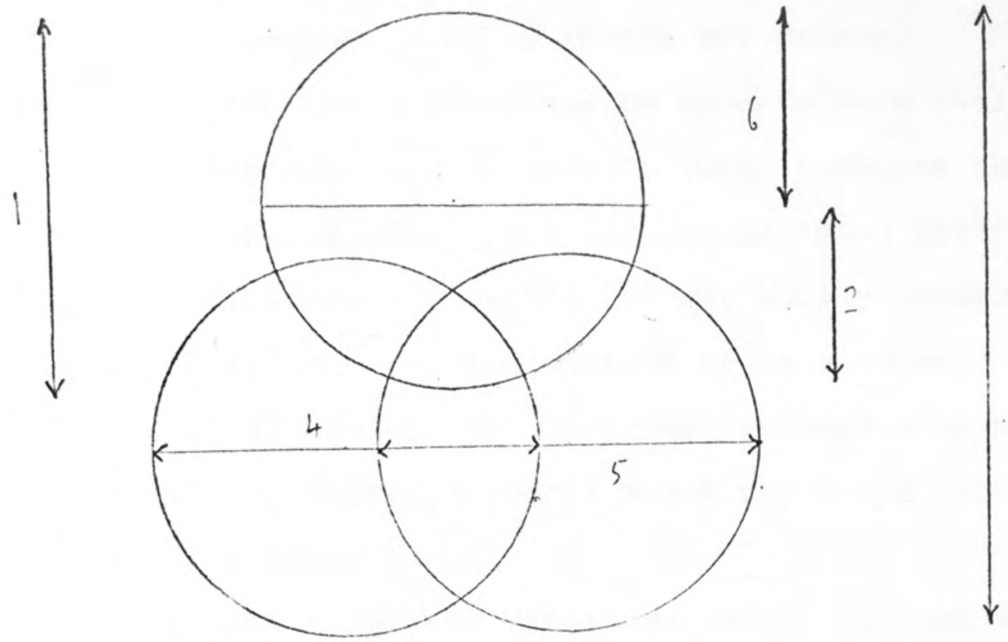
In order to become a specialist in occupational health the occupational health practitioner would have to acquire a grounding in the field of health and safety which would need a system of postgraduate education. For the part-time physician a postgraduate education as described by a Joint ILO/WHO Committee in 1957 would undoubtedly be appropriate.

The safety and health specialist's educational requirements will to some extent overlap education provided for occupational physicians. In order to delineate the borders of knowledge and thus redefine the responsibilities of practitioners in the field of occupational medicine it is useful to compare the educational requirements of full-time and part-time occupational health physicians, as recommended by a Joint ILO/WHO Committee on Occupational Health in 1957, and those of the safety and health adviser soon to emerge from the universities; Department of Safety and Hygiene BSc syllabus (1974). This comparison is set out in chart form at the end of the chapter.

From a comparison of these duties it seems that the work advocated as the province of the occupational health practitioner overlaps to a large extent that which will be provided by the health and safety specialists.

Recently my co-authors and I have put forward a scheme whereby the role of occupational health may be seen in the context of other emerging health and safety professions (Atherley and Kolozyn 1976). This is shown in a diagramatic role in Figure 1.

Figure 1 Scope and interaction of occupational health and safety services



1 occupational health service

2 occupational health nursing and occupational medicine

3 occupational health and safety service

4 occupational hygiene

5 occupational safety

4&5 safety and hygiene service

6 occupational medicine

There are important degrees of overlap where cooperation between the various professions must exist and be actively nurtured so as to achieve the maximum degree of effectiveness in terms of reducing risks to health and safety.

The points which the diagram can be used to make include:

(a) The occupational health service (OHS) combines the work of occupational physicians and occupational health nurses. Their activities are mainly but not wholly concerned with people's health - as individuals or in a group.

(b) Occupational hygiene is concerned fundamentally with physical and chemical agents which may cause injury to the health of people.

(c) Occupational safety is concerned mainly but not exclusively with prevention of injury caused by plant, processes, or equipment.

(d) There are crucially important areas of overlap: for example, occupational health and occupational hygiene combine in the consideration of toxicity; occupational hygiene and occupational safety combine on questions of machine design, and personal protection. Occupational hygiene and occupational safety often overlap so much that they can be combined into a single safety and hygiene service (SHS).

(e) No occupational health and safety programme is complete without some degree of representation of all elements.

Thus the figure incorporates the Robens definition of occupational medicine and occupational hygiene and shows where and how occupational safety is involved in the categorisation. Occupational safety was implicit in the Robens Committee definition of occupational health in that they accepted the role of engineers who are concerned with plant, processes and equipment. However they combined safety under the general heading of occupational hygiene. I submit that the three disciplines of occupational health, hygiene and safety are emerging as distinct professions with elements of overlap where cooperation is possible.

What Robens called occupational health I take to mean occupational health and safety because this was implicit in Robens' definition. Occupational medicine can be defined in a narrow sense as by Robens or in a wider sense incorporating the effects of ill-health, not caused by work, on health and safety. The important point is that occupational medicine is concerned with people's health and there is a distinction between this and the activities of occupational hygienists and safety advisers who are more directly concerned with the physical and chemical agents of harm. Once the different emphasis for each discipline is recognised, each can emerge in its own right as a contributor to the occupational health and safety team in the fight against danger.

Comparison of activities of specialist advisers in occupational health and safety

(KEY: / = CLEARLY HIS PROVINCE, + = PARTLY HIS PROVINCE)

Full-time specialist in occupational health	Part-time Specialist	Safety & Health Specialist
1. Principles of occupational medicine	/	
a) Historical background	/	+
b) Scope and aims	/	+
c) Resources, public health and medical care	+	
d) Structure and function of industry	+	/
e) Industrial relations and labour politics	+	/
2. Industrial physiology		
a) Muscular and mental work, energy expenditure		/
b) Fatigue, monotony, rhythm of work and rest pauses		/
c) Physiological organisation of work, human engineering		/
d) Nutritional problems		+
3. Industrial hygiene	/	/
a) Environmental hygiene	+	/
b) Temperature, humidity, ventilation, light, noise	+	/
c) Air pollution - gases, vapours, fumes and dusts and their control Maximum allowable concentrations	+	/

Full-time specialist in occupational health	Part-time Specialist	Safety & Health Specialist
d) Personal hygiene and personal protective equipment	+	/
e) Sanitary conditions	+	/
4. Occupational pathology and toxicology	/	
a) General principles of industrial toxicology	/	/
b) Disease due to chemical, physical, biological and dust agents		+
c) Occupational cancers		
d) Occupational skin diseases		
e) Occupational allergies		
5. Special medical problems		
a) Specific pathology by trade or branch of industry		
b) Relationship between employment and non-occupational disease	/	/
c) Methods for assessment of disability		
d) Medical aspects of vocational rehabilitation		+
e) Psychoneurosis related to work and injury		
6. Accidents at work		
a) Causes of accidents	/	/
b) Principles of accident prevention	/	/

Full-time specialist in occupational health	Part-time Specialist	Safety & Health Specialist
c) 1st aid and treatment	/	
d) Rehabilitation of the injured worker	/	
7. Occupational psychology		
a) Psychological appraisal and assessment of aptitudes		/
b) Mental health and human relations		/
8. Preventive medicine		+
a) Pre-employment and periodic medical examinations	/	
b) Health counselling		
c) Vaccinations and immunizations		
d) Care of special working groups (young, old, female, handi-capped, etc.)		
e) Leisure, sports, addictions (tobacco, alcohol, etc.)		
f) Education and propaganda		
9. Industrial technology		
a) Work organisation		/
b) Industrial processes		/
c) Job analysis		/
10. Medico-legal problems, social security		
a) Labour legislation		/
b) Social insurance		/
c) Workmens compensation		/

Full-time specialist in occupational health	Part-time Specialist	Safety & Health Specialist
d) Reporting and notification		/
e) Medical ethics		
f) Liaise with other medical and health organisations		
11. Organisation and administration		
a) Organisation of OHS		
b) Nursing services in industry	/	
c) Administration and economic problems		+
d) Medical records and reports	/	/
12. Statistical methods	/	/

CHAPTER 3

3. Resource allocation in Occupational Health

3.1 The need for effectiveness and efficiency studies

Effectiveness and efficiency are terms which are sometimes used interchangeably but on closer scrutiny are shown to have a specific meaning. Etzioni (1971) in the context of modern organisations has said that the effectiveness of a specific organisation is determined by the degree to which it realises its goals while the efficiency is measured by the amount of resources used to produce a unit of output or the maximum level of output that can be produced from a given set of inputs.
In a symposium on the efficiency of medical care in 1966 by the World Health Organisation, Feldstein said that there is a difference between medical or technical efficiency and economic efficiency. A method of health care is medically (technically) efficient if there is no other technique combining the same quantity of inputs and producing more of the same product (or, equivalently, producing the same output of health care with smaller quantities of at least some of the inputs). If several medical techniques are technically efficient then economic efficiency is used to choose between them. Thus, medical or technical efficiency is logically prior to economic efficiency: a technique must be medically efficient if it is to be economically efficient, but not all medically efficient techniques are economically efficient.
Cochrane (1972) considered the terms effectiveness and efficiency in the context of the National Health Service. He criticised some of the medical procedures in use as being untested and medically as well as economically inefficient and recommended

the use of randomized controlled trials to compare different treatment regimes. The randomised controlled trial (RCT) consists of allocating patients into two groups by a method independent of human choice, such as random numbers. In this way the characteristics of the patients are randomised between the two groups and it is possible to test the hypothesis that one treatment is better than another and express the results in terms of the probability of the differences found being due to chance or not. Cochrane went on to say that in order to make the correct choice there must be accurate comparable data about the benefit and cost of the alternatives.

These studies have to some extent been made in certain areas of the NHS, for example in 1966 the Department of Health and Social Security carried out a social and economic assessment of a multiple health screening clinic in Rotherham, (DHSS 1969). Studies of mass radiography (Pole 1971), and dental caries and the use of fluoride (Davies 1974) have also involved input-output decision criteria. In a consultative document entitled "Prevention and health: everybodys' business" issued in 1976 the DHSS noted that owing to the explosive growth in the cost of medical care the cost effectiveness of medical procedures is being questioned more closely than ever before. (Other evaluation studies of specific treatment regimes have also been reported in the scientific journals and these are dealt with in Section 3.2.)

In occupational health, however, there have been relatively few studies. Hence, at a meeting on organisational patterns of occupational health services under the sponsorship of the European Regional Office of the World Health Organisation the

Senior Medical Inspector presented a paper in which he could say:

> "In spite of many claims over many years that medical services in industry save working time, no objective evidence that they do has been produced: even if they do, the present view is that the amount of medical and nursing time deviated from therapeutic medical services (including general and hospital practice) is not justified."

The Chief Medical Inspector was thus apparently unaware of the evidence quoted in the Ministry of Labour booklet on the Organisation of Industrial Health Services in 1966 which said that although it was not easy to translate the benefits of such services into money, two examples would serve to illustrate in a general way what could be achieved:

> "An engineering works employing 850 people found that as a result of setting up a medical department the time previously lost through sickness and injury was reduced by half."

and

> "In another factory infection from wounds was reduced from ten cases per week to an average of less than one."

Unfortunately the detailed evidence upon which these claims are based was unavailable as they are internal documents of the Health and Safety Executive, (Hookham 1976).

A call for research in this field was made by the Office of Health Economics in 1971 in their pamphlet "Off Sick":

> "research is badly needed in this country to establish

the value of such (occupational health) schemes both to the firm, in reducing absence and improving the quality of manpower, and to individuals themselves in improving their standard of health."

and

"schemes financed and run by individual firms may bring savings both to the firms themselves and to the Department of Health and Social Security"

Schilling (1974) in his contribution to a symposium on the provision for health care of people at work in Britain said:

"there is a need to examine the cost benefits and other possible advantages of providing treatment services and other types of medical care in the larger work units"

Wade (1974) in the same symposium describing the establishment of a Department of Occupational Health in a University says that one of the facets of expertise that could be given priority is cost benefit studies.

Cost benefit studies are being advocated not only on local factory-based services but also in a wider sphere. One of the recommendations of a World Health Organisation report on Environmental and Health monitoring in occupational health in 1973 was:

"6. Governments, institutions, and other interested bodies should carry out evaluative studies of monitoring systems in occupational health, including, where possible, cost benefit assessments"

Lloyd-Davies (1973) in a lecture entitled "Whither Occupational Medicine" added that:

> "after 128 years of statutory fossilization a new look is wanted. What sort of medical intervention is wanted in the affairs of industry and when? Both questions must be answered in terms of demonstrable benefit and commensurate with the manpower and resources committed"

and that:

> "claims should only be made on medical manpower when demonstrable benefits are likely"

This is because:

> "In Britain we neither have available the extra 2000 medical practitioners, nor can we afford the yearly subvention of 220 million or more for a comprehensive occupational health service, if by that we mean a doctor in every factory"

Of occupational health services that exist at present Duncan (1974) wrote:

> "Many services were in fact set up to save time, money or absence though it is doubtful if they can really be justified in this way."

There have in the last few years been several attempts in Europe and in the US to estimate the value of occupational health services or to provide a method for others to do so. A general criticism of some of these methods has been published by me in conjunction with other authors and we proposed a method of financial evaluation of occupational health services, (Atherley et al 1976). The applicability of this method is discussed in more detail in Section 3.3.

There is not, however, enough information available to assess the worth of occupational health services. It seems that the resource constraint argument has been one of the major factors in influencing Government attitudes to the formation of a national occupational health service.

This was perhaps best exemplified in the Robens report in their comments on the organisation of occupational medicine:

> "...neither this country, nor any other for that matter, is ever likely to be able to afford a comprehensive workplace-based health service on top of a comprehensive home and family oriented health service such as we have at present. Whether a comprehensive health service should be based mainly upon the workplace or mainly upon the home and family is a question which... raises fundamental issues concerning the deployment of national medical resources which, amongst other things, would require for their determination extensive analysis of the costs and benefits of the possible alternative forms of organisation."

Robens is thus raising a societal question which can only be answered when preliminary evaluative studies have been made at company or factory level. The relation between company and State health services could then be assessed and some indication given towards redirecting available resources.

A recent publication by the Health and Safety Commission, called "Occupational Health Services - the way ahead", suggests that such cost benefit studies within the NHS and the occupational health spheres should be encouraged.

The issue has thus been left unresolved in that until it can be shown that a redirection of medical effort into occupational health is economically more efficient and effective, to the community as a whole, then progress in occupational health is likely to continue to be haphazard.

In the next section I briefly review some of the resource allocation techniques that can be used as an aid to more rational decision making and planning. I then go on in Section 3.3 to describe how these have been applied to occupational health services.

3.2 A brief review of certain resource allocation techniques as applied to health care

3.2.1 Introduction

Resource allocation techniques fall within a variety of disciplines and, dependent on complexity and application, are given a multitude of names such as operational research; systems analysis; planning, programming and budgeting; cost benefit analysis; cost effectiveness analysis and input/output analysis, among others. All have been applied to health care delivery problems at one time or another. It is not my intention to review here the advantages and disadvantages of each technique. Rather, my intention is to define and discuss the techniques of cost benefit and cost effectiveness analysis as these have been put forward by me (in conjunction with other authors) as being particularly applicable to occupational health. Our specific approach is outlined in more detail later in the chapter.

3.2.2 Cost benefit and cost effectiveness analysis

Cost benefit analysis

Cost benefit analysis has been defined by Prest and Turvey (1965) as:

"a practical way of assessing the desirability of projects, where it is important to take a long view (in the sense of looking at repercussions in the further, as well as the nearer, future) and a wide view (in the sense of allowing for side-effects of many kinds on many persons, industries, regions etc). i.e. it implies the enumeration and evaluation of all the relevant costs and benefits."

In practice a cost benefit study rarely if ever satisfies all these criteria in that the choice of costs and benefits to be included is affected by the considerable difficulty in quantifying many of the costs and benefits that are relevant. Prest and Turvey formulated a description which, in their view, best covers most cost benefit analyses:

"the aim is to maximise the present value of all benefits less that of all costs, subject to specified constraints"

This enables one to set a series of questions, the answers to which constitute the general principles of cost-benefit analysis:

1. Which costs and which benefits are to be included?
2. How are they to be valued?
3. At what interest rates are they to be discounted?

The discount rate is a measure of the differing values placed upon inputs and outputs according to the time at which they are committed or consumed. It reflects the community's or society's view of the value of extra consumption (in the sense of an increment to the general living standard) in the future as compared with the present.

The following discussion is based on that of Drummond (1976).

1. Usually all the costs and the relevant benefits are

identified and listed. If there are many intangible* costs and benefits then it may be difficult to proceed further. It is important that the enumeration is made so far as possible so that the decision maker can, after considering those costs and benefits that have been quantified, weigh the intangibles on one side of the equation or the other depending on his value judgements. (A value judgement is a statement which is ultimately reducible to the form "X is good/bad".)

2. Normally attempts are made to attach monetary units to costs and benefits so that "like is compared with like" in the final estimation. A common method used by economists is valuation which is based on market prices (if these exist).

   In some cases the goods and services do not yield a market price and other methods of valuation may be employed. These valuations may stem from policy makers, they may be professional judgements or they may be the client's values. Examples of these are a) costs of implementing safety legislation can be used to derive an implicit estimate of the value of life b) judges' compensation awards for pain and suffering, disability and death c) individuals may be asked about the money value they would place on reductions in risk of death or disability.

3. When a project has costs and benefits which arise in the

* Intangible costs and benefits are those for which there is no market or where there is reason to believe that existing markets do not adequately reflect their value.

future some method is usually adopted in order to obtain present day values of the costs and benefits. An interest or discount rate is used but the correct rate is difficult to determine. Rates between 5 and 15% have been used in the past. In the UK it has been common practice to use the Treasury 'Test Discount Rate' of 8%; Cmnd 3437 (1967). The rate was raised to 10% in 1969.

A sensitivity analysis is sometimes carried out by considering the magnitude of future costs and benefits under a range of different assumptions with probabilities attached to their likelihood.

General reviews of the applicability of cost-benefit analysis to health care have been carried out by Wiseman (1963), Marshall (1965), Emlet (1968), Klarman (1972), Williams (1974) and others. In 1970, Rossman applied cost benefit analysis to an industrial health situation - accidents in coal mining in Taiwan. Other cost benefit applications in occupational health are mentioned in section 3.3. Examples of cost benefit studies to specific health problems are in the treatment of rheumatic diseases Brookes (1971), cholera control by Abel-Smith (1973), and anti-malaria programmes by Cohn (1972).

Cost-effectiveness analysis

Cost effectiveness analysis has been called a special but narrow form of the cost benefit approach, Klarman (1968). Benefits are not quantified to the same extent as in cost benefit analysis. Cost effectiveness analysis is usually employed when benefits are difficult to measure or when there are several benefits to be measured which cannot be made commensurate. Costs are calculated and compared for alternative ways of achieving a specified set of objectives.

Examples of specific cost effectiveness studies include the treatment of chronic renal disease (Klarman, 1968), rehabilitation after treatment for mental health (Fox, 1968) and audiometric screening in children and adults (Jauihianen, 1973). Essentially, the difference between cost benefit and cost effectiveness analysis is that although both measure costs in monetary units, the same technique is not used for benefit measurement. In cost benefit analysis as many as possible benefits are converted to monetary units. In cost effectiveness analysis the benefits are specified in non-monetary units such as number of lives saved or number of disability days prevented.

3.3 Cost benefit and cost effectiveness analyses in occupational health

A number of attempts have been made, with varying degrees of success, in applying evaluative techniques to occupational health services:

In 1957, a report by the University of Michigan for the Public Health Service showed that there were savings in compensation costs directly associated with industrial health programmes;

> "Analysis of the present data indicates that employers in machinery manufacturing and general merchandise retailing save enough in reduced Workmen's Compensation premium to pay the salaries of the doctor and the nurse, to say nothing of other possible savings in reduced absenteeism, reduced health insurance costs and greater overall employee efficiency."

There is no information, however, on how these savings were related to specific activities by the industrial health unit and whether other variables might have contributed to the savings.

In 1958, Fraser reported on the value, to management, of medium sized and small plant health programmes.

> "In 1947 the year before the Medical Department was organised, the absenteeism record was about the same as the present (1957) national average, 70 hours or almost 9 days per year, which represents 3-5% of an employee's normal work time per year. In 1957, the absenteeism dropped to 32 hours or 4 days, which equals 1.6% of the year's total working time. Translated into earnings between the two periods, using the 1957 average, the company showed improved earnings for the employee of 38 hours or almost one week's pay, and a saving of over $800 of production per employee per year."

These and other savings are quoted and attributed to the establishment of the medical service. These results are impressive although there may be no direct cause and effect relationship between the improvements and the establishment of the medical service.

In 1960, in a paper prepared by the American Association of Industrial Nurses, a number of references and case histories were quoted to illustrate the economic value of an industrial health service.

> "A Medical Program established in a warehouse employing 150 people resulted in a $7,921 saving in the first six months it was in existence. The cost of the Medical Program for the same period was $3000."

There is no indication how this saving was calculated or why it could not be attributed to other variables.

Other examples quoted include:

"An insurance office of 200 employees reduced its labor turnover in two years from 6.4% to 3.4% after the initiation of a Medical Program."

and

"An electronics plant of 4000 employees reduced absenteeism in a six year period from 5.8% to 1.7%."

The detailed evidence on which these claims are based is not given and these figures must, therefore, be treated with caution.

Mehee (1963) has written on the subject of evaluation of programmes in occupational health. His article is a general statement of the objectives of an occupational health programme and a suggestion that in the evaluation of the services provided, practical approaches must be kept in mind.

According to Mehee, the approaches to consider are:

"1. Accompany the plant physician on a visit through the plant. How do the workers respond?

2. Note the interest and understanding of management in the function of the medical department...

3. Conferences attended by management representatives and physicians will bring improved understanding about how we are doing."

Points 4 and 5 question the emphasis on health education, on preventive medicine, on mental and emotional health and the adequacy of the medical record system.

This is an elementary narrative approach which contributes little to the evaluation of occupational health services.

Doran (1964) described a medical audit system as a tool in appraising occupational health programmes. This is said to "identify the value and pertinency of the medical activities, and therefore the effectiveness of the particular health unit or medical program as a whole."

The data gathering portion of the audit consists of a procedure whereby information is gathered on personnel information and welfare benefits, and on health programme activities. The former consists of a description of the characteristics of the plant population eligible for (OH) service, of the physical and socioeconomic aspects of the plant environment, and of the administrative regulations concerning those in the plant population who receive service.

The latter consists of a description of the medical programme itself: its organisational structure, facilities, services rendered, productivity, administrative costs, and the inter-relationship existing between the medical directors and other management, and between the medical programme and allied disciplines and activities.

The end product of the audit is thus said to be:

"a narrative statement with extensive description of the program, discussion of its activities, evaluation of its efficiency and productivity, and recommendations for its improvement."

This seems a step in the right direction in that an extensive background is needed of activities, costs, labour turnover and so on. However this in itself is in no way an audit or an evaluation of its efficiency.

It is merely the starting point from which the feasibility of evaluative procedures may be assessed and from which pilot projects may be planned.

Grimaldi (1965) specifically in relation to periodic physical examinations expressed the nature of the research succinctly:

> "there is a maximum of generalisations and a minimum of incontrovertible specifics in the resource material relative to occupational health programs. Lacking most is the means for measuring the programs over-all effectiveness."

As an example of an important component of occupational health programmes that suffers from contradictory opinions of its merit Grimaldi gives the periodic health examination.
Having surveyed the literature on the worth of periodic physical examinations, he admits that the examination of hypothetically healthy individuals frequently reveals physical defects hitherto unsuspected. However, the significance of the findings with respect to the cost of their identification and the value of their contribution to furthering the individual's health is said to be unclear.
Grimaldi attempted a statistical study which compared the medical and surgical expenses submitted by employees participating in an Insurance Plan. The study tested the assumption that individuals who receive an appropriate physical examination periodically will be better able to maintain a healthy state than those who are not examined. The difference between the examined and unexamined with respect to the hospitalization, doctor's fees, and related expenses incurred from year to year, was assumed to be an indication of differences in the health status of the population studied. The examined population consisted of those middle management employees who consented to take part in the periodic examination. The control groups consisted of those

employees who did not take advantage of the opportunity of periodic examinations and of a group of employees at another plant who had no opportunity to partake in the examinations.
After analysing the medical expenses of examined and unexamined employees over an 8-year span, Grimaldi found that the average expense for the unexamined was significantly higher than for the examined.
The major criticism of this study, which Grimaldi admits as one of the practical limitations, is that the groups of examined and non-examined should have been randomly assigned between the groups. In the study the examined group were self selected and Grimaldi says

> "it may be assumed that they possessed a more earnest attitude towards health maintenance with consequent beneficial effects."

Nonetheless, studies such as this are valuable in that they are quantitative and involve hypothesis testing rather than unsubstantiated claims.
Bamber (1973) used hypothetical data to show how the cost savings of an occupational health service can be calculated.
The savings were calculated by assuming that 80% of attendances for industrial and non-industrial injuries and associated redressings would have necessitated absence of at least two hours. In the case of surgery attendances for sickness or illness and associated revisits he assumed that 10% might have necessitated an absence of two hours if an occupational health service was not available. In considering medical examinations Bamber considered the cost of examination and time lost if the examination was carried out by outside sources. An objection

to his method is that emphasis should be put on the question whether there is any identifiable output from performing the examination rather than assuming that they are all necessary. The total costs of the occupational health service were given, by Bamber, as £4550 and the calculated savings as £5736. The profit was thus £1186. However, only a relatively small change in the basic assumptions might result in this becoming a loss rather than a profit.

Using actual data from a medical centre Bamber (1972) showed that for a total outlay of £32,380 a saving on costs of £42,750 is possible, or a profit of £10,470. Activities, for which cost savings were calculated, included industrial injuries and reattendances (50% assumed to necessitate absence), illness and reattendances (10% assumed to necessitate absence), pre-employment medicals (all assumed done by outside sources), and attendances for physiotherapy, vaccinations and innoculations, and visits to chiropodist and dentist (10% assumed to necessitate absence during works time). The entire case rests on these assumptions and until these can be verified these figures must be treated with caution.

Bagley et al (1975) examined the prevalence, during a particular period, of hospital-treated industrial accidents in the Greater Brighton area, to assess the degree to which those injuries could be treated by an industry-based occupational health service providing both an industrial nurse in larger firms, and a mobile emergency treatment service.

The method was to estimate, by means of a postal questionnaire, what time had been lost by people injured at work, in travelling to the accident department and in subsequent absence from work.

They estimated that of the 50,000 cases seen each year by the hospital accident and emergency department some 17% (8,500) involved injuries sustained in the workplace.

Of these 8,500 cases 16% were serious enough, in their estimation, to need treatment by hospital emergency department.

There thus remained an estimated 7140 cases a year which could be treated by an occupationally-based health service in the Greater Brighton area.

Bagley et al from this concluded that:

> "Clearly there are marked economic advantages for the country in having a universal and well-endowed occupational health service."

But this does not necessarily follow from their study. The value of this lay in its showing how many employees might be treatable at work. However, not all those people, would necessarily remain at work even if treated there because the occupational health nurse would probably send a proportion of these employees home. Before such wide-ranging conclusions could be drawn, it would be necessary to assess the costs of providing an occupational health service to treat all or most of these 7140 cases, the costs of redistributing the medical personnel from hospital or other nursing facilities into the industrial situation (and any other relevant costs) and to compare these with the benefits of time saved, production loss averted, and other benefits. Bagley et al stated that one of the benefits would be a decrease in the demand on the services of the hospital emergency department. However, if nurses are diverted from hospital to industry, total demand may fall but because of the reduction in the number of hospital nurses the workload per nurse may be unchanged or even increased.

Other studies on the evaluation of occupational health services or their components include those by Eich (1967), Bond et al (1968), Modi (1970) and (1972), Phillips and Hughes (1974) and Craig (1974). These have been criticized by me and my colleagues in a recent paper on the financial evaluation of occupational health services (Atherley et al, 1976). Following a review of previous studies we proposed that a method should have the following attributes:

1. It must be possible for the method to be understood by those doctors and nurses working in industry who will make the evaluation.
2. For any activity of the OH service it must be possible to identify specific benefits from engaging in that activity. That is, specific rather than global benefits should be laid claim to.
3. It must be clear who incurs the costs and who receives the benefits from a particular activity. We think it is particularly important to distinguish between those benefits that go to the company and those that go to the employee. This enables us to discover to what extent employees' and employers' interests are the same with respect to services or aspects of services.
4. Although the company and the employee are the two major parties with a stake in occupational health, the existence of a third party, the State, should be recognised.

As a result of these considerations we suggested that

1. Activities in the OHS should be considered singly.

2. The 'boundaries' of the study should be set at the company and the employee. (In my physiotherapy study, Chapter 6, the DHSS was included because of the availability of data.)

3. A clear distinction should be made between quantifiable benefits and non-quantifiable benefits.

4. Occupational health practitioners should be involved from the start.

We divided benefits into two categories: hard benefits, corresponding to quantifiable benefits, and soft benefits, which include benefits not quantifiable for various reasons. As is implied by the quantifiable and unquantifiable terminology, we did not see hard and soft benefits as being essentially different in character. Hence, as our understanding of the problems increases, more benefits may be moved from the soft to the hard category.

We described hard benefits as those where the process by which these accrued to the party concerned was adequately understood; hard benefits could be clearly identified and allocated to a particular occupational health service activity; and they could be quantified. An example of hard benefit to the company would be the averted loss in employees' time through treatment at the workplace rather than at the nearest NHS facility.

Soft benefits are those where the process by which they accrued to the party concerned is not adequately understood; or where they are difficult to identify and allocate to a particular occupational health activity; or that they are difficult or impossible to quantify and likely to remain so. An example of a soft benefit to the company would be the reduction in sickness-absence rates through improved morale of employees arising from, say, a medical screening programme. The rationale here was that, first, we did not adequately understand the process by which the benefit accrued to the company - even if the employees' morale were raised (which would be difficult to show) how would this benefit be transferred to the company in terms of a reduction in sickness absence? Secondly, any change in morale may be difficult to attribute to a particular occupational health activity rather than to the company's other employee services. Once the costs and hard benefits to the company and employee have been quantified and note has been taken of any potential soft benefits we suggested that the occupational health service activities can be evaluated singly as follows:

Hard test of financial viability -

for a given activity to be worthwhile to the company the sum of the hard company benefits should exceed the sum of company's costs:

$$\sum_{i=1}^{i=h} CB_i \quad - \quad \sum_{i=1}^{i=m} CC_i > 0$$

where CB = company benefits

CC = company costs

h = hard company benefit categories

m = cost categories

Soft test of financial viability -

If the hard test fails, an activity could still be justified from the company's viewpoint if:

1. There was reason to believe that the sum of the company soft benefits exceeded the discrepancy found in the hard test:

$$\sum_{i=1}^{i=s} CBi > \sum_{i=1}^{i=m} CCi - \sum_{i=1}^{i=h} CBi$$

where s = soft company benefit categories

and if

2. The company thought that employees' costs and benefits should be taken into account:

$$\sum_{i=1}^{i=e_B} EBi - \sum_{i=1}^{i=e_C} ECi$$

where e_B = employees' benefits (hard and soft)

e_C = employees' costs

In this way a ranking could be obtained depending on whether the activities have passed the hard or soft test.

This essentially is the approach taken in the thesis, that is, objectives are identified, hard benefits where they exist are pinpointed and they are then compared with the costs of provision of the activity.

CHAPTER 4

4. The Research at Cadbury Schweppes

4.1 The scope of the research

The research in this thesis was concerned with three activities at the Bournville site of Cadbury Schweppes. These are audiometry, physiotherapy and pre-employment medical examinations. Other services which the occupational health service at Bournville engages in are: X-ray facilities, a treatment service for injury and illness including emergencies, participation in a heart disease prevention project, counselling, medical examinations which include those of fork lift truck drivers, examination of young persons under 18 years of age (previously done by appointed factory doctors), heavy goods vehicle drivers, outside sales force, personnel travelling overseas, pipe-laggers who have an examination once a year and an X-ray once every three years, fitters who work with oils, examination of directors and senior managers and examination of employees from other company sites who after a works accident may be seeking compensation, and of employees who return after illness who may need further medical supervision. There are also available on a part-time basis the service of an optician, dentist and chiropodist.

Other activities include liaison with the safety officer, running first aid courses including short courses for supervisors, lecturing to outside organisations and talking on courses for senior management. One of the ways general health education is achieved is by medical staff being represented on the company health committee. A further function of the medical department is liaison with doctors and medical students who may visit the company to learn about the working conditions within the factory.

The activities were selected, from the above, for the research because they are representative of most of the other activities undertaken by the medical department.

The three activities embody crucial concepts which are common to all activities in an occupational health programme. They have claims made about them which have not been tested in the field - these especially relate to savings in sickness absence; they are accepted by some medical practitioners and not by others on the basis of inadequate economic knowledge; they are accepted by some practitioners and not by others on the basis of poorly defined objectives; these objectives have not been tested to see whether, and to what extent, they are being achieved. A three category classification is proposed such that physiotherapy, pre-employment medical examinations and audiometry are examples within each category. Their analysis may thus throw light on the other activities within these categories. The proposed classification is as follows:

a) personnel therapy: as a regimen of directly applicable medical care such as physiotherapy. Other activities within this category are post-accident and post-illness treatment.

b) personnel input screening (screening here and below being interpreted widely): involves the examination of personnel before their employment or placement within the company and the selection or screening out of those considered medically unsuitable for the work involved - the prime example of this category is the pre-employment medical examination. Another activity in this category is the examination of heavy goods vehicle drivers.

c) personnel throughput screening which involves examination and testing, of selected groups of employees already employed, for particular disorders. The example here is audiometry whose major emphasis is on screening persons already employed although there is an element of input screening in terms of placement of individuals with hearing disorders. Other activities in this category are the examination of fitters and pipe laggers.

For each of the selected examples I have below listed specific reasons why an analysis of these activities is necessary.

a) Audiometry

- this is a medical technique the use of which is controversial and is established in some companies and not in others, (Sawtell et al 1975).
- the objectives and benefits are unclear and ill defined, (Merriman 1976).
- the costs of implementing audiometry on a national scale have been said to be disproportionate in relation to the benefits, (Atherley et al 1973).
- further knowledge has been called for as a matter of urgency, (Atherley et al ibid)
- until this knowledge is forthcoming one course of action advocated has been for occupational physicians not to undertake audiometry on a large scale, (Atherley et al ibid).

b) Physiotherapy

- this is an established medical procedure in many workplaces, according to the Association of Chartered Physiotherapists in Industry (1974).
- it is generally believed that physiotherapy in industry is of benefit to the company and the employees, (Slattery 1975).
- a specific claim by the Association of Chartered Physio-

therapists in Industry is that "treatment on the spot saves time and money" although there has been no way that this claim could be tested until the present research, (ACPI 1974).

- an opportunity arose whereby a population who had physiotherapy could be compared with a population who needed but could not receive physiotherapy in terms of relative sickness absence.

c) <u>Pre-employment medical examination</u>

- this is a medical procedure about which opinions on effectiveness are in disagreement, (Taylor 1968).
- the technique is said to be too expensive in terms of medical manpower in relation to the return, (Taylor et al 1973).
- in relation to the food industry there is no direct evidence about who benefits from the examination, (Lowbury 1975).
- the question of who benefits can be discerned by looking at the relation between product safety orientation and employee welfare.

CHAPTER 5

5. Audiometry

5.1 Introduction - the campaign against noise

It has been known for many years that prolonged exposure to loud continuous or intermittent noise can cause hearing loss. It is now possible to predict with some degree of accuracy the noise-induced hearing loss which a population can expect after a period of exposure to noise over certain limits. The Department of Employment's Code of Practice specifies that the working population should not be habitually exposed to an equivalent-continuous sound level in excess of 90 dB(A). The Health and Safety at Work Act 1974 also has provisions which could encompass exposure to noise. In Section 2(1) under the general duties of employers to their employees the Act specifies that employers should ensure, so far as is reasonably practicable, the health and safety and welfare at work of all his employees. The employer must interpret the Act and respond accordingly. More recently the Health and Safety Executive has published a report by the Industrial Health Advisory Sub-committee on noise called "Framing Noise Legislation" which sets out a proposed legislative method for protecting workpeople from occupational hearing loss. This would include obligations on employers and employees. Employers would have to carry out noise surveys wherever there was a likelihood that 90 dB(A) was being exceeded. Where it was shown from the noise survey that 90 dB(A) had been exceeded, all reasonably practicable steps would have to be taken to reduce the sound level or the duration of exposure or both to below 90 dB(A). All areas where 90 dB(A) is exceeded would have to be marked and all persons entering or working in such areas would have to be issued with suitable hearing protectors.

Employees would have a duty to wear the ear protectors provided. This requirement would be in line with the general duties of employees as set out in Section 7 of the Health and Safety at Work Act.

On audiometry the report stated that separate recommendations will be made. This is discussed in more detail below.

In respect to noise there have been several common law cases where the responsibility of employers has been mentioned. In the case of Carragher -v- Singer Manufacturing Co. (UK) Ltd in April 1974 the judge held that the defendants could, in law, be liable for a breach of Section 29(1) of the Factories Act 1961 if they conducted a noisy workplace. In Berry -v- Stone Manganese Marine Ltd in 1972 the judge held that although there was a duty to take reasonable care to protect workmen from loss of hearing that duty did not include taking steps to find out whether a workman's hearing was affected.

The employer may perceive it to be reasonably practicable as far as noise is concerned to adhere to the Code of Practice and if noise control is not practicable to provide hearing protectors. An employer may also consider it desirable to provide audiometry as part of the noise programme, in order to minimise noise-induced hearing loss. The provision of audiometry may or may not result in an efficient allocation of resources within the noise programme itself, or within the broader context of safety and health measures generally.

In the report on Framing Noise Legislation mentioned earlier, the Noise Sub-committee said that they did not, at this stage, want to issue an Approved Code of Practice on Audiometry as Approved Codes under the Health and Safety at Work Act would have a special legal significance in relation to specialised statutory requirements. They suggested that recommendations on Audiometry, when finalised, should be published as voluntary guidance.

In 1978 the Health and Safety Executive published a Discussion Document entitled "Audiometry in industry" which is a report of the working group on audiometry.

Comment on the report was invited, especially on the broader issues in:

a) the value of audiometry and the extent to which its benefits justify allocation of resources as compared with other activities to improve safety, health and welfare at work;
b) the indications for introduction of an audiometric programme and the frequency with which examinations should be conducted bearing in mind cost and benefits provided;
c) the practical issues in implementing the procedures required;
d) the uses which should be made of the information provided by audiometry and the social implications, particularly in the employment field;
e) the availability of manpower at the right level and physical resources to introduce industrial audiometry.

The research described in this thesis thus begins to provide information for judgements to be made in relation to (a) and (b) above which has not been previously generally available. The following paragraphs describe the measures introduced and in force at Bournville in the strategies against noise and noise-induced hearing loss.

1.1 <u>The noise problem</u>

It had been recognised for some time by several senior managers that there was a noise problem at Bournville. Noise walls were erected in several noisy areas in the late 1950's by the then chief engineer. Through the efforts of the company medical officer and safety officer, management was made more aware of the situation and decided to introduce measures to safeguard the "aural health" of the workforce.

Noise surveys were carried out, noise zones (over 90 dB(A)) were delineated and measures to educate employees were discussed. It was decided to introduce, after discussion with the appropriate committees, the wearing of hearing protectors in areas having noise levels over specified limits. Audiometry was introduced as one of the later measures in tackling the noise problem and its consequences. The general situation to date includes the showing of a film, made by the Royal Navy, which shows audiometry in use, and a slide tape presentation by Ford of Great Britain at specified intervals to employees working in noisy areas. These presentations are made to educate employees about the noise hazards and methods of prevention of noise-induced hearing loss.

The presentations are also attended by a senior manager, a shop steward, the safety officer and the medical officer who take part in the discussion. The company are now (late 1977) in the process of preparing a slide tape presentation which will be more specific to the situation at Bournville.

1.2 Noise control

The Department of Employment's Code of Practice stated that the primary aim of management should be a general reduction of noise exposure. This is done by making machines quieter, where possible.

At Bournville this is the responsibility of the development engineers who have resources set aside for possible use in machinery noise reduction. There is liaison with the safety officer who monitors the noise levels and updates a noise register every six months.

There is a noise specification of 85 dB(A) on machines bought for use within the factory premises.

Noise control on many machines is limited because of the costs involved, hence, hearing conservation by hearing protectors becomes necessary. The relevant methods are described in the company statement on noise policy issued in June 1973 (Appendix 2).

5.2 Methods of hearing conservation at Bournville

Hearing conservation is effected by the issue and use of personal protection, namely: ear muffs and ear plugs.

2.1 Use of hearing protectors

Approximately 600 men and women work in areas of the Bournville factory where the noise level is 90 dB(A) or more. About 200 of them are women. All 600 people are employed on continuous work so that about as many work at night as during the day. Two types of hearing protectors are available: ear muffs and ear plugs. The company insists that employees working in areas over 100 dB(A) wear ear muffs. Between 90 and 100 dB(A) employees may wear ear muffs or ear plugs. Almost 600 people work in noise levels of 90-100 dB(A) and about 80-90 people in levels of 100 dB(A) or more.

2.1.1 Ear Muffs

The Department of Employment's Code of Practice emphasised that ear protectors should be regarded as an interim measure for use during the time when other methods are being perfected - for example, the separation of noisy areas by suitable partitions, the use of quieter machines and processes. Where hearing protectors are necessary, their use should be ensured; places where protectors are required should be clearly identified and marked and where necessary entry into such areas controlled; there should be instruction in the use and care of the protectors; and, where the overriding limits set by the Code may be exceeded, reduction made of periods of exposure.

At Bournville, muffs are issued by the general stores and employees can collect them from the stores or from a supervisor. In the noise zones delineated over 100 dB(A) supervisors are responsible for employees wearing ear muffs. In areas of 90 dB(A) or more it is the employees responsibility to obtain and wear hearing protectors.

Initially, ear muffs with fluid seals were issued. These are said to provide better protection than those with foam seals. However, it was soon recognised that the fluid seal is liable to puncture. The escaping fluid may constitute a food hazard. Fluid sealed muffs are also more expensive than foam sealed muffs. For these reasons only muffs having foam seals are now purchased.

The audiometry technician and the nurses all play a part in instructing the employees about the correct method of wearing and maintaining their hearing protectors.

2.1.2 Ear Plugs

Ear plugs are fitted by the audiometric technician or one of the State Registered nurses. To prevent the plugs falling into the chocolate the two ear plugs are joined by a thread so as to minimise the likelihood of this occurrence.

2.2 Enforcement

It is not a condition of employment, nor is it likely to be under present circumstances, for workers to wear hearing protectors in noisy areas. Apparently it is a condition of employment at one of the factories of GKN and, I was told by the doctor at Cadbury's, workers still sometimes do not wear hearing protectors. At Bournville the situation is as follows: If an employee is seen by a supervisor not to be wearing his ear muffs then this employee is warned and a record of this preliminary warning is made on his employment card in the presence of a shop steward. This is the limit of the enforcement procedure as such at Bournville.

The noise zones have at their entrances a pictorial representation of a head with ear muffs. This indicates to persons entering these zones that they are requested to wear hearing protectors. The Department of Employment recommended representation is not used because the safety committee preferred the head with ear muffs. (See Appendix 3 for the corresponding diagrams.) In fact it has been shown that the head with ear muffs was found to be better by subjects who had not seen either sign in a relevant setting; (Jackson, 1975). Her research contributed to the standardisation of safety colours and safety signs by the British Standards Institution. The BSI now recommends the use of the diagram depicting a head with ear muffs; (BS5378, 1976), following ISO pattern.

Visitors and people passing briefly through these areas are also requested to wear hearing protectors even though exposure for this short period of time would not in itself constitute a hazard to hearing. The reason for this is to set an example to the employees constantly at work in these areas.

5.3 Audiometry

Audiometry is a technique of measuring a person's hearing by presenting pure tones at various frequencies to each ear in turn and recording the response on a standard sheet which is then called an audiogram. Appendix 4 shows some examples of "normal" hearing and that due to exposure to noise as charted on the audiogram.

The tests at Bournville are done in a room in the surgery. The employee sits inside a "sound-proofed" booth whilst the audiometric technician presents tones through ear phones. The employees' responses are recorded manually by the technician outside the booth and out of sight of the employee.

3.1 Objectives of audiometry at Cadbury's

The medical officer was asked to look at a list of stated purposes of industrial audiometry culled from several papers on the subject. He was asked whether he agreed or disagreed with these objectives and if it were possible for him to rank these in order of importance. The medical officer stated that an order of priorities from a medical viewpoint would not necessarily be the same as that of the company's.

The following list in order of priority, according to the medical officer, provides a guide to industrial audiometry from a medical viewpoint:

1. Provides an occasion for persuading reluctant workers to wear hearing protectors.
2. Provides a rough check to select individuals with abnormal hearing for more exhaustive tests.
3. Provides information in deciding what to do with noise-deafened individuals.
4. Provides a record of changes in an individual's hearing.

5. Provides information about individuals who are at risk - making sure they wear protectors or don't work in noisy environments.

The following items fall low in the order of priorities or in usefulness from a medical viewpoint:

6. Provides information about noise susceptible individuals.*
7. Provides a baseline for later comparisons.
8. Provides information for use in compensation cases - pre-employment. The pre-employment audiogram gives an indication of the state of a person's hearing before starting work at Cadbury's. Any hearing loss would then be attributed to factors outside Cadbury's control. In practice, audiometry is undertaken within a month or two of a person starting work.
9. Provides possible evidence of use in compensation cases - post-employment. The post-employment audiogram gives an indication of the state of a person's hearing after a period of work at Cadbury's. This may be useful to Cadbury's in that an ex-employee would not be able to successfully claim that further hearing loss after leaving Cadbury's, was attributable to noisy work while at Cadbury's.

* The Health and Safety Executive Discussion Document on Audiometry stated that it is not yet possible to identify susceptible ears in advance of exposure to noise.

One objective, that of reducing the strain upon NHS ENT departments was disagreed with by the medical officer. It was suggested by him that possibly industrial audiometry increased the workload for the NHS.

3.2 <u>The employees tested</u>

In its initial stages the audiometric programme was concentrated on those employees working in areas of 105 dB(A) or over. The testing then proceeded to people working in areas of 100 dB(A), 95 dB(A) and 90 dB(A). All these employees have now had at least one test. Eventually it is hoped, by the medical officer, to extend the tests to employees working in 85 dB(A) and possibly 80 dB(A). (A Board Minute states that eventually all people who request an audiometric test should have one.) It is also proposed to extend testing to tradesmen or such people who during the course of employment have occasion to enter a noisy area.

All new male employees now have an audiometric test within two or three months of employment whether or not they are working in noisy areas.

3.2.1 <u>The testing procedure</u>

An employee is informed by a note from the surgery, via his/her supervisor, that he/she is requested to present himself/herself for an audiometric test on a particular date; see Appendix 5. The note states that it is vital that ear muffs should be worn all the time at work, on that day, until the time of the test. The note also states that ear muffs may be obtained from the surgery prior to starting work. The muffs are to prevent temporary threshold shift which is a temporary change in hearing that may occur when the ears are exposed to noise. An audiogram taken at this time would not be an accurate measure of that persons hearing which may take some time to revert to its "normal state", (Burns, 1973). At GKN employees for audiometric testing will only be accepted within two hours of the employee arriving at work, ear protectors being worn from arrival (Pelmear, 1973).

At Bournville there is no such time limitation. Before the initial test, the employee is asked about past experience of noise; for example military service, other noisy employment or frequent visits to discotheques. He is also asked about hobbies considered to have a possible bearing on his hearing and thus on the test result; for example, skin diving, shooting or playing in pop groups. He/she is questioned about past ear infections or diseases as this may affect the resulting audiogram. He is also asked whether there is any deafness in his family.

The technician then explains to the employee the nature of the testing procedure, that is to press the button in the booth each time he hears the tone through his ear phones. He is told that first one ear will be tested and then the other. When the technician is about to change from testing one ear to the other she gives a hand signal to the employee in the booth through the window. This is explained to the employee before the test starts.

The frequencies presented, using a Bekesey audiometer, are 250, 500, 1000, 2000, 4000 and 8000 Hz. If there appears to be a dip at 4000 Hz then 3000 and 6000 Hz frequencies may also be presented and tested. However there are very few audiograms with these frequencies tested.

The employee is warned about the hazards of noise, loss of hearing and the wearing of hearing protectors by the technician before or after the test.

It may be that an ear infection is discovered as a result of asking an employee to undertake audiometric testing. At Bournville the surgery is adequately equipped to deal with certain conditions; for example by ear syringing, and the employee will be asked to return when the condition has cleared. His general practitioner is informed of any treatment given.

It is questionable whether such medical treatment is a part of the function of audiometric personnel. Some industrial medical officers may think not and refer the patient directly to his G.P. for treatment. The G.P. in turn may refer the patient on to an ENT consultant at a hospital. Upon discovery of noise-induced hearing loss or other conditions some medical officers may then refer the patient to his G.P. who then may refer on to a consultant. See Section 3.6 for the result of such referrals.

At Bournville employees are treated in the company surgery if this is at all possible.

If an employee's audiogram appears "normal" to the technician, there is no change in hearing or hearing loss, then the technician may tell the employee that he will probably need a retest only after twelve months. The medical officer decides, however, when a retest is required. See Section 3.2.2 below.

When audiometry was first introduced the medical officer was not certain about the nature of employees' hearing, or the likely workload on the technician. Thus, at that time employees were told that they would have a retest after two years, eighteen months or twelve months so as to stagger the workload.

The situation is becoming clearer now and people with "abnormal" hearing, some degree of hearing loss or deterioration, are asked for a retest after three months or six months. The total time taken for the initial test, including instructions and questioning is about a quarter of an hour.

3.2.2 Subsequent action

All the audiograms of the previous day are given to the medical officer who then decides upon the action to take.

People with normal hearing for their age group are not required to see him unless they specifically request to do so.

This is a statistical judgement and is made in practice by bearing in mind tables of hearing loss due to age and noise such as those provided by Burns (1973).

People with hearing loss whether due to noise or other causes are given an appointment to see the medical officer.

It may be that hospital treatment would benefit these patients in which case they may be referred to their G.P. who may refer them to a consultant. There may be a degree of hearing loss due to noise in which case the medical officer informs the employee about the dangers of working in noisy areas and the need to wear hearing protectors at all times. This is mainly an educative procedure. In some cases the employee will be shown his audiogram and warned about the possible consequences of not wearing hearing protectors; for instance, the employee may be told that his onset of natural deafness due to age may occur quicker than usual or be more severe when it does occur. He may be told that by not wearing hearing protectors it is his responsibility if this occurs - in other words the onus is placed on the employee to wear the equipment provided.

In Section 7 of the Health and Safety at Work Act there is a general duty of employees to take reasonable care for their own health and safety as well as to cooperate with employers who are carrying out statutory duties. More specifically the Health and Safety Executive report on Framing Noise Legislation recommends that noise legislation should contain an obligation on employees to wear ear protection provided when in designated noisy areas.

3.2.3 <u>The retesting procedure</u>

A retest is performed after three, six, nine or twelve months. In a few cases a retest is performed after two years. Retesting may be more frequent than this if there is ear discharge. Several audiograms are done when the condition appears to have cleared to ensure accuracy in audiometric examination. The medical officer compares the audiogram from the retest with that of the previous test. If there is a 5 dB or more deterioration in the speech frequencies (from 500 Hz to 4000 Hz are used) then the medical officer sees the employee in the surgery to warn him to be vigilant in wearing his hearing protectors as described above.

In some cases there is an improvement in hearing levels at the retest. This is ascribed to the employee being more vigilant in wearing hearing protectors as a result of the educative procedure in the initial test and thus abolishing his temporary threshold shift. It was suggested that the temporary threshold shift can sometimes last for weeks or months, (Burns, 1973), and that vigilant use of hearing protectors gives this a chance to recover and hence account for improvement which sometimes occurs in a retest. It may be that variability in the testing procedure may be responsible for the improvement in hearing levels. During discussions with the medical officer it was agreed that this variability is one of the factors which could play a part in contributing to the apparent improvement in hearing.

The 5 dB deterioration level is chosen arbitrarily because the medical officer believes that this allows for observer and participant error and perhaps errs on the side of safety. A criterion is thus established by the medical officer which gives him reasonable confidence in being able to distinguish between those people to be seen again and those passed as probably unchanged.

This criterion is chosen by the medical officer, as in his view probably encompassing all those people whose hearing may have deteriorated between tests. It is recognised by the medical officer that people may be seen whose hearing has not changed significantly but that seeing these people is justified in the interests of those whose hearing has changed.

If an employee persistently refuses to wear hearing protectors and audiometric testing shows that noise-induced hearing loss is occurring then that person will be taken out of his work and given work in a non-noisy area. (This situation has not arisen in practice and would raise many issues; for example: reduction in earnings.) The specific industrial relations and legal issues involved are unclear although it has been stated that the employer is not expected to dismiss an employee whose health may be prejudiced if he does not leave: Kossinski -v- Chrysler UK Ltd heard before the Court of Appeal under Edmund Davies, Stamp and James (1973).

3.2.4 <u>Pre-placement testing</u> (usually called pre-employment)

All new male employees are tested within two or three months of starting work. Eventually all employees ever likely to encounter noise over 90 dB(A) will undergo audiometric testing.

Pre-placement audiometry is generally thought to be important in establishing a baseline audiogram of a person's hearing level. It is said to be important in detecting abnormal levels of hearing loss or ear disease which can either be treated by the company surgery or by a general practitioner.

The Health and Safety Executive Discussion Document on Audiometry stated that "the main purposes of industrial audiometry are to establish quantitatively the hearing status of an individual and monitor hearing during the period of employment, in order to control the risk of occupational hearing loss. Industrial audiometry also provides the ultimate success of a hearing conservation programme, and can demonstrate the benefit of using personal ear protection".

The Document also says that although routine audiometric examination of workers whose exposure to noise does not exceed 85 dB(A) Leq is not normally necessary, "an audiometric programme should be instituted for all those working in a noise environment of 105 dB(A) Leq or above". (Leq refers to equivalent continuous sound level over an 8-hour working day.)

As noise levels increase between these two values there is, according to the Working Group on Audiometry, a corresponding increase in the desirability for the institution of an audiometric programme.

At Bournville, if an employee is found to have an abnormal hearing loss then he will not be allowed to work in a noisy area (over 90 dB(A)) even if he might have agreed to wear hearing protectors. This is so that any risk to that employee's remaining level of hearing will be eliminated.

3.2.5 Post-employment testing

Post-employment testing is not done routinely at Bournville. If a person is near retirement age then the medical officer may see him/her after the hearing test and inform the person that this may be the last audiogram before retirement. The employee is told that after retirement, if desired, he/she may come for a further test as a reassurance.

3.2.6 Office personnel testing

Office men

The male office staff who have had an audiogram can be sub-divided into four categories:

- the sales force; these are people who fly abroad either occasionally or frequently and who thus may have frequent pressure changes put upon their ears. Audiometry has been incorporated into their regular full medical examination because, in the view of the medical officer, "the pressure changes may affect the eustachian mechanism". However, no evidence appears to exist which shows that frequent pressure changes have any effect on auditory threshold.
- directors; some directors have had the technique demonstrated to them so as to be aware of the extent and nature of the examination.
- office volunteers: these are people who have heard of the examination and for one reason or another have asked for it.
- doctor referrals; these are men whom the doctor has referred for audiometric examination owing to some abnormality of hearing.

Office women

The female office staff who have had an audiogram can be subdivided into two categories:

- doctor referrals; these are women whom the doctor has referred for audiometric examination owing to some ear condition.
- office volunteers; these are people who have heard of the examination and for some reason eg. working in a noisy typing pool, have requested one.

3.3 Results of audiometry at Bournville - factory men

3.3.1 Number of tests and retests

Table 1 shows the number of tests and retests undertaken on factory men from April 1972 to June 1975.

The apparent discrepancy between the number of initial tests and the retests, and between the retests, is due to preplacement audiometry being gradually introduced. As many of these people only stay at Cadbury's for a short period of time they do not appear for a retest.

Table 2 shows the number of factory men tested with a breakdown into "in-place" and new employees, and subdivided into those tested who have then left or retired. "In-place" employees refers to those already employed when audiometry was introduced. "New employees" refers to those arriving after audiometry had been introduced.

3.3.2 Past noise exposure other than civilian employment

Table 3 gives a breakdown of the number of instances that noise exposure other than in civilian employment was recorded among factory men. Experience in HM Forces includes all branches and the Cadets. All these people may have experienced noise exposure, principally gunfire.

TABLE 1

NUMBER OF TESTS AND RETESTS ON FACTORY MEN

NUMBER OF TESTS				
INITIAL TESTS	RETESTS			
	1st	2nd	3rd	4th
1917	350	151	33	3

TABLE 2

NUMBER OF "IN PLACE" AND "NEW" EMPLOYEES TESTED SHOWING NUMBER LEFT OR RETIRED

NUMBER OF EMPLOYEES TESTED			
POST 1972		PRE-1972	
1149		768	
LEFT FIRM	RETIRED	LEFT FIRM	RETIRED
463	2	68	13

TABLE 3

PAST NOISE EXPOSURE AMONG FACTORY MEN

		HOBBIES			
	HM FORCES	SHOOTING	HI-FI	DISCOS	PLAYS IN GROUPS
POST 1972	231				
PRE-1972	398	27	80	171	22
TOTAL	629	27	80	171	22

3.3.3 History of ear trouble

A proportion of the male factory population was found, during the course of audiometric examination, to have a history of ear trouble.

Of the 155 men found to have an abnormality of hearing 91 or 59% were subsequently seen in the surgery by the doctor at least once. On most of these occasions advice about the effects of noise on hearing and the need to wear hearing protectors in noisy areas was given. Eight of the men had more than one condition and these are listed separately in Table 4a. Up to June 1975, 1,917 men had been examined.

3.3.4 Treatment and action taken

Table 5 shows the number of people who had some form of treatment, usually ear syringing for wax, before the audiogram was taken. Of the people tested a few were referred to their general practitioner and in some cases there was successful treatment by operation with the NHS.

See Section 3.6 for results of referrals.

A large number of people, especially those working in noisy areas, had ear plugs fitted and others were told to wear ear muffs. This is also shown in Table 5.

Some employees were told that they would not be allowed to work in noisy areas owing to some degree of hearing loss which had already occurred. (Whether this advice is appropriate or not is discussed in section 7.4.) They were all new employees employed post-1972 after the audiometric programme commenced. Of the "in-place" employees, pre-1972, a number; 27, refused further tests and a small number, 4, refused even an initial test. The number of men referred to their G.P. and the number not allowed to work in noise is shown in Table 5.

TABLE 4*

HISTORY OF EAR TROUBLE AND ADVICE GIVEN TO FACTORY MEN

	A	B	C	D	E
Condition	Number of men seen by doctor	Number of occasions men seen and advised about noise	Number of occasions men seen and no advice noted	Number not seen by doctor	TOT A + D
Stapedectomy				1	1
Mastoid	14	13	6	6	20
Perforation	24	12	16	10	34
Otitismedra	5	4	2	3	8
Otitisexterna	7	9		7	14
Abscess	10	10	2	11	21
Ear trouble as a child	11	7	7	15	26
Tinnitus	4	2	3		4
Vertigo	3	4	1	1	4
Polypus-aural				1	1
Deafness: infancy	2	1	1	1	3
later	8	3	9		8
infamily	1		1		1
Meniere's disease	1				1
Labyrinthitis	1				1
TOTAL	91	65	48	56	147

* Continued on Table 4a

TABLE 4a

BELOW IS A LIST OF MULTIPLE CONDITIONS WHICH SHOULD BE USED IN CONJUNCTION WITH TABLE 4

Peforation	1		1		1
Deaf r. ear and tinnitus				1	1
Deaf l. ear and tinnitus			2		1
Damaged r. ear	1		1		1
Ot. med and ext., mast., and tinnitus	1		2		1
Ot. med and externa	1	2			1
Perfor., ot. med., mast. and tinnitus	1				1
Mastoid and ot. media				1	1
GRAND TOT. AND % COL. E.	97 63.0%	67	54	58 37%	155

TABLE 5

TREATMENT AND ACTION TAKEN BEFORE AUDIOGRAM AND RECOMMENDATIONS

TREATMENT OR ACTION	NUMBER
TREATMENT BEFORE TEST	74
REFERRED TO G.P.	24
NOT TO WORK IN NOISE	23
EAR PLUGS FITTED	250
NOTED WEARS EAR MUFFS	85

Upon examination of the audiograms on the day after the audiograms were taken, the doctor selects those employees whom he wishes to see. (For method of selection see section 3.2.3.) This takes about five minutes per ten audiograms, difficult ones may take about two minutes to evaluate while most only take about five seconds. Since about 2700 audiograms have been done to date this is a total of approximately 22 hours of the doctor's time. When the employee is seen he may be advised, or if his hearing is deteriorating readvised or strongly advised about the effects of noise on hearing and the need to wear hearing protectors. Some people may already have an appreciable hearing loss and they are strongly advised to wear protectors. The words advised, strongly advised or readvised are marked on the employee's audiogram or his medical card. Table 6 shows the number of men seen by the doctor, the number of times they have been seen and the comments made. These figures include those from Table 4 on the history of ear trouble.

Table 7 shows men whose audiogram showed an improvement upon retest. Most of the men were advised and are thus included in Table 6.

The total number of factory men seen by the doctor is given by summing the numbers in Table 6: 589 men. The total number of occasions on which men are seen is 696 given by summing Table 6 again but this time multiplying by a factor of two or three indicating the number of times they had been seen. Each appointment lasts fifteen minutes so that for factory men, 696 appointments result in 174 hours of the doctor's time; approximately 4½ weeks at 40 hrs/week. Of these appointments, 590 (consisting of 522 men) result in "advised",

TABLE 6

NUMBER OF MEN SEEN BY DOCTOR AFTER AUDIOMETRY AND NATURE OF COMMENT

Advised (seen once) 407	Advised and advised again or readvised or strongly advised (seen twice) 52	Strongly advised (seen once) 27	Strongly advised and strongly advised seen twice 3
Advised and readvised twice (seen 3 times) 6	Advised and other (seen twice) 25	Advised and other twice (seen three times) 2	Seen for reasons other than advice eg catarrh (seen once) 53
Seen for reasons other than advice (seen twice) 10	Not specified (seen once) 3	Not specified (seen twice) 1	

TABLE 7

NUMBER OF MEN SHOWING IMPROVEMENT UPON RETEST

Comment	Slight Improvement	Very Slight Improvement	Big Improvement
No.	19	1	2
		5 (not in table 6 adv. not noted)	

"readvised" or "strongly advised" being registered on the audiogram; 147.5 hours or 3½ weeks at 40 hrs/week in all.

A few of the men show a slight improvement in their audiograms upon retesting as shown in Table 7. Five of these were not marked advised but presumably advice was given during the appointment. Thus of a total of 589 men advised about hearing protectors between 22 and 27 showed improvement in hearing levels upon retesting. (Twenty two men have documented evidence of being advised about noise and ear protection while a further 5, although showing improvement in hearing, have no such evidence.) The number of men without change in hearing has not been determined here. It would be difficult to ascribe the 'no-change' or improvement in hearing levels solely to the medical advice in that the medical component is not easily isolated from other factors involved, such as the work of the safety department or management supervision. Up to June 1975 1,917 men have had audiograms and of these 589 or 31% have been advised about the effects of noise and the need for hearing protection.

Thus purpose 1, (stated in 3.1), that audiometry provides an occasion for persuading reluctant workers to wear hearing protectors is supported by this evidence. Whether the advice has any effect on hearing loss appeared at first to be difficult to ascertain.

It was at first thought that the research would involve psychological measures of the relative effectiveness of different forms of propaganda. This would involve measuring the effects of warnings about noise and hearing and isolating and comparing other inter-relating variables such as safety propaganda involving posters and films, and the effectiveness of persuasion by the safety adviser and supervisors. These would have been outside the scope of the present research. The approach focused on the sixth purpose of audiometry as stated in section 3.1 that is - whether audiometry detects noise susceptible individuals or not.

3.3.4.1 Audiometry and "noise-susceptible individuals"

Several authors have claimed that audiometry can be used to detect "noise-susceptible individuals": They include Shone (1958), Juselius (1962), Hickish (1963), Bragg (1965) and Bell (1966) among others. None of them, however, has specified exactly what noise susceptible means in quantitative terms, although Hartley and Sinclair (1973) and Trevethick (1973) recognised the need for a practical way to identify noise susceptible people.

The method I adopted was to state in operational terms a definition of "noise-susceptible individuals" in such a way that their existence could be tested in numerical terms. What is needed is a way of identifying, from an examination of their first audiogram, people who will suffer appreciable hearing loss. It was proposed, as a hypothesis for testing, that those who are "worst" on first audiogram will be "worst" on subsequent audiograms. For this analysis the Spearman rank order correlation coefficient was used by me to compare the first and third audiograms of the first 100 men who had the required three audiograms.

3.3.4.2 The Spearman rank order correlation coefficient

The Spearman rank order correlation is a measure of association between two variables which can be ranked in two ordered series. The two variables in this test are the first and the third audiograms of a number of individuals. There are about 100 men who have had at least three audiograms.

TABLE 8

RESULTS OF SPEARMAN RANK CORRELATION BETWEEN 1st AND 3rd AUDIOGRAMS N = 100

FREQUENCY	Rs		Corrected Rs	
	R. EAR	L. EAR	R. EAR	L. EAR
4000	0.911	0.877	0.910	0.876
Aver. $\frac{1}{2}$,1,2	0.827	0.821	0.826	0.820
8000	0.910	0.813	0.909	0.812;
250	0.635	0.722	0.620	0.706

P 5% $\angle$ Rs = 0.306
P 1% $\angle$ Rs = 0.432

TABLE 9

RESULTS OF SPEARMAN RANK CORRELATION BETWEEN 1st AND 3rd AUDIOGRAMS FOR PATHOLOGY GROUP (N = 24)

FREQUENCY	Rs		Corrected Rs	
	R. EAR	L. EAR	R. EAR	L. EAR
4000	0.776	0.763	0.772	0.761
Aver. $\frac{1}{2}$,1,2	0.897	0.734	0.897	0.733

P $\angle$ 5% Rs = 0.343
P $\angle$ 1% Rs = 0.485

The analysis proceeds by ranking in respect of hearing loss, all the first audiograms, and then similarly for the third audiograms for the same individuals. A high correlation would suggest that individuals tend to keep their ranks between the two variables. This would suggest that those individuals who are "worst" on their first audiogram will tend to be "worst" on their third audiogram. Tables of significance are used to show whether a particular correlation figure is significant at the $P = .01$ or $P = .05$ level.

3.3.4.3 Results of Spearman rank order correlation coefficient between first and third audiograms

Tables 8, 9 and 10 show the results of the Spearman rank order correlation coefficient for the total population of 100 men, the sub-population of 24 with ear pathology, and the sub-population of 58 who had advice from the doctor excluding those with pathology.

Table 11 shows the results of the test on a group of men who did not see the doctor for advice and also excludes those with pathology.

During the ranking procedure some individuals tied on a particular rank, they had the same degree of hearing loss. An allowance must be made for such ties which tend to raise the correlation coefficient. The calculated and corrected coefficients are both shown.

From Tables 8 and 9 it appears that the presence of pathology has no effect on the rank order correlation coefficient. Those individuals who have most hearing loss on their first audiogram are also in the group with most hearing loss on third audiograms, irrespective of pathology.

The effects of advice from the medical adviser and how this might affect the rank order correlation coefficient are described

TABLE 10

SPEARMAN RANK CORRELATION ON ADVICE AND INTERVIEW GROUP (N = 58)
EXCLUDING EAR PATHOLOGY

FREQUENCY	Rs		Corrected Rs	
	R. EAR	L. EAR	R. EAR	L. EAR
4000	0.926	0.920	0.925	0.919
Aver. ½,1,2	0.723	0.849	0.792	0.848

$P < 5\%$ Rs = 0.306
$P < 1\%$ Rs = 0.432

TABLE 11

SPEARMAN RANK CORRELATION ON NON-ADVICE GROUP (N = 18)
EXCLUDING PATHOLOGY

FREQUENCY	Rs		Corrected Rs	
	R. EAR	L. EAR	R. EAR	L. EAR
4000	0.905	0.900	0.903	0.898
Aver. ½,1,2	0.802	0.908	0.798	0.907

$P < 5\%$ Rs = 0.399
$P < 1\%$ Rs = 0.564

below.

The primary objective of audiometry at Cadbury's is to provide an occasion to persuade reluctant workers to wear hearing protectors. This is done by the doctor's interviewing selected workers and warning them about the dangers of noise, as described in sections 3.2.2 and 3.2.3. Tables 4 and 6 show the number of workers who were seen by the doctor and the strength of the advice given. Of the men who have had audiograms 31% have been given this advice.

The use of audiometry in this educative role has been supported by Bell (1966), Hiegbel (1970), Sataloff and Michael (1973), Trevethick (1973), Coles (1973) and Ensell (1973).

However, Howell (1973) has criticised this role as being very expensive for such a limited objective.

The audiograms at Cadbury's are marked according to whether the individual has been interviewed by the doctor and advised about the effects of noise and the need to wear hearing protectors. The results of the Spearman rank order correlation on this group, consisting of 58 men, are shown in Table 12. One would expect at first sight that if the doctor had been successful in persuading them to wear hearing protectors so that noise-induced hearing loss was prevented or lessened that the correlation would be low. This would then suggest that those persons worst off on their first audiogram (those with the largest hearing loss of the group) had improved relative to the other individuals, such that in the group having the third audiogram they were no longer in the worst group. A further eighteen individuals excluding those with pathology were not seen by the doctor. Apparently, their hearing loss was not serious enough to justify a personal interview. A

TABLE 12

RESULTS OF SPEARMAN RANK CRDER CORRELATION COEFFICIENT BETWEEN 1st AND 2nd AUDIOGRAMS, MEN AGED UNDER 30; (N = 88)

SUBJECT GROUP	PROBABILITY 5%	1%	FREQUENCY	Rs R. EAR	Rs L. EAR	Corrected for ties R. EAR	Corrected for ties L. EAR
1. N = 88 ALL SUBJECTS	0.306	0.432	4000 Aver. ½,1,2	0.759 0.757	0.857 0.782	0.752 0.755	0.854 0.780
2. N = 17 WITH PATHOLOGY	0.425	0.601	4000 Aver. ½,1,2	0.627 0.525	0.865 0.724	0.617 0.522	0.863 0.721
3. N = 37 NO PREVIOUS NOISE EXPOSURE EXCLUDING PATHO.	0.306	0.432	4000 Aver. ½,1,2	0.804 0.774	0.781 0.710	0.799 0.771	0.773 0.707
4. N = 34 WITH PREVIOUS NOISE EXPOSURE EXCLUDING THOSE WITH PATHOLOGY	0.306	0.432	4000 Aver. ½,1,2	0.792 0.623	0.899 0.736	0.782 0.616	0.896 0.733

continued...

TABLE 12 CONTINUED

5. N = 22 NO PREVIOUS NOISE EXPOSURE NO PATHOLOGY AND NO ADVICE FROM DOCTOR	0.359 0.508	4000 Aver. ½,1,2	0.768 0.787	0.794 0.642	0.761 0.780	0.786 0.635
6. N = 10 AS 5 BUT WITH ADVICE FROM DOCTOR	0.564 0.746	4000 Aver. ½,1,2	0.797 0.900	0.964 0.979	0.789 0.897	0.962 0.978
7. N = 10 HAD PREVIOUS NOISE EXPOSURE AND/OR PATHOLOGY THEREFORE ADVICE FROM DOCTOR	0.564 0.746	4000 Aver. ½,1,2	0.812 0.526	0.873 0.618	0.802 0.512	0.869 0.616
8. N = 38 WITH NOISE EXP. AND/OR PATHOLOGY BUT NO ADVICE	0.306 0.432	4000 Aver. ½,1,2	0.704 0.741	0.855 0.858	0.692 0.739	0.849 0.857
9. N = 28 WITH NOISE EXP. EXCLUDING PATHO. BUT NO ADVICE	0.317 0.448	4000 Aver. ½,1,2	0.766 0.584	0.855 0.767	0.752 0.576	0.847 0.763

Spearman rank correlation was done on this group, Table 11, to see how they compared with the group analysed in Table 10. The results shown in Tables 8 to 11 are discussed in the following section.

3.3.4.4 Discussion of results of analysis of 1st and 3rd audiograms

The figures in Tables 8 to 11 are all significant at the P = .01 level, that is, they suggest that those individuals who are "worst", that is show the most hearing loss on their first audiograms are also the worst on their third audiogram. This seems to occur irrespective of ear pathology or advice from the doctor, about the effects of noise, to individual workers. Thus, if "noise susceptibles" were defined, for example, as the worst 10% of the group, taking into account the range of hearing loss of these 10%, one could predict to a certain degree the expected hearing losses of future tested groups of individuals.

However, two variables have not been accounted for in these tables. It has not been possible to isolate the effects of past noise exposure since almost all these individuals have had experience of previous noisy employment and/or military service with exposure to gunfire. It might be that the men are continuing to lose hearing irrespective of wearing hearing protectors and of advice from the doctor because the total loss of their hearing due to noise has already occurred and further loss is due to age-related effects. This is possible because the sample of 100 contained only 6 men aged under 30 years. A further analysis was done on a population of men aged under 30 years to see whether similar results were obtained when the effects of age-related effects are minimal.

Table 12 shows the results of this analysis which are discussed

TABLE 13

GROUP MEAN AUDIOGRAMS FOR DIFFERENT GROUPS OF MEN AGED LESS THAN 30 YEARS

	GROUP N =	4000				Average ½,1 and 2			
		RIGHT EAR		LEFT EAR		RIGHT EAR		LEFT EAR	
		1st AUD.	2nd AUD.	1st AUD.	2nd AUD.	1st AUD.	2nd AUD.	1st AUD.	2nd AUD.
1	88	13.49	13.64	16.99	15.89	11.44	9.81	13.89	11.04
2	17	19.41	16.47	27.94	26.47	19.11	17.25	26.86	23.87
3	37	12.84	12.30	11.76	10.27	9.64	7.02	10.58	6.93
4	34	11.76	13.68 *	17.20	16.62	9.55	9.11	11.03	9.11
5	22	12.50	11.59	11.59	10.91	9.77	7.42	10.22	6.28
6	10	16	17 *	12.5	11.5	10.99	6.99	12.16	8.83
7	10	16	22.5 *	30	30.5 *	13.99	16.48 *	20.16	19.33
8	38	14.34	12.76	18.68	17.76	12.58	10.74	14.99	12.41
9	28	10.71	12.14 *	14.46	13.57	9.04	8.39	9.7	7.85

* Deterioration between 1st and 2nd audiogram group means

below.

3.3.4.5 <u>Discussion of results of analysis of 1st and 2nd audiograms</u>

It can be seen from Table 12 that there is a significant association for all groups except group 7, that is, those individuals who have had previous noise exposure and/or pathology and have received advice from the doctor about the effects of noise and the need to wear hearing protectors. For this group at 4000 Hz there is a significant correlation at the P = .01 level for the left and right ears. At the average of 500, 1000 and 2000 Hz the left ear correlation is significant only at the P = .05 level while the right ear is not significant at the P = .05 level.

In order to account for this difference and to see whether hearing is deteriorating between 1st and 2nd audiograms I calculated the group mean audiograms for groups one to nine for both ears and at the same frequency combinations. The results are set out in Table 13.

The starred figures refer to deteriorations in group means between first and second audiograms.

Although there are deteriorations in the group means in groups 4, 6 and 9 these are limited to the right ear at 4000 Hz. Group 7 shows deteriorations in group means at both the right and left ear at 4000 Hz and at the right ear for the average of 500, 1000 and 2000 Hz. The left ear group means at the average of 500, 1000 and 2000 Hz show a slight improvement. However, if the average for the right and left ear is used then there is still an overall deterioration from 15.99 dB on first audiogram to 16.50 dB on second audiogram.

One possible reason for this may be that one individual with

TABLE 14

SPEARMAN CORRELATION FOR GROUP 7 WITHOUT "WORST" INDIVIDUAL (N = 9)

FREQUENCY	Rs		Corrected Rs	
	R. EAR	L. EAR	R. EAR	L. EAR
4000	0.92	0.83	0.92	0.82
Aver. $\frac{1}{2}$,1,2	0.43	0.47	0.41	0.46

$P < 5\%$ $Rs = 0.600$
$P < 1\%$ $Rs = 0.783$

a large deterioration from first to second audiograms may be responsible for the overall group mean deterioration. Group means recalculated after removal of the "worst" individual still show deteriorations though not of the same magnitude. The Spearman correlation coefficient for group 7 was also calculated to see whether the removal of the "worst" individual would change the correlation coefficient significantly. These results are summarised in Table 14.

The correlation coefficient at 4000 Hz has increased for the right ear and decreased slightly for the left ear. At the average of 500, 1000 and 2000 Hz the correlation has decreased so that the correlation for the left ear is no longer significant, in terms of rank association at the P = .05 level. Indeed, there is quite a marked decrease in the correlation coefficient relating to the speech frequencies. This may be accounted for in the following way: if the difference between the first and second audiograms is less than average then removing one individual from the calculations will lower the correlation and vice versa. Obviously with small sample sizes the correlation coefficient is unstable and the addition or removal of one individual can have a marked effect.

3.4 Results of audiometry at Bournville - factory women

The number of factory women tested to June 1975 was 165 of whom eight have left employment.

3.4.1 History of ear trouble

Table 15 shows the extent of ear disorders which either came to light as a result of audiometry or were recorded as having a bearing on the hearing test result.

In Table 15 the figures in brackets refer to those women who had an appointment to see the doctor subsequent to audiometry.

TABLE 15

FACTORY WOMEN - HISTORY OF EAR TROUBLE AND NUMBER SEEN BY DOCTOR

Otitis media (1)	Otitis externa 1	Perforation 1 (3)	Ear trouble as child 4(1) Left: 1 (1)
Perf. and ear trouble as child (1)	Stapedectomy 1 (1)	Mastoid 1	Infection 2
Nerves; dislikes noise (1) Left	Tinnitus (3)	Wax 1 (4)	Mastoid and tinnitus (1) Left
Deafness from childhood 1 (1)	Deafness later (1)	Deafness in family (1)	Deafness later and in family (1)

TABLE 16

NOISY HOBBIES AND PAST MILITARY SERVICE AMONG OFFICE MEN TESTED

	HM FORCES	RIFLE/SHOTGUN SHOOTING	HI-FI	DISCOS	GROUPS
	79	1		2	
TOTAL	79	1		2	

TABLE 17

EXTENT OF EAR DISORDERS AMONG OFFICE MEN TESTED

STAPEDECTOMY	MASTOID	PERF.	OTITIS MED.	OTITIS EXT.	INFECTION
1	1	2		1	2
CHILDHOOD EAR TROUBLE	ABSCESS	TINNITUS	LABYRINTHITIS	INFECTION	BOMB BLAST DURING WAR
3	1	1	1	2	1

or example: in the category "ear trouble as a child" 4(1) eft: 1(1), four women had ear trouble as a child and one saw he doctor: a total of five. Two women have left one of hom saw the doctor making a total of women with ear trouble n childhood of seven.

wenty one women subsequent to audiometry had an appointment ith the doctor in the surgery.

.5 Results of audiometry at Bournville - office men and women

p to April 1975 102 office men and 6 office women have had n audiogram at Bournville.

Office men

able 16 gives a breakdown of noisy hobbies and past military ervice among office men.

able 17 shows the extent of ear disorders amongst the tested ffice men.

f the office men tested two were referred to their G.P.

Office women

f the office women tested so far one has been referred to her .P. about her catarrh and one had a case of deafness which riginated in adult life.

.6 Results of referral to a general practitioner

ndividuals with abnormal hearing fall into two groups: hose with past history of ear trouble and those ith noise-induced hearing loss. With most of these conditions here is little that can be done other than to make sure that hen working in noise he is vigilant in the use of hearing rotectors. A few individuals may possibly benefit from urther exhaustive tests and for this reason they may be eferred either to their G.P. or to an otologist.

o far 16 factory men, 2 office men, 5 factory women and 1 office woman were referred to their G.P. Of the factory men referred three were able to benefit from further treatment which resulted directly from the audiometric examination. One person had conductive deafness and was checked at school but not followed up. His hearing has now improved. Of the other two people referred to hospital for further treatment one now has normal hearing, as a result of the treatment, and the other is awaiting an operation. Six of the factory men and the two office men were referred but not followed up; that is they were told to report to their G.P. but have not been questioned, nor has any communication been received from their doctors, about any treatment.

The remaining factory men were not or could not be treated by the G.P. (3 men) or had been treated in the past (1 man) or were referred as a result of the ear examination and interview prior to audiometry and have since improved slightly (two men). Of the two office men who were referred by their G.P. to the ENT clinic one was still waiting at the close of the investigation for an appointment, the other was seen by a specialist and not treated but was recommended to wear a hearing aid.

Of the five factory women referred to their G.P.s two were not followed up (of these two, one did not, in fact, consult her G.P.), two could be treated and one was recommended for a hearing aid.

Thus of the 24 people referred to a G.P. as a result of examination before or after audiometry only three have any prospect of improved hearing. Another two people were recommended for hearing aids.

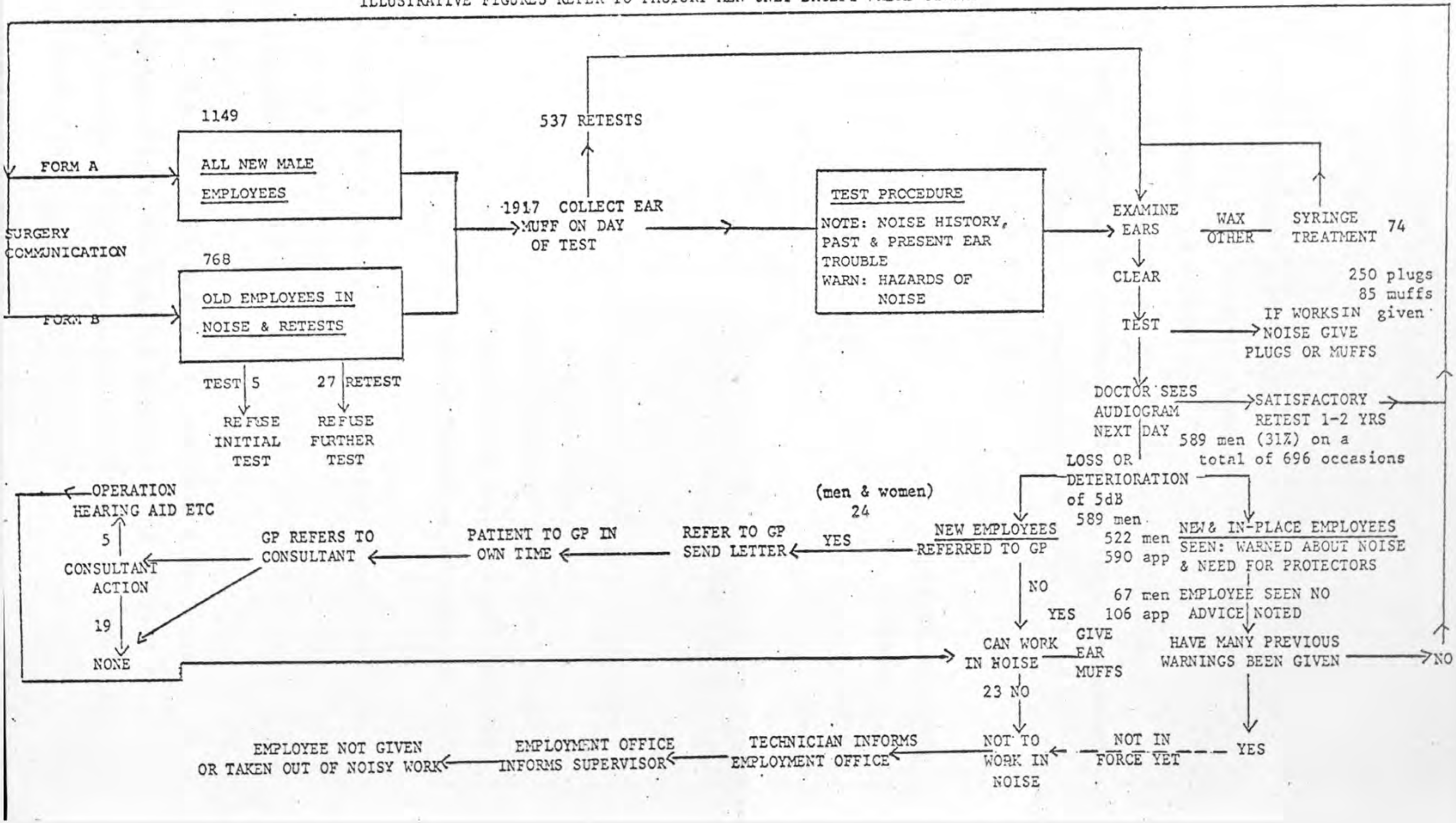
Figure 2 shows in a diagramatic form the audiometric procedure at Cadbury's, illustrated mainly by the figures referring to

FIGURE 2

AUDIOMETRY AT CADBURYS - DIAGRAMMATIC REPRESENTATION

ILLUSTRATIVE FIGURES REFER TO FACTORY MEN ONLY EXCEPT WHERE STATED

NOT INCLUDING NEW WOMEN EMPLOYEES AND OFFICE PERSONNEL



factory men.

3.7 Cost effectiveness of audiometry

Accounting costs are used here as these are the figures available from company records.

The following cost calculations have been agreed by the accountant at Cadbury's, as representing a realistic assessment of the cost of the audiometry programme from January 1972 to June 1975; three and a half years.

Capital costs

Item	Cost	Date of purchase
Audiometric booth	£465	26 December 1971
Audiometer	105	12 January 1972
Mains unit	75	12 January 1972
Microphone unit & amplifier	28	Not known
Desk, 2 chairs, files	58	Not known
Total:	£731	

It is company policy to write off in the first year all items that cost less than £500: they are not capitalised.

However, in order to get a present day value from these items it is reasonable to depreciate them at 20% p.a. as for certain production machinery. Hence, they can then be written off after five years.

After the three and a half years have elapsed these items in total are worth 3.5/5 less: £220.

Running costs

Doctor's time

To get an estimate of the worth of a doctor's time I have assumed earnings of £4000 p.a. in the beginning of 1972 to £7000 p.a. during 1975. This gives an average over the three years of £5500 p.a.

"Associated employee costs" refer to the costs of employing the doctor. National Insurance contributions were not more than £16 per month and company pension about £20 per month or a total figure of approximately £500 p.a.
This gives an average figure of £6000 p.a. over 1972-75 or £2.88 per hour per 40 hours per week.

Audiometric technician's time

The audiometric technician's salary in 1973 was £1400 and in 1974, £1600. Therefore I have taken an average of £1400 p.a. over the three and a half years, from January 1972 to June 1975.
Associated employee costs are approximately £300 p.a. giving a total of £1700 p.a.
In the first year of operation the technician worked about half time on audiometry and half time on other duties. If the six months of 1975 are taken in conjunction with half time working in the first year then this may be considered as one full year.
Total costs therefore = £1700 x 3 = £5100.
The audiometer has needed repair and maintenance since it was installed:

Service	Cost £	Date
Repair audiometer	11.55	28 March 1972
Recalibrate and overhaul	7.30	16 July 1973

The cost of audiogram sheets and folders must be estimated. These were not purchased outside but were provided within the company.

Audiometry folders

These were printed in the printing section at Cadbury's. For 2000 the labour charge was £6; overheads £4; total £10.

Audiogram charts

About 6000 of these were made up and photocopied by the typing office in Cadbury's. The cost of these is not entered as a figure in the surgery budget. The cost is borne by the typing office which provided a figure of £13.50 for the 6000 charts. This includes labour, materials, and overheads.

Cost of doctor's time in selecting persons for appointment

All the audiograms are seen by the doctor who then decides which people he wishes to see.

So far about 2727 audiograms have been produced.

The doctor can go through these at approximately the rate of 10 audiograms every five minutes.

2727 audiograms = 22.7 hours

or at £2.88 per hour cost of doctor's time £65.37.

Employee attendance

From my observation of employees being tested and upon discussion with the technician a time of 15 minutes for initial tests and 10 minutes for a retest is realistic.

The difference is due to the employee receiving instructions in the initial test and giving details of previous noise exposure.

I estimate a time of 10 minutes to get to the surgery and 10 minutes to return to work after the test. Therefore the total employee time spent on initial testing is 35 minutes and on retesting 30 minutes.

Factory men

The latest estimate (up to June 1975) is that 1,917 men have had an initial test and there have been 537 retests.

Initial tests

Total time = 1,917 x 35/60 = 1118.25 hours.

I have used the average wage in the years 1972-74 and of the first six months of 1975 to get an overall average wage figure for factory men of £32.80 per week.

Associated employee costs are 25% of the basic wage = £8.2.

This gives a total cost figure of £41 or 1.025 per hour.

total cost of time of initial tests = 1118.25 x 1.025 = £1146.

Retests

Similarly 537 x 30/60 = 268.5 hours x 1.025 = 275.

Cost of retests = £275 (for factory men)

Doctor's time at appointments

So far there have been 696 appointments with the doctor of approximately 15 minutes duration for each appointment.

This is 174 hours of doctor's time at £2.88 per hour.

= £501

Employee costs of seeing the doctor are calculated as for initial tests:

696 app. x 35/60 = 406 x 1.025 = £416.

Factory women

The number of factory women tested so far is 165 at total time each away from work of 35 minutes = 96.25 hours.

The average wage calculation is used here as for factory men.

This gives a figure of £25.77 per week plus associated employee costs of 25% or £6.44 giving a total of £32.21 per week or 80p/hour.

∴ Cost = 96.25 x 0.80 = £77

The number seeing the doctor for an appointment was 21.

Employee costs = 21 x 35/60 = 121/4 hours.

Cost = £9.8

Doctor's time = 21 x 15/60 = 5.25 hours at £2.88 per hour

= £15.12

Office men and women

Here I have used a composite figure of clerk's wages from 1972-75 to obtain an average cost figure for office men and women. The figures used assume all men on a rate divided equally between the top two grades; Grades 1 and 2 and Grade 3 figures for women. This represents the numbers of people on these grades in 1975.

This gives a figure of £32.19 per week for office men clerks plus associated employee costs at 25% = £40.23 per week or £1.005/hour.

102 men at 1.005 p/hour x 35/60 = £60

6 women at £26.62 per week plus associated employee costs of 25% = £33.27 per week on 0.83 p/hour.

Costs = 6 x 35/60 x 0.85 = £2.9

Allocation for heat, light, power, accommodation and general overheads

This is done on the basis of the proportion of area used in square feet in relation to the total surgery area.

The figure for accommodation in 1973 was £7449.

The room used and an apportionment of the surgery corridor space = 328 sq. ft. Total surgery area = 5803 sq. ft.

328 sq. ft = 5.7% of total area.

∴ £7449 x 5.7% = 424.6 x 3½ years = £1486 over 3½ years.

Total cost summary

	£
Capital costs	220.00
Running costs	
repairs	11.55
maintenance	7.30
folders and charts	23.50
Factory men	
initial tests	1146.00
retests	275.00
Doctor's appointment time	501.00
Men appointment time	416.00
Factory women	
initial tests	77.00
Doctor's time	15.12
Women appointments	9.80
Office men and women	63.00
Doctor's time selecting for appointment	65.44
Technician's cost	5100.00
Accommodation etc.	1486.00
	9416.71

Total number of audiograms = 2727

Cost per audiogram = 9417/2727 = £3.45 over the period

Jan 1972 - June 1975

5.4 Discussion

A convenient way of discussing the results of the research on audiometry at Cadbury's is to consider in turn the objectives of audiometry and the degree to which these purposes are achieved.

1. The main purpose of audiometry at Cadbury's is that it provides an occasion for persuading reluctant workers to wear hearing protectors. Audiometry probably does provide an occasion to advise workers about noise but this could equally be done, and is being done, by the safety office which shows films about the effects of noise and also gives advice. The question then centres on the relative effectiveness of one form of advice compared with any other. The figures illustrated in Table 10 suggest that for the group of fifty eight men who had an interview the advice was not effective - the men who have an appreciable loss of hearing on their first audiogram compared to other members of the group will still continue to be the ones who are worst off in their subsequent (in this case the third) audiogram. It could be said that the advice given by the doctor prevents the individuals in the worst category from losing even more hearing than is the case. There are at least seven possible reasons which could explain why these men maintain their ranks between the first and third audiograms and these will be discussed in turn.

1.1 It may be that the men are not wearing their hearing protectors consistently because the advice given by the doctor is inappropriate.

This seems unlikely because it is difficult to think of advice other than telling the workers to wear hearing protectors which would achieve the same end result. This possibility, however, is not as remote as it may seem. For example research is being conducted by the Safety and Hygiene Department to see if first aid training by itself, with no emphasis on safety training and accident prevention will influence people to behave safely and have less accidents. It may be that there are forms of training or education which could persuade people to wear hearing protectors without the direct influence of an interview with a medical officer.

1.2 The workers may not be wearing hearing protectors because they are uncomfortable or there may be pressure from peer groups which detracts from their consistent use. Merriman (1976), surveyed the use of hearing protectors at Cadbury's and has found that 85% of persons issued with hearing protectors were wearing them at the time of observation. The survey was done by walking around and counting the number of people wearing and not wearing hearing protectors. It thus seems unlikely that the reason for the men maintaining rank between first and third audiograms is that earmuffs are not consistently worn.

1.3 There is a possibility that the attenuation afforded by the hearing protectors is not adequate owing to poor maintenance and fitting so that noise-induced hearing loss occurs in spite of their consistent use. This possibility means that much more care may have to be given in instructing people in the use of ear protectors and that general supervision of their use would need to be more vigilant.

1.4 In a situation where people are over exposed to information extolling a particular course of action there may be a counter-reaction. This could occur by inducing anxiety or fear in employees to such an extent that the whole subject of noise and hearing loss is suppressed. This has been found after displaying horrific posters where the information content was extremely disturbing (Piccolino, 1966). On the other hand, if the information is repetitive and not borne out in practice this could result in saturation and boredom brought about by a lack of relevance and identifiable results. This counter-reaction could be evident as information and persuasion are directed at employees by medical staff, safety office staff, supervisors, films and posters.

1.5 One explanation for the maintenance of rank between the first and third audiograms may be that, although the individuals are wearing their hearing protectors at work, there may be some who continue to lose hearing due to exposure to non-industrial noise.

1.6 Another explanation may be that audiometry is not sensitive enough to show, in individuals, improvement in hearing due to increased vigilance in wearing hearing protectors. It may be that a comparison between the first and say, tenth audiogram, would show a significant decrease in noise-induced hearing loss owing to the wearing of hearing protectors, which does not show in a comparison of first and third audiograms.

The doctor selects for a personal interview those individuals who already have a degree of hearing loss. It is possible that this selection is inappropriate - once people have a certain degree of hearing loss, any noise-induced component becomes insignificant.

1.7 The most likely reason for the maintenance of rank between the first and third audiograms is that because most of the men are over thirty years old, presbycusis (hearing loss due to age) may be the predominating component in the continuing loss. Only four of the fifty eight men are under thirty with a total of six out of the hundred being under thirty. Because of the small number of men below thirty years of age in the group of fifty eight their contribution to the overall figures is minimal. However, it was possible to calculate the correlation coefficient for that group of men under thirty who have had at least two audiograms.

This was done for the population of men aged under thirty years whom, it might be expected, have had less exposure to previous noisy employment than men over thirty years and little or no presbycusis. As discussed in section 3.3.4.6 the groups of individuals tended to keep their ranks irrespective of pathology, advice from the doctor about noise and hearing, and past noise exposure and presbycusis. However, there was generally in the under-thirties group, an improvement in hearing when group means from the first and second audiograms were compared. This could be a learning effect owing to people's becoming more experienced in the procedure of audiometry on their second attempt. Robinson et al (1975) found that even with subjects who had previous experience of audiometry the learning effect was quite marked, and predominant compared with other errors.

All these explanations for the maintenance of rank between first and second or third audiograms may be present either singly or in some combination. Further research is needed to isolate and identify the factors responsible for the maintenance of ranks between groups of individuals and to see whether comparable data is observable in other factories and industries.

2. The second purpose of audiometry at Cadbury's is to provide a rough check to select individuals with abnormal hearing for additional tests. From section 3.3.4.7 we can see that of the twenty four people referred, for additional tests, to their G.P. (from a total number of 2190 people) only three gained improvement in hearing by being referred as a direct result of audiometry. The medical adviser at Cadbury's informed me that he considers these benefits as a "spin-off" of the application of audiometry in industry. It may be that a method could be devised to select these people at interview by questionnaire. This is something that would have to be explored by further research. However, if this purpose is stated as being one of the main purposes of audiometry it seems a costly method of selecting people for further treatment and raises questions about the relation between the National Health Service and occupational health services as well as the responsibilities of private industry. It also opens the debate about how much of a given limited resource should be spent on say, audiometry, when more effective use might be made of such resources in other areas of safety and health. Atherley et al (1978) discussed the place of audiometry within the pattern of occupational health services and suggested that where comprehensive medical examinations are offered as a matter of routine then audiometry would require little justification as it would not represent more than a small proportion of total medical resources. In organisations not offering comprehensive examinations, the introduction of audiometry would need to be justified in cost benefit terms as it is likely that either provision of new resources or reallocation of existing resources would be necessary.

3. The third purpose of audiometry is that it helps in deciding what to do with noise deafened individuals. There are two areas of action here: a) at pre-placement (often known as pre-employment) and b) in connection with audiometry during employment. Since the audiometric programme started twenty three new employees were advised against employment in noisy areas owning to the degree of hearing loss which had already occurred. The assumption behind this action is that people with a large degree of hearing loss need to protect what hearing they have left. However, there is no reason why these individuals should not be issued with hearing protectors as is the case with "normal" workers who have not only more hearing at risk, but whose hearing may be more susceptible to noise than the hearing of workers who already have some degree of loss. The action taken with noise-deafened individuals after tests during employment falls within the scope of the primary purposes of audiometry and has been dealt with earlier.

4. The fourth purpose of audiometry is that it provides a record of changes in an individual's hearing. Crucial to this argument is the reliability and accuracy of the audiometric technique itself. Rodda (1965) and Howell and Hartley (1972) have shown that there is great variability between operators while Atherley et al (1963) and Hartley et al (1973) have shown that there is great intra-subject variability. This suggests that the variability in the measurement technique is such that differences in an individual's repeat audiogram are suspect unless they are large or sustained over several audiograms. It has been suggested by Burns (1968) that a more accurate estimate of a person's hearing can be made if two or three audiograms are made within a short interval of time and the mean of these used.

Burns and Robinson (1970) suggested that the mean of three audiograms should be used, where the audiograms are taken at three separate sittings with a week between each. It seems impractical on cost grounds alone to justify audiometry on such a scale especially in the light of the other limitations mentioned.

5. The fifth purpose of audiometry is to pick out individuals who are at risk and to make sure that they wear hearing protectors or do not work in noisy environments. This is an amalgam of objectives one, two and three and has been dealt with earlier.

The following purposes were said to be low in the order of priorities or usefulness from a medical viewpoint.

6. The sixth objective was that audiometry detects noise-susceptible individuals. This has been supported by Juselius (1962) and Hickish (1963) among others. However Howell and Hartley (1972) and Atherley et al (1973) support the view that the uncertainties of audiometry are so great as to make audiometry too slow in detecting any real changes before they become detectable by other means by which time the damage has been done. Ward (1965) attempted to define the concept of noise susceptibility. He suggested that the term "noise susceptible" is too wide for quantitative determination. In the present research if noise susceptibles are defined as that 10% of persons who on their first audiogram have suffered most hearing loss then for that group one may predict that the same 10% will be suffering most hearing loss on their third audiogram. However, this group seems to lose hearing irrespective of advice from the doctor and the use of hearing protectors and could be due to presbycusis or to inadequate or incorrect use of hearing protectors.

7. The seventh purpose of audiometry at Cadbury's is that it

provides a baseline for later comparisons. It is obvious that if accuracy were required in any measurement technique, it is where a baseline is being established against which future readings can be compared. However, the questions of reliability and accuracy which were mentioned earlier are relevant here too: more than one audiogram must be made and these then averaged to obtain the baseline. The limitations of cost apply as much here as to the earlier discussion.

8. The final purpose of audiometry is that the audiogram may be useful in compensation cases. This concerns audiometry at pre-placement; to assess the worker's hearing loss, if any, on starting work at Cadbury's, and at post-employment; to refute any future claims that may occur once the worker has left his employment and gone elsewhere and perhaps subsequently sustained hearing damage. So far, post-employment audiometry has only been done in two cases before the employees have retired. There is no evidence up to 1975 that pre-placement testing would benefit the company in compensation cases. Indeed, it has been suggested by the medical officer that audiometry in highlighting noise and noise-induced hearing loss, may stimulate or initiate compensation claims although no published evidence exists.

It is also possible that audiometry may be useful to the plaintiff during a common law claim. In the common law claims which have been successful so far the fact that audiometry was being performed was favourable in one case and unfavourable in another and was not mentioned in a third. In the USA audiometric tests are recommended as part of an effective hearing conservation programme which has to be instituted if noise levels are above 90 dB(A), (Federal Occupational Safety and Health Act, 1970), and has been used in litigation for many years. The use of audiometry in the USA has been widely supported by Miller et al (1974), Smith (1976) and Swift (1976) although dissenting views have also been expressed; (Harris, 1975).

5.5 Conclusions and Recommendations

Audiometry, as performed at Cadbury's was examined in the light of the purposes of audiometry placed in order of priorty by the medical adviser. The degree to which the purposes are being fulfilled and the cost involved can then be used in decisions about the effectiveness of audiometry and suggest whether redirection or expansion of effort is desirable.

The purposes of audiometry are listed below with a summary of the findings pertaining to each objective. The list is dealt with in order of priority as decided by the medical officer.

1. Audiometry provides an occasion for persuading reluctant workers to wear hearing protectors.

From a comparison of advised (N=58) and non-advised (N=18) employees, using first and third audiograms and excluding pathology it appears that there is no difference between the two groups in their relative ranks in the Spearman rank order correlation coefficient. The most likely reason for this was that allowance had not been made for presbycusis and past noise exposure.

From a comparison of interviewed (N=10) and non-interviewed (N=22) employees, using first and second audiograms of men under thirty years and excluding those with previous noise exposure or pathology, there was no difference in their relative ranks. In one group, (no. 7, N=10) who had previous noise exposure and pathology and were advised by the doctor, there was significant change of rank at the speech frequencies. However, an examination of their group mean audiograms showed a general deterioration in hearing between first and second audiograms while the other groups showed a general improvement, probably a learning effect. I have thus been unable to show that an interview with the medical adviser has a beneficial effect on hearing levels. This may be due to some of the sample sizes being too small (all that were available were used for the analysis) and to the fact that the time period between first and third audiograms is too short for any small changes to be detectable especially in the light of the known limitations of audiometry.

2. Audiometry is a rough check to select individuals with abnormal hearing for additional tests.

Out of a total of 2190 individuals tested in the period from April 1972 to June 1975, 24 were referred for further tests to the NHS. Of these, three gained some lasting improvement in hearing and two were recommended for a hearing aid. On this basis I accept that audiometry can be used as a rough check to select individuals for further tests.

3. Audiometry helps in deciding what to do with noise-deafened individuals.

During the research period twenty three new employees were advised against employment in noisy areas owing to the degree of hearing loss which they had already sustained. I have argued in the previous pages that it may not be necessary to exclude individuals with hearing loss from work in noisy areas. The medical adviser has informed me that he no longer does so but instead gives these employees advice about hearing protector use. During the various stages of the project I held discussions with the medical adviser about the nature and role of audiometry. He agreed that these discussions may have been one of the factors which contributed towards this change of emphasis.

4. Audiometry provides a record of changes in an individual's hearing.

There is some evidence which suggests that audiometry, as practised throughout most of industry, is not reliable enough to provide an accurate record of changes in an individual's hearing. It has been suggested that two or more audiograms, within a short space of time, would be needed in order to make an accurate estimate of a person's hearing in order that small changes could be reliably detected. On cost grounds alone this would appear impractical for all employees. However, it should only marginally increase total costs if two or more audiograms are taken for those employees exposed to very high noise levels. A cut-off point might be noise levels of 100 dB(A) or above which would affect about eighty people. In this way the reliability of the audiometric technique will improve and more weight can be attached to the interpretation of audiograms. I also recommend that hearing at the 3000 Hz frequency be tested. This will generate data which may be useful when the scope of the National Insurance benefits scheme for occupational deafness is widened to include other industries and less stringent noise exposures.

5. Audiometry can pick out individuals who are at risk and make sure they wear protectors or do not work in noisy environments.

This is an amalgam of 1, 2 and 3 and those conclusions apply here.

6. Audiometry detects noise susceptible people

When the effect of noise on populations is studied it is found that a proportion of people lose hearing at a faster rate than others. However, there is no known technique whereby this group can be identified in advance of any major hearing loss. I therefore conclude that as used at the present time audiometry cannot detect noise susceptible people.

7. Audiometry provides a baseline for later comparison.

If accuracy is required it is when a baseline is being drawn with which to make comparisons at a later stage. The comments under objective 4 apply here.

8. Audiometry may be useful in compensation cases when done at pre-employment or post-employment.

This is usually taken to mean that a company will be able to forestall or successfully defend claims for deafness which had occurred in areas outside the company's responsibility.

There is no evidence that audiometry has been useful in this way. On the contrary there is suggestive evidence, from talking to company medical advisers, that audiometry through making employees generally aware of noise and noise-induced hearing loss may be a factor in initiating claims against employers which might not otherwise have occurred.

If audiometric data is used in successfully defending claims for deafness it needs to be reliable. The action recommended under 4. above thus has special relevance here in that Cadbury's would be seen to be taking precautions to increase the reliability of their monitoring procedure.

CHAPTER 6

6 Physiotherapy

6.1 Introduction

The occupational health service at Bournville has for a number of years provided a physiotherapy treatment service on a full-time basis for the benefit of its employees. The service is used by employees while at work or on an appointment basis from home if the employee is unable, because of injury or illness, to attend for work.

The main functions of a physiotherapy service in industry have been outlined by the Chartered Society of Physiotherapy (1956) and by Hayne (1975) and Slattery (1975). A more detailed statement of the functions and benefits of physiotherapy in industry has been made by the Association of Chartered Physiotherapists in Industry (1974). This statement is outlined below in a brief review of the evidence and claims made for the efficacy of physiotherapy in industry.

1.1 Critical review of benefits of physiotherapy in industry

1.1.1 The Association of Chartered Physiotherapists in Industry (ACPI) described the function of the physiotherapist in industry as being one in which:

> "each patient's particular function within the works must be understood and assessed by the physiotherapist in order that injuries may be prevented as well as cured"

The ACPI goes on, in its booklet Physiotherapy in Industry; (ACPI, 1974), to state that the advantages of an industrial physiotherapy department are threefold:

> "1. Early treatment at the onset of a condition will in the majority of cases reduce the time lost from work."

This reduction is said to occur because general practitioners can refer people directly for prompt treatment if the company employs a physiotherapist. The alternative would be a wait of perhaps several weeks for treatment in hospital.

"2. Treatment on the spot saves time and money."

It is claimed, though no evidence for this is presented, that the time lost attending for treatment at work is often only one-third of that required for a comparable treatment at a local hospital because of travelling and waiting time.

"3. Half-an-hour on the shop floor may avoid the need for six hours treatment in the department"

The preventive role of physiotherapy is espoused as being all important. The ACPI claims that many of the conditions treated are as a result of incorrect manual handling, lifting or incorrect functional posture. The physiotherapist is thus ideally placed, says the ACPI, to advise on the correct working methods in order to minimise potential strains and sprains.

The preventive role could not be substantiated at Cadbury's because the giving of shop floor advice is not undertaken by the physiotherapist. This extension of the physiotherapist's role from providing treatment after injury to one of prevention has been described by Hayne (1974). He chronicles the extension of physiotherapy in industry from its beginnings in 1923 to the formation of the Association of Chartered Physiotherapists in Industry in 1947 and through to 1975.

There are now about 74 full-time or part-time members of the ACPI working in industry. The proportion of physiotherapists engaged in effective preventive measures, however, is difficult to ascertain.

Hayne (1973) attempted to link the preventive aspects of physiotherapy with ergonomics and went on to describe how physiotherapists are essential members of the occupational health team in combating environmental problems of noise, temperature, lighting and machinery design. Whether this extension of physiotherapy from its primary role of injury and illness treatment is effective has not been tested and is a matter for discussion.

The main benefit that can be discerned and tested is that physiotherapy as provided at work reduces sickness absence and to compare the saving with the cost of provision of the service.

1.1.2 In 1955 Aims of Industry conducted a survey among a cross section of British Industry because:

> "the health benefits of physiotherapy to the individual are well recognised but no attempt seems to have been made to evaluate on a broad scale, in statistical terms, the benefits in saving of man hours and consequently in increasing productivity derived by companies which provide such treatment for their employees at comparatively small cost..."

As a result of the investigation they concluded that on average the saving is upwards of three man-hours per treatment. Two typical examples of the saving of man-hours were given as being representative of the savings involved:

> "A famous aircraft manufacturing company employing two full-time and two part-time physiotherapists gives 36,000 treatments a year. The company estimates a saving of 1,100 man-hours per week, or 57,200 per year.

Assuming that a man works 2000 hours in a year this is equivalent to the free services of 28 more men for one year" and

"Another company employing only one part-time physiotherapist claims a saving of at least 20,000 hours - worth 10 extra men a year"

There is however no method given of how these savings have been calculated and Aims of Industry, now called Aims for Freedom and Enterprise, informed me that records from the period of 1955 have long ago been scrapped. Everybody who would have had anything to do with the survey has also long since left the organisation.

It is probable that the estimates of savings in this survey were made by assuming that every treatment session given in industry would have necessitated treatment at hospital. One department store employing a physiotherapist is quoted by saying:

"an employee attending for treatment may lose only half an hour away from work, whereas several hours might be lost if he had to attend for treatment elsewhere."

However, it has not been shown what proportion of people attending for industrial physiotherapy would have had to attend for treatment at hospital.

One motor manufacturer estimated that in 1954 the cases treated at the plant lost on average three days, as against 22.4 days for cases treated at hospital. The comparative figures for 1951-53 are:

	Days Lost	
YEAR	Plant	Hospital
1951	2.2	28.3
1952	3.4	32.71
1953	2.0	14.33

How these figures are arrived at is not given nor is there any indication whether the people being compared were matched for injury, age or severity or other relevant factors.

The main conclusions of the survey are summarised in Table 18 which shows examples of individual companies experience of the time-saving benefits of industrial physiotherapy.

The above criticisms also apply to Table 18.

1.1.3 Taylor (1973) showed that the running cost of the physiotherapy department at Shell Haven (reported to the General Manager for the years 1966 and 1967) was only half the cost of the working time saved, not including capital depreciation and accommodation charges.

He described another refinery physiotherapy department set up jointly with a local hospital which was used by the physical medicine and orthopaedic consultants as an extension of their own hospital department.

The economic advantages of this arrangement were said to be demonstrable but detailed figures for these studies were not shown.

1.1.4 A more detailed analysis has been prepared by a large Midlands steel company which carried out a survey of physiotherapy services at various sites within the company; (Engineering Employers Federation, 1973).

1.1.4.1 For site A the report concludes that for the annual cost of £3660 a saving of £8650 is attainable. This represents

TABLE 18

MAN-HOURS SAVED DUE TO PHYSIOTHERAPY

Type of Industry	No. of Employees	No. of Treatments & Physiotherapists	Man Hours Saved (Est.)
Furniture	300	3,200 - 1 therapist	4,380 (at least)
Steel Works	589	415 - 2	5,380
Engineering Company	c. 700	1,900 - 1	5,700
Paper Mill	15 patients	335 - ?	1,173 (say)
Building Contractors ..	700	1,000 - 1	4,800
Insulation Engineer	1,500	c.500 - 2 part-time	c.900
Linoleum Manufacturers ..	2,000	c.2,000 - 1	c.4,000
Cable Makers	3,500	4,600 - 1 plus 1 trainee	16,100
Shoe Machinery Manufacturers	1,000	1,155 - 1 twice weekly	2,310 (or more)
Oil Refiners	5,000	4,700 - 1	14,100
Textile Manufacturers ..	5,400	c.900 - 1 for 10½ hours a week	20,000 (at least)
Hydraulic Brake Manufacturers	6,000 6,500	c.4,000 - nurses only	c.6,500
Electrical Engineers ..	10,000	7,000 - 1	No estimate
Aircraft Builders	10,000	4,300 - 1	5,000
Steel Works	10,000	10,690 - 1	"Considerable"
Aircraft Builders	c.25,000	36,000 2 full-time & 2 part-time	57,200

a 50% return on the investment in building and equipment. The main saving is in the reduction of the waiting time for both orthopaedic opinion and subsequent treatment at hospitals. The saving of £8650 is calculated as follows:

A study was made of patients returning to work after absence caused by disease of bone, joint and muscle - that is those diseases or injuries which it is assumed would benefit from physiotherapy. Only patients absent for more than twenty eight days were included. It was considered that eighty nine such cases, seen in a four month period, could have benefited from physiotherapy treatment. This represents about 270 cases or about 6800 working days a year which could possibly be avoided.

The cost of absence from work is calculated at £3 a day (at 1973 prices) which over 6800 working days is approximately £20,000 per annum. The report then goes on to imply that even if only half of these patients accepted treatment in work there would be a potential saving of £10,000 per annum. It would be necessary to set against this the working time lost in attendance at the works physiotherapy unit.

The average time spent away from work was about one hour for each treatment with an average of 20 treatments to each of the 135 cases. (Number of cases approximated from 89 ÷ 2 x 3 for per annum figure.)

This represents about £1350. The saving is calculated as £10,000 - £1350 equals £8650 per annum. The net return on capital of 50% is thus based on:

£10,000 saving - (£3660) cost of department + £1350 cost of attendance) = £5000 per annum.

This is regarded in the report as a conservative figure since no account has been taken of:

a) any savings which might accrue from the reduction in average duration of treatment of the cases which are at present being treated in work, or

b) those cases attending hospital physiotherapy departments while still at work and who lose on average one day for each treatment.

The major criticism of this study is that the savings figure rests on the assumption that at least 44 patients who had been absent for more than 28 days, if physiotherapy at work had been available, would have chosen to continue to work and be treated at work.

Another criticism of the study is that only absences of 28 days and over were considered. It may be that physiotherapy has a part to play in reducing or eliminating short absences and this does not come out in this study.

1.1.4.2 A study at company site B showed that some 3995 working days were lost which it was estimated could have been recovered had a physiotherapist and equipment been available in the medical centre. At £3 per day the loss amounts to £11885. The investment was taken only to be for equipment, as the building exists, and was taken to be £2000 giving a return on capital invested of 500%.

In the above study the days lost were calculated for the number of people in 1970 who were absent for more than 28 days due to illness and injury of bone, joint and muscle conditions. It was then assumed that all this lost time would be recoverable if a physiotherapist had been available which is a wider assumption than in the site A study where it was assumed only half of these days lost were potentially recoverable.

1.1.4.3 A letter from a representative of the company at site C commented that while it is difficult to quantify the benefits in pounds and pence the overall opinion is that the system is worthwhile.

1.1.4.4 A brief report from the company representative at site D gave the number of visits made to the surgery for physiotherapy treatment. The report stated that the number of visits totalled 988 representing 3052 hours which would have been lost if the physiotherapy service had not been available at the factory. In this report it was assumed that everyone who had physiotherapy would have had time off had the service been unavailable, an assumption which is unsubstantiated.

1.1.4.5 A letter from the company medical officer at site E described the physiotherapy treatments provided and stated that:

> "If patients attended the local hospital, time lost would be in the region of 3 hours with travelling and treatment time. The saving in work time lost is considerable."

The letter stated that the medical department has kept monthly, since 1967, records of treatments and attendances and that they show consistently increases in treatments given.

There then follows the physiotherapy department's work load for March 1971 which is given as part of the evidence which "...clearly establishes the value of an efficient works Physiotherapy Department."

Here the implication appears to be that the maintenance of a high throughput of patients was an indicator of efficiency and effectiveness. No attempt was made at calculating possible savings achieved by the physiotherapy department.

A letter from the medical representative at site D also mentions the attendance figures and number of treatment sessions and says that this:

> "...represents a pretty good turnover, thus demonstrating a physiotherapist's time in industry is used to the full."

Again no attempt is made at calculating savings.

1.1.5 The Honorary Secretary of the Association of Chartered Physiotherapists in Industry, C R Hayne has made an estimate of the time saved as a result of physiotherapy in his company; (private communication, 1976): The total number of half hour treatments in 1974 was 14,500 on the company site. If these patients had gone to hospital it is estimated that 70% would have had two treatments weekly and the remaining 30% three treatments weekly. Treatment at hospital normally resulted in a minimum of two hours absence from work. Hayne estimated a total of 13,340 hours lost if patients had to go to hospital for treatment with 7250 hours lost had treatment occurred at work achieving a saving of 6090 hours.

It is not certain, however, that all patients would have had to go to hospital if the service had been unavailable.

1.1.6 Somerville (1976,a) estimated hours saved as a result of the provision of a physiotherapy service at one of the London banks.

She asked every patient attending for physiotherapy the following two questions:

1. How long did it take you to get from your branch office?
2. If you had a 9.00 am hospital appointment for treatment, what time would you expect to get to work?

The answers were noted on the patient's treatment card and at the end of the month totalled to give the number of patients treated, number of treatments and hours lost. The results were presented as follows:

	Feb. 1976	May 1976
Time lost through attending physio-therapy at work	54	65
Time lost if treatment given at hospital	117	138

It is not certain that all people treated would have sought hospital treatment had the service been unavailable. However, Somerville (1976,b) stated that all patients seen would have had to attend hospital. She is aware, however, that as the department becomes better known there will be a tendancy for patients to attend for treatment which would not have necessitated a hospital visit. To make sure that the service will not be 'overworked' a doctor's letter is required before treatment is given. Apparently since the service started demand has far outstripped the time available for treatment.

1.1.7 These studies demonstrate that although savings in absences are seen as one way in which the usefulness of physiotherapy in industry can be quantified, the research to date has been limited and not very rigorous. Clearly any activity which can substantially reduce sickness absence in industry would be one which merited expansion.

I therefore set out to devise a method of determining, at Cadbury's, whether the provision of a physiotherapy service reduces sickness absence.

Ideally one would need a comparison of two identical populations having similar injuries or illnesses, matched for age and other relevant factors, the only variable being the provision or absence of a physiotherapy service. In practice, it would not be practicable to arrange an ideal research model. Alternatively one could observe an established physiotherapy service and arrange to have it closed from a particular date. By monitoring the sickness absence of that population and comparing it with the sickness absence of a similar population with normal access to physiotherapy one could estimate the value of physiotherapy in terms of prevention of sickness absence. The following paragraphs describe how just such a situation arose unintentionally at Cadbury's and how the opportunity was taken to monitor and compare the resulting sickness absence. As a result any saving in sickness absence, could be quantified in terms of man-hours saved, and compared with the cost of providing the service.

6.2 Sickness Absence Monitoring and Comparison

2.1 Description of absence monitoring of test population

During a visit to the Cadbury's surgery in the first week of October 1974 it was noticed that the physiotherapist had been away ill for a few days and it was not certain when she would be available again for work.

There was no immediate replacement physiotherapist and it could have been some time before a full-time service was restored. It was possible to make a list of all employees, male and female, who were being treated by physiotherapy. People being treated had their physiotherapy attendance card kept in a separate box at the reception in the surgery so that it was possible to obtain a complete list of all employees who would still have been undergoing treatment but were not able to do so because of the physiotherapist's absence. With the cooperation of the nursing and reception staff a system was introduced whereby an indication was put on the medical cards of employees who would normally have been referred for physiotherapy. The complete list then represented all those employees who would normally be undergoing physiotherapy for various injuries or illnesses but who had to wait as the service was unavailable. After several weeks one, and later two, part-time physiotherapists were engaged to deal with those employees most urgently requiring treatment. The company physiotherapist returned on the 2nd December and worked mornings only for the rest of the month. The full-time service was resumed in January 1975.

Table 19 shows the three month period of October to December 1974 and the corresponding period of 1975 with details of the hours worked each week by the part-time physiotherapists as well as gross moneys earned.

2.2 Choice of control population and comparison with test population

The control group for comparison of sickness absence data was chosen from the period October to December 1975 so that seasonal absence variations between the two groups would be minimal.

The employees whose absence data were required fell into three categories: factory workers, office staff and management.

I decided to limit the study to a comparison of absence data of factory workers because:

1. no detailed absence figures are available for management i.e. those employees who are paid monthly
2. factory workers constitute the main body of people being treated and
3. detailed absence figures are available for male and female factory workers.

TABLE 19

DATES, HOURS WORKED AND MONEY EARNED BY PART-TIME PHYSIOTHERAPISTS

	Date W.E.	Hours Worked	Rate/Hour	Total
Mrs W.	9.9.74	35	£2.00	£ 70.00
	4.11.74	38	£2.00	£ 76.00
	5.12.74	53	£2.00	£107.00
	3.1.75	27	£2.00	£ 54.00
Mrs G.	14.11.74	52½	£2.00	£105.00

Table 20 shows that in October-December 1974 of the 214 males who had been referred for physiotherapy or had been undergoing physiotherapy over half, 60.7% were factory workers, 20.1% management and 17.8% office staff. In October-December 1975 as interest was now centred on factory employees the number of management employees undergoing treatment was not recorded. An approximation can be made, however, by assuming that the ratio of factory to management employees is similar to that in 1974 giving a total of 31 men. The figures in brackets thus refer to 31 management employees being treated in the period October-December 1975. In both periods of 1974 and 1975 factory employees constitute over 50% of men undergoing physiotherapy. Of the female employees referred for physiotherapy or undergoing physiotherapy over 80% are factory employees in the period of 1974 and 1975.

The percentage of staff personnel is 17.2% in 1974 and 24% in 1975.

Initially, 50 factory men and 50 factory women were selected using random number tables from those factory employees who had or would have had physiotherapy during the period September 30th to the end of December 1974. It was felt that this would be adequate for comparison in the time available.

I proposed, originally, to select a similar number at random from the population treated during September 30th to December 31st 1975 but as the research progressed it seemed that some matching of the population would be necessary eg. employees with back injuries seemed to appear in greater numbers than those with other injuries and appeared to have more time away from work. I thus decided to match the population chosen from 1975 with that from 1974 in such a way that each population

TABLE 20

PROPORTION OF FACTORY EMPLOYEES TO MANAGEMENT AND STAFF TREATED BY PHYSIOTHERAPY

MALES					
FACTORY		MANAG.	STAFF	PENSIONERS	TOTALS
1974 % of TOT.	130 60.7	43 20.1	38 17.8	2 1.4	214
1975 % of TOT.	93 86.9 (67.4)	(31) (22.5)	14 13.1 (10.1)		107 (135)
FEMALES					
FACTORY			STAFF		
1974 % of TOT.	106 82.8		22 17.2		128
1975 % of TOT.	54 76		17 24		71

would have a similar number of disease/injury categories; ie. if there were ten men in 1974 with a strain to area A of the body and 13 in 1975 with a strain to area A then I used random number tables to pick ten out of the 13 in 1975. The resulting populations of 1974 and 1975 were thus matched for site of injury or illness.

This method of matching resulted in the original population size of 50 being reduced to 46 in each of the male populations and to 33 in each of the female populations.

Further matching for example by age, was not done as the populations were found to be comparable in variability; not significantly different at 5% level using F test and no significant difference between the means at the 5% level using the t test.

Table 21 shows the number of employees and their distribution among the disease/injury categories by site of injury for both the male and female populations.

6.3 Derivation of absence data

Details of employee absence are kept in both the wages office and in the surgery personnel files. The wages office records every spell of absence however small.

The surgery keeps a record of every absence over three days duration. For the purposes of this research I used initially wages office records because they are the more comprehensive so that it is possible to see at a glance all the absence an employee has over the whole year.

The surgery records are also not as accurate as they could be because the number of work days lost is noted from the doctor's note which the employee sends or brings to the factory. Very often the date of first absence is not recorded and the date

TABLE 21

NUMBER OF EMPLOYEES IN SAMPLE AND DISEASE/INJURY CATEGORY DISTRIBUTION

SITE OF INJURY	NO. OF FEMALES	NO. OF MALES
BACK	11	15
SHOULDER	3	8
WRIST	4	4
KNEE	3	2
FOOT	6	7
HAND	2	4
ELBOW		1
ARM	2	1
HIP/THIGH	1	
NECK	1	1
RIBS		2
LEG		1
TOTAL	33	46

of issue of the doctor's note is then noted as the first day of absence.

Therefore, all absences recorded by the surgery could be underestimated by between one to three days.

Another reason for using the wages office records is that one readily sees the amount of State sickness benefit that was paid and the amount that the company contributed ie. the direct costs to the State and to the company of employees being absent from work.

It has been suggested in the past that sickness absence should be recorded on a seven day week basis as this would allow for greater comparability between different occupational groups rather than merely recording work days off, (London Transport Executive, 1956). I have here, however, used the work days off method because I am attempting to place a cost figure on work days off. The cost of absence on Saturday and Sunday will not normally be borne by the State or by the company although there may well be a cost, not necessarily financial, to the employee in terms of changes in weekend activity.

The two male populations which were being compared consisted of full-time employees. The female populations however consisted of full and part-time workers.

As there were different numbers of part-timers and full-timers in the two female populations I tested to see whether there was any significant difference between the two populations in the number of part-timers and full-timers.

I found, using chi-square, no significant difference at the P = .05 level between numbers of part-timers and full-timers in 1974 and 1975 (1974- 25pt, 8ft, 1975- 19ft, 14pt).

In totalling sickness absence data I have taken parts of a day or half-day to the nearest day or half day. Time is recorded in tenths of an hour for wage calculation purposes and a period of absence marked as 0.5 refers to a recorded absence of 30 minutes. This absence, to the nearest half-day, would not be marked down as an absence in my analysis. Initially, when comparing the populations under study I totalled all absence within the three month periods to arrive at sickness absence totals ie the illness or injury was not specified on the wages office records, other than to say whether the absence resulted from a works accident. (If a works accident was responsible for the absence then the benefits payable were recorded in a separate works accident book which is also kept in the wages office.) Totalling gross absence figures thus resulted in absences due to a variety of conditions being included such as influenza, gastric complaints and headaches, which are unrelated to the study of whether physiotherapy reduces sickness absence. In the following paragraphs graphs prefixed by 'A' are in Appendices 6 and 7. Graphs 1, 2 and A1 to A4 for men and graphs 5, 6 and A8 for women show gross absence comparisons. Graphs 3, 4 and A5 to A7 for men and A9 to A11 for women show only absence that can be ascribed to a particular condition which was being treated by physiotherapy or which should have been treated by physiotherapy but was not done so due to the restriction in the period of 1974.

The method of elimination of extraneous absence was as follows: for each employee in the sample populations I excluded all absences which were not related to the condition for which physiotherapy had been prescribed. This was fairly straightforward for absences over three days in length because the reason for absence was recorded in the medical records which in turn was taken from the employees doctor's note. Absences of three days or less presented a different problem. They are recorded on the files in the wages office so that a record of these absences is available.

However, it is not possible to ascertain the reason for absence from the medical cards in the surgery because absences, and the reason for absences, are not recorded if the absence is of three days duration or less.

On a few occasions the reason for absence could be determined from examination of the daily log of visits to the surgery where a record was kept of the reason why an employee was sent home.

In view of this difficulty, which presumably could only be resolved by questioning employees about every short absence, it was decided not to include any of the absences of three days or less unless it was clear that the absence was related to a referral for physiotherapy.

Graph A3 compares absence due to leg injury in the two sub-populations each of ten men. The term "leg injuries" covers two knee injuries, one leg injury and seven foot injuries for each of the two male populations. Within this grouping the term "foot injuries" covers ankle, toe and other general foot injuries.

6.4 Results of absence comparison

4.1 Male Employees

Graphs 1 to 4 in the text and graphs A1 to A7 in Appendix 6 represent a comparison of sickness absence between the October to December 1974 and October to December 1975 populations each having 46 male employees.

Apart from graphs 1 and 3 they are subdivided into injury categories. Thus graph 2 represents a comparison between 15 men in 1974 with back injuries with 15 men in 1975 also with back conditions.

Of the 46 men, 21 had injuries other than of the back and a comparison of their sickness absence is shown in graph A1. Graph A2 compares shoulder injury absence in the two sub-populations each of eight men.

4.1.1 Total absence and back injury absence analysis

Graph 1 is a representation of the total absence sustained by each of the 46 men in each of the two populations. Week 1 on the graph represents absence from week ending October 4th of 1974 and week ending October 3rd of 1975.

Week 14 represents part of the last week in December 1974 and 1975.

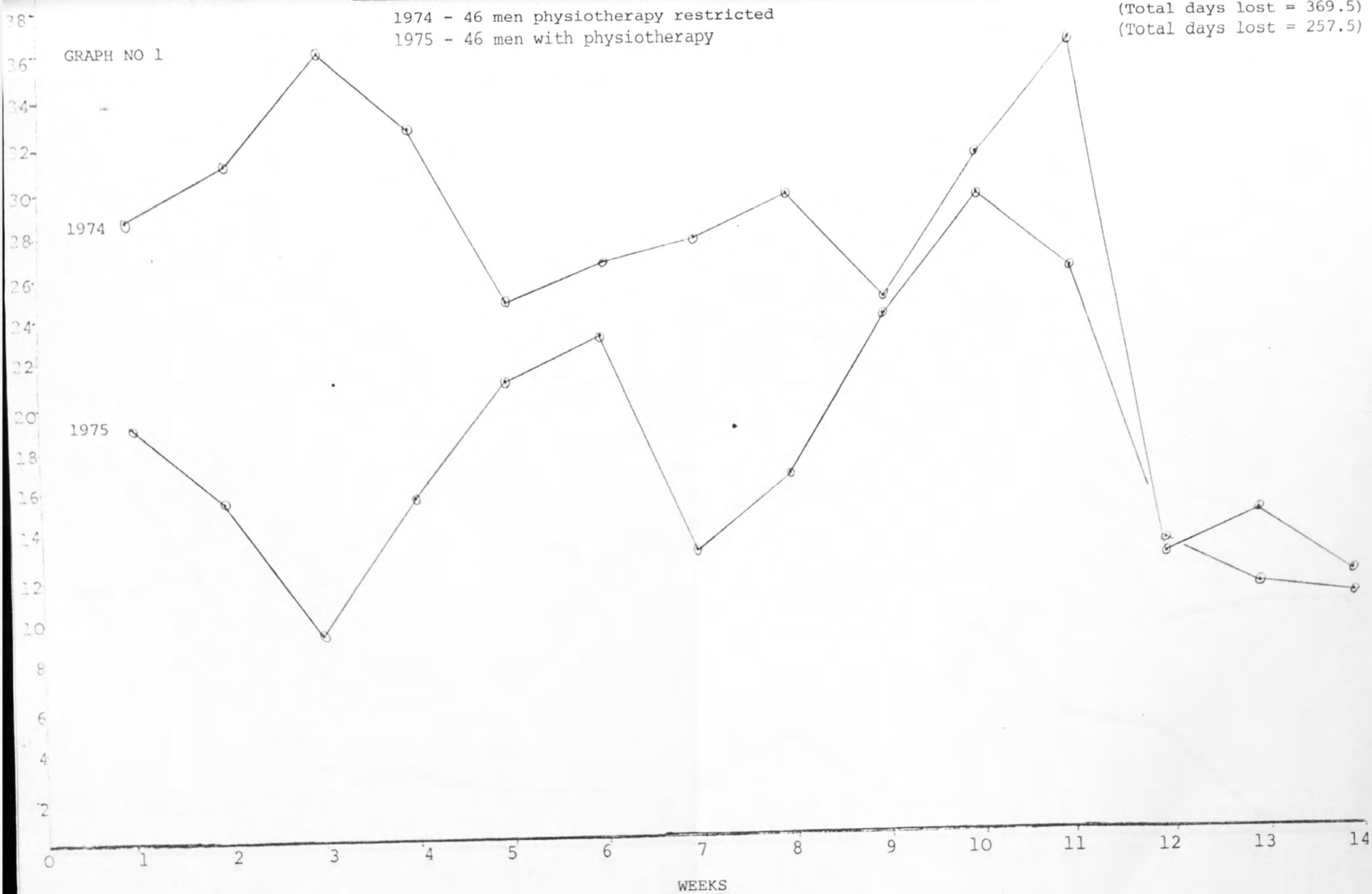
I performed the Student t test (testing the hypothesis that the observed difference between the means is significant) and the t test (which tests whether the variance between two populations is significantly different) on all the graphed data. In each case the data is treated as groups of 14 pieces of data to which the following assumptions apply:

1. The sample for 1974 is independent of that of 1975
2. To attach any value to the results from the t test it is important that the two underlying population variances σ_1^2 and σ_2^2 are approximately equal - even if the means are different.
3. The data are on an interval scale and that they come from approximately normal populations.

With reference to 2 above, for each set of data I performed

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END

GRAPH NO 1



GRAPH NO 2

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 15 men physiotherapy restricted (Total days lost = 221.5)
1975 - 15 men with physiotherapy (Total days lost = 72)

BACK INJURIES ONLY

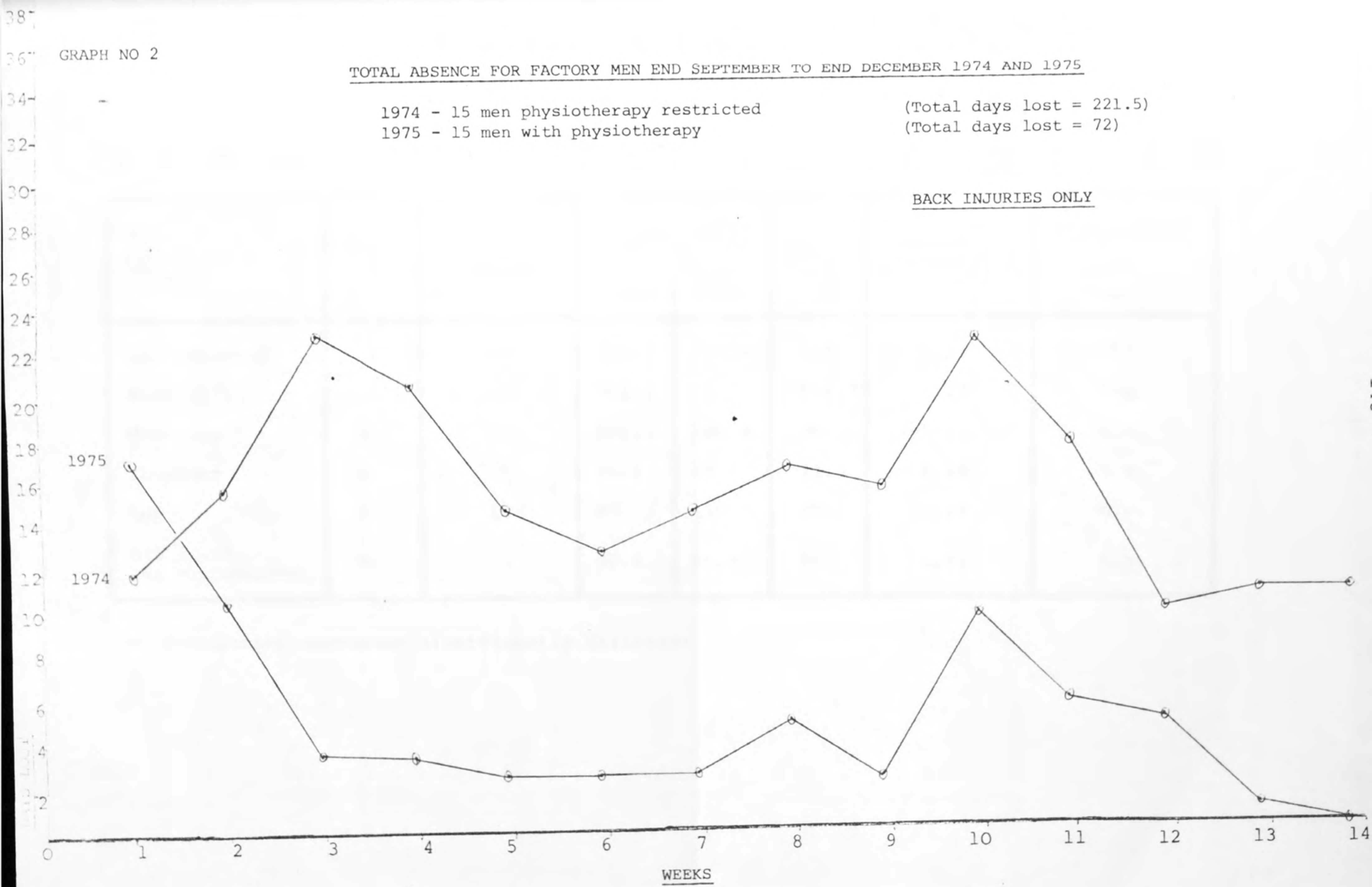


TABLE 22

TEST OF SIGNIFICANCE ON MALE PHYSIOTHERAPY ABSENCE DATA USING t- TEST - ALL ABSENCES INCLUDED

Site of injury or illness	GRAPH NO.	NO. IN POPULATION	Days lost Oct - Dec		Net days lost	Calculated probability	Significant at 0.05 level
			1974	1975			
All injuries	1	46	369.5	257.5	112	2.83	Sig.
Back only	2	15	221.5	72	149.5	6.25	Sig.
Non-back	A1	31	148.0	185.5	38	-1.15	n.s.
Shoulder	A2	8	24.5	13	11.5	1.28	n.s.+
Leg	A3	10	83	110	27	-1.28	n.s.
All (back + leg + shoulder)	A4	13	40.5	62.5	22	-0.71	n.s.

+ Population variances significantly different

F-tests, which test the hypothesis $\sigma_1^2 \neq \sigma_2^2$; at the 5% level of significance. I accept this hypothesis if the F-statistic is greater than 2.58 which is the tabulated value, at the 5% level, of the F-distribution with 13 x 13 (n -1, n -1) degrees of freedom. In most cases here I reject the hypothesis but for graphs 3, A2, A5, A6 and A8 there is evidence of basic differences. The effect of this is to detract from the significance tests in that the test is not valid in those cases. The method of calculation of the F-statistic is:

$$\frac{\text{larger sample variance}}{\text{smaller sample variance}} = \frac{\dfrac{(x_i - \bar{x}_i)^2}{n_i - 1}}{\dfrac{(x_2 - \bar{x}_2)}{n_2 - 1}}$$

The t-test calculations were done as follows:

(a) Means $= \dfrac{xi}{n}$

(b) Standard Error of difference between means $= \dfrac{(x_i - \bar{x}_i)^2 + (x_2 - \bar{x}_2)^2}{n_i + n_2 - 2} \quad \dfrac{1}{n_i} \quad \dfrac{1}{n_2}$

$$\text{The t-statistic} = \frac{(x_i - \bar{x}_2)}{SE\ (\bar{x}_i - x_2)}$$

This statistic is distributed according to the Student-t distribution with $n_i + n_2 - 2$ degrees of freedom. I am testing the hypothesis that the observed differences between the means is significant. If the t-statistic is greater than the tabulated value for the 5% level at $n_i = n_2 - 2$ degrees of freedom (in all cases = $\pm$ 2.05 taken from table of percentages points of the t-distribution) then I can accept the hypothesis that the means are significantly different. The sign of t-statistic is important - if it is negative and less than -2.05, the differenct between the means is still significant but in the other direction. 95% confidence limits are calculated by the formula:

$$\bar{x}_i - \bar{x}_2 \pm 2.05 \times SE\ (\bar{x}_i - \bar{x}_2)$$

Thus for the data on graph 1, I can make the following statements about the results:

1. The Standard Error of the difference between the two means = 2.82
2. The t-statistic = 2.83. Therefore at the 5% level there is a significant difference between average days lost (all injuries) per week in 1974 and average days lost (all injuries) per week in 1975.
3. The F-statistic = 2.09. Therefore at the 5% level, I can reject the hypothesis that the population variance for 1974 is significantly different from that for 1975.
4. 95% confidence intervals are $8 \pm 2.05 \times 2.82$
   $= 2.22$ to 13.78

Thus I am 95% confident that the average number of working days per week saved by the new circumstances in 1975 is at least 2.22 days and as much as 13.78.

Table 22 shows the calculated t-statistic for other injury categories and whether the difference between days lost per week is significantly different at the 5% level.

These are however preliminary results and it is to graphs 3, 4 and A5 - All that closer attention needs to be drawn.

4.1.2 Absence analysis after exclusion of non-physiotherapy related absences

The injury/illness sub-groups in Table 23 are the same as in Table 22. The difference lies in the exclusion of non-physiotherapy-related absences as well as absences of up to

TABLE 23

TEST OF SIGNIFICANCE ON MALE PHYSIOTHERAPY ABSENCE DATA USING t- TEST - ONLY PHYSIOTHERAPY RELATED ABSENCES INCLUDED*

Site of injury or illness	GRAPH NO.	NO. IN POPULATION	Days lost Oct - Dec 1974	Days lost Oct - Dec 1975	Net days lost	Calculated Probability	Significant at 0.05 level
All	3	46	223	156	67	2.24	Sig.+
Back only	4	15	171	23	148	10.05	Sig.
Non-back	A5	31	52	133	81	2.09	Sig.+
Leg	A6	10	28	80	52	-2.77	Sig.+
All - (back + leg + shoulder)	A7	13	24	53	29	-1.98	n.s.

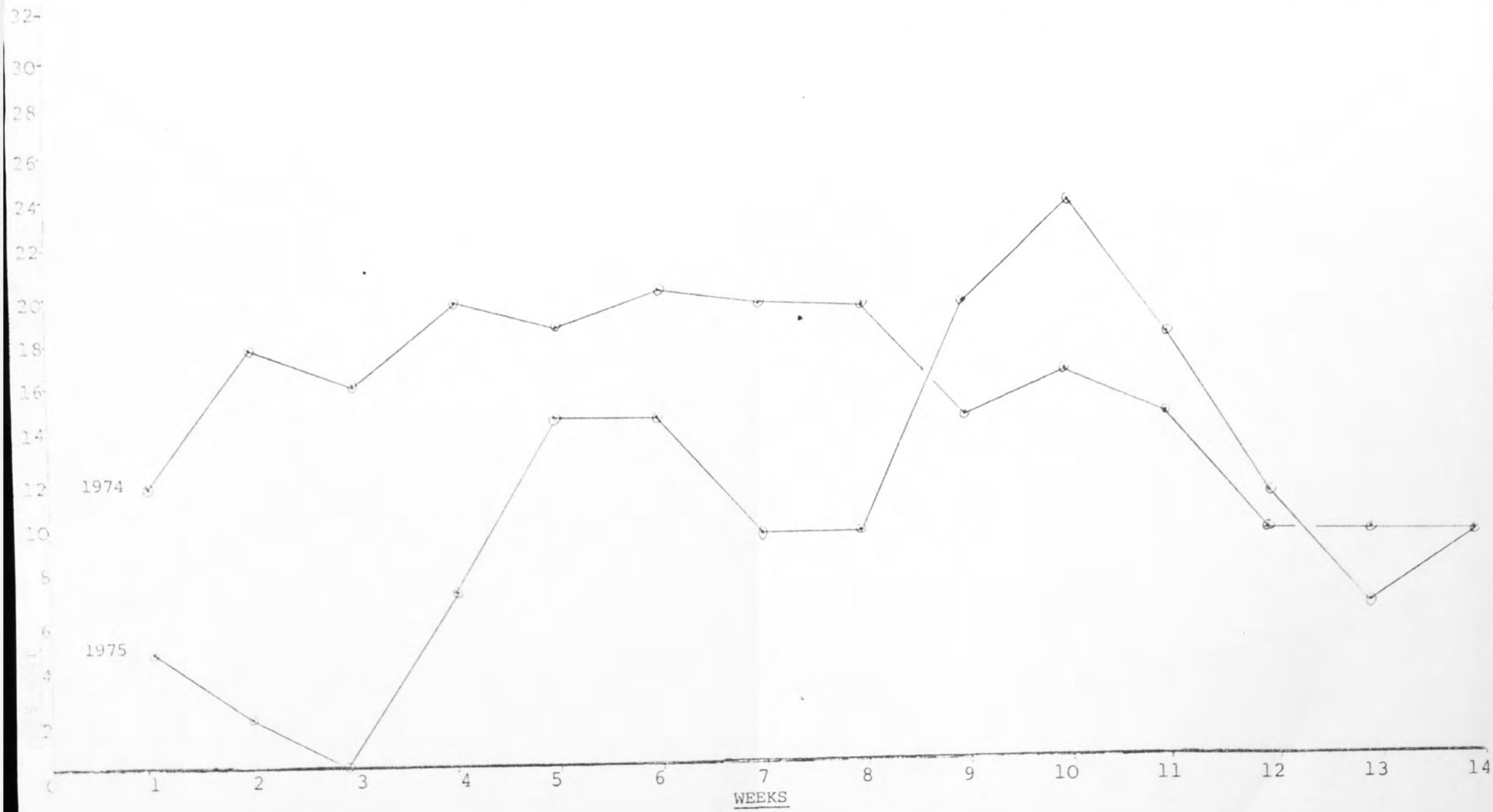
* Men with shoulder injuries now absence free

\+ Population variances significantly different

GRAPH NO 3

ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 46 men physiotherapy restricted) non-physiotherapy related (Total days lost = 223)
1975 - 46 men with physiotherapy) absences excluded (Total days lost = 156)

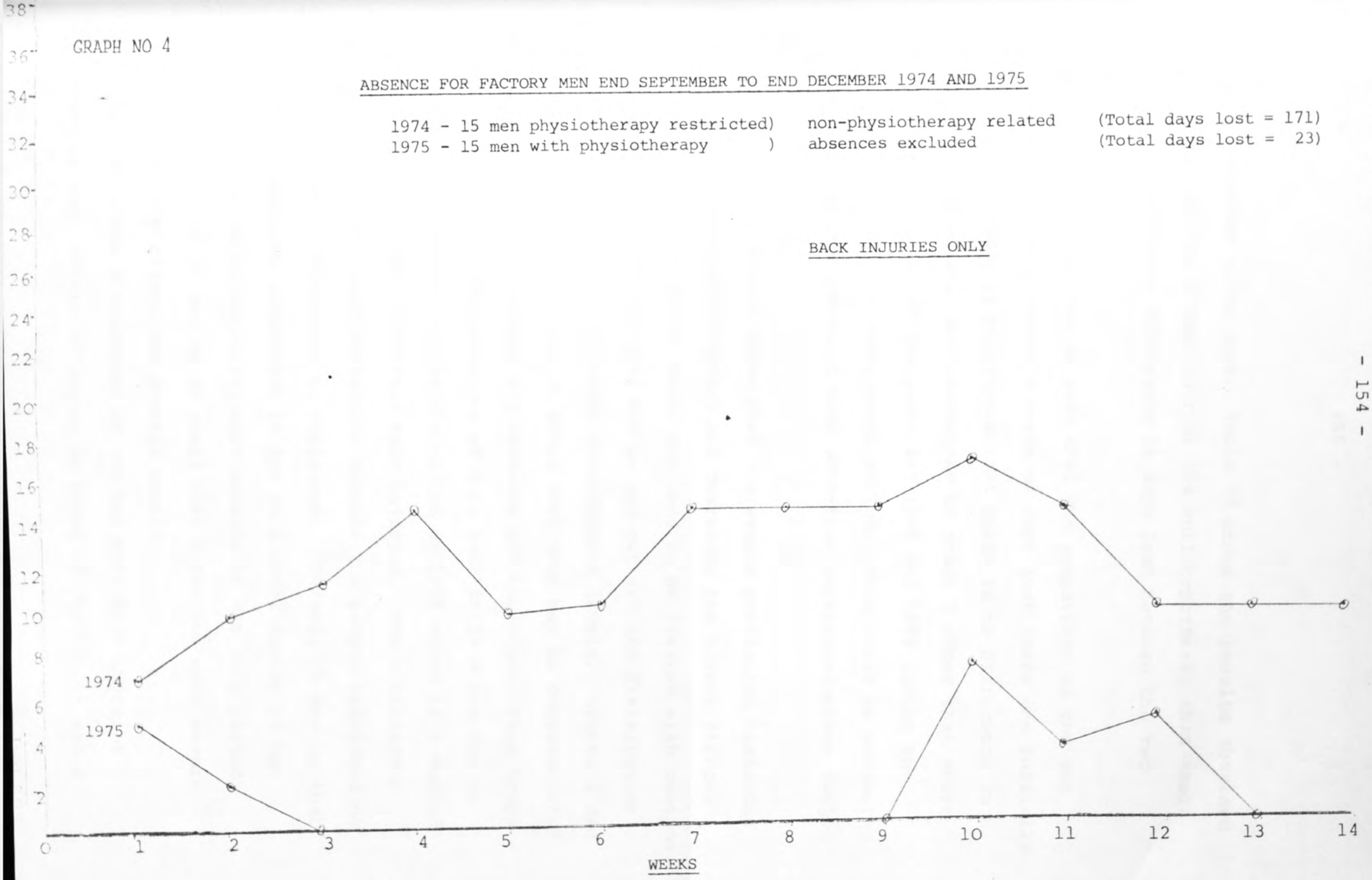


GRAPH NO 4

ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 15 men physiotherapy restricted) non-physiotherapy related (Total days lost = 171)
1975 - 15 men with physiotherapy) absences excluded (Total days lost = 23)

BACK INJURIES ONLY



and including three days. Table 23 shows the results obtained by applying the t-test to test the null hypothesis that there is no significant difference in days lost between the two populations.

From Table 23 it can be seen that the comparison of the two populations as a whole in terms of days lost leads one initially to reject the null hypothesis that there is no difference in sickness absence. An examination of graph 3 shows that there is a convergence of the plots for 1974 and 1975 during the latter half of the three month period. This could be accounted for by the employment of both part-time physiotherapists during this period.

However, the F-test shows that the sample population variances are significantly different and therefore the t-test figures for Graph 3 may not be valid and need to be treated with caution. The important factor here may be the pattern and distribution of absence rather than gross significance levels. Graphs 3 and 4 are shown in the text in order that they may be compared with Graphs 1 and 2 in which all absences are included. From Graph 4 it seems that the majority of days lost in 1974 are due to back injuries and that in the period of 1975 there is a marked reduction in days lost from back injuries. The t-statistic shows a significant difference between the sample means and no significant differences in variances. However, it may be that the significant difference is due to a small number of men having one relatively prolonged absence in the 1974 period; the sample of 15 may be so small that a few men with severe injuries may affect the overall result.

Table 24 gives a breakdown of the men with back injuries showing age, origin of injury in terms of whether it was a

works accident or not, and the time lost per man.
There is no difference between the age means at the 5% significance level using the t-test; t = 0.865.
Using the information in Table 24, I compared the number of men losing time and the number of men with no time lost with respect to whether they had received physiotherapy or not ie whether they were in the 1975 or 1974 group, using the Fisher exact probability test. This is a nonparametric technique for analysing discrete data when the two independent samples are small in size. It is used when the scores from two independent random samples all fall into one or the other of two mutually exclusive classes; in this case whether physiotherapy was restricted or not and whether the men lost time or not. I found the difference to be not significant at the 5% level. I similarly compared the non-works accident groups and the works accident groups and found no significant difference at the 5% level between those men having restricted access to physiotherapy and those with easier access.
It thus seems that the sample is too small for any significant differences to emerge or that in fact there is no difference between the groups under test. As the sample is so small (15 men in each group with back injury) it is likely that data of a more extensive nature need to be gathered to show whether physiotherapy reduces sickness absence in men with back injuries.
A comparison of the absence data of the populations of 46 men is thus more likely to yield results from which conclusions can be drawn rather than by breaking the population down into sub-populations.
Table 25 shows the number of physiotherapy treatment sessions given to the two male populations being compared and shows the

TABLE 24

MALE BACK INJURIES: WORKS ACCIDENT AND AGE DISTRIBUTION AND TIME LOST

Oct - Dec 1974				Oct - Dec 1975			
Works accident		Work days off	Age	Works accident		Work days off	Age
	NO		62	YES			40
YES			18	YES			31
	NO		35	YES			35
	NO		62	YES			17
	NO		22	YES			27
YES			23		NO		38
YES			20	YES			50
YES			26		NO		28
	NO		25		NO		42
	NO	22	31		NO		58
	NO	70	54	YES			59
YES		6.5	25	YES		8.5	54
	NO	52	41		NO	7	61
	NO		24	YES		5	26
	NO	20.5	54	YES		2.5	27
5	10	171	$\bar{x}$ = 34.8	10	5	23	$\bar{x}$ = 39.5

TABLE 25

NUMBER OF PHYSIOTHERAPY SESSIONS RECEIVED AND DAYS LOST

	No. of men	NO. OF PHYSIOTHERAPY SESSIONS			TOT. SESSIONS	MEAN PER MAN	DAYS ABSENCE	MEAN DAYS LOST PER MAN
		OCT.	NOV.	DEC.				
		OCTOBER TO DECEMBER 1974						
WITH ABSENCE	9	32	39	13	84	9.3	223	24.8
WITHOUT ABSENCE	37	82	121	39	242	6.5	NONE	
TOTAL	46	114	160	52	326	7.1	223	4.8
		OCTOBER TO DECEMBER 1975						
WITH ABSENCE	14	29	51	54	134	9.6	156	11.1
WITHOUT ABSENCE	32	128	148	91	367	11.5	NONE	
TOTAL	46	157	199	145	501	10.9	156	3.4

number of sessions received by men sustaining absence and by those without absence. The number of days lost overall and expressed as mean days per man is also shown.

Table 25 shows that in the three month period of 1975 there were one and half times more treatment sessions given to this population than to the corresponding population for the period of 1974.

Of the 46 men in the 1974 population, nine had absence and 37 had no absence. In the 1975 population 14 men had absence and 31 had no absence.

Thus contrary to expectations it looks as if less men had time off in the period of physiotherapy restriction than in one where access was more freely available.

Similarly there were more people in the 1974 period who had no absence (of a physiotherapy referred nature) than in the corresponding period of 1975.

I performed a chi-squared test to see if these differences were significant and found no difference at the 5% level of significance.

However, using the t-test, there is a significant difference between the days lost by each of the two populations of 46 men. I now performed the median test on the total days lost by each man to see whether the two populations are drawn from populations with the same median. The object of the test is to see whether the 1974 period population has a significantly higher median than that of the corresponding population in 1975. When analysing data split at the median Siegel (1956) gives a method for choosing either the chi-squared test or the Fisher test, which depends on the size of $n_1 + n_2$; that is the size of the two populations. Normally the test would be performed on the total populations of 46 men each ie $n_1 = n_2 = 46$. However the chi-squared test above has shown that the difference would not be significant at the 5% level.

I therefore performed the test on only those men who incurred absence. Once absence has occurred, a significant difference between the two populations with absence ($n_1 = 9$; $n_2 = 14$) reflects the degree of severity, in terms of days lost, between the two populations.

Given these values for n_1 and n_2 Siegel recommends the Fisher test if any cell has an expected frequency of less than five, as is the case here.

I thus found that there is a significant difference between the median of the population in the period 1974 and the population in the corresponding period of 1975. In other words, once absence occurs the population undergoing physiotherapy returns to work significantly quicker than the population with restricted access to physiotherapy.

Table 26 gives a breakdown of the category I have labelled in the previous table "all - (back, leg, and shoulder)" showing the number of men with absence and the absence, expressed as days lost, sustained by them.

The Table shows that the majority of absence in the periods of 1974 and 1975 derives from injuries to the neck of two individuals. In the period of 1974 two of the 13 individuals have absence and in the period of 1975 there are four individuals with absence. The difference found is thus probably a spurious one owing to the small sample and the fact that two relatively large absences can thereby influence the gross result.

TABLE 26

A BREAKDOWN OF ABSENCE EXCLUDING BACK, LEG, AND SHOULDER INJURIES

Site of injury	No. of men in each of the two populations	No. of men with physiotherapy related absence and absence in days lost			
		OCT - DEC 1974		OCT - DEC 1975	
		NUMBER	ABSENCE	NUMBER	ABSENCE
Wrist	4	1	9	1	2
Hand	4				
Elbow	1				
Arm	1			1	11
Neck	1	1	15	1	35
Ribs	2			1	5
TOTAL	13	2	24	4	53

TABLE 27

A BREAKDOWN OF ABSENCE DUE TO LEG INJURIES

Site of injury (leg injuries)	No. of men in each of the two populations	No. of men with physiotherapy related absence and absence in days lost			
		OCT - DEC 1974		OCT - DEC 1975	
		NUMBER	ABSENCE	NUMBER	ABSENCE
Knee	2			1	26.5
Foot	7	1	3	5	53.5
Leg	1	1	25		
TOTAL	10	2	28	6	80

4.1.3 Leg injury absence analysis

Table 27 gives a breakdown of the category labelled in Table 22 as leg injuries. This category includes injuries to the knee, the leg itself (site not specified) and the foot which includes sprained ankles, toe injuries, and general foot bruising and injury.

The Table shows that although both populations were matched for site of injury the population for the period of 1975 had more employees sustaining absence due to injuries for which physiotherapy was recommended but that this absence was not significantly higher in the period of 1975, than in the corresponding period of 1974.

Table 28 gives a more detailed picture and shows the age, and whether the absence was caused by a work accident or not, of each of the men sustaining leg injuries.

The data were analysed using the Fisher exact probability test and it was found that there is no significant difference at the 5% level between the number of men who lost time and the number of men who did not lose time in relation to whether physiotherapy was restricted or not. When works accident and non-works accident populations are similarly analysed the outcome is the same: not significant at the 5% level.

4.1.4 Shoulder injury absence analysis

In graph A2 I have shown a comparison of the total absence due to shoulder injuries of eight men in the period of 1974 compared with eight men in the period of 1975. Both groups of men received, or were referred for, physiotherapy in their respective quarter year periods.

When absences not related to shoulder injuries are excluded both groups are found to be absence-free. There is not therefore,

TABLE 28

MALE LEG INJURIES: WORKS ACCIDENT AND AGE DISTRIBUTION AND TIME LOST

	OCT - DEC 1974				OCT - DEC 1975			
Site of Injury	Works accident		Work days off	Age	Works accident		Work days off	Age
Knee		NO		37		NO	26.5	62
Knee		NO		53	YES			28
Foot		NO	3	53		NO	8.5	26
Foot	YES			19	YES		35	61
Foot	YES			59	YES		5	22
Foot		NO		58		NO	3	26
Foot	YES			25	YES		2	54
Foot	YES			38	YES			19
Foot	YES			62		NO		54
Leg	YES		25	55	YES			29
TOTAL	6	4	28	$\bar{x}$ = 45.9	6	4	80	$\bar{x}$ = 38.1

in this limited sample, any difference in sickness absence between the two groups.

4.1.5 Discussion of male absence data analysis

A comparison was made of the sickness absence sustained by two male populations each consisting of 46 factory employees. One population had restricted access to physiotherapy while the other had relatively unrestricted access to treatment. Each employee had been referred for treatment requiring physiotherapy. Sickness absence unrelated to referral for physiotherapy was excluded from the data as were absences of up to and including three days because it was not possible to determine the cause of absence for very short spells. The original populations of 50 men each were reduced to 46 in each as a result of matching for site of injury, as described in section 2.2. I found that there are significantly more days lost in the population where physiotherapy was restricted than in the population where physiotherapy was relatively unrestricted, though there is a significant difference in the variance of the two populations with back injuries there are significantly more days lost in 1974 than in 1975 and there is no significant difference in variance between the two populations.

There is, however, no significant difference in the numbers of men losing time and not losing time between the two populations. Once absence occurs, though, analysis of the men with time off work shows that the population undergoing physiotherapy returns to work quicker than the population with restricted access to physiotherapy. Matching of the two populations for site of injury was done so that there would be a possibility of finding which injuries or illnesses most contributed to sickness absence and of testing which categories of injury would be amenable to physiotherapy in terms of reduction of sickness absence. With back injuries (15 men in each population) I found that there was a significant difference in the numbers of men losing time and not losing time between the two populations. With such small numbers it requires only a few people with severe injuries to distort the figures such that absence in one population appears to be significantly greater than in the other. I found this phenomenon to be true in sub-dividing the populations into other injury categories such as leg injuries (10 men in each population), and other in-juries such as wrist, arm, neck, ribs, hand and elbow grouped together (13 men in each population).

Such a breakdown can, however, give indications of possible trends in absence which need to be followed up. It seems as if back injuries are responsible for much of the sickness absence and the effects of physiotherapy on male back disorders is one which needs careful analysis to yield meaningful results. The data in this study can give a general picture of the use-fulness of physiotherapy but more data is needed before injury categorisation and sickness absence can be related.

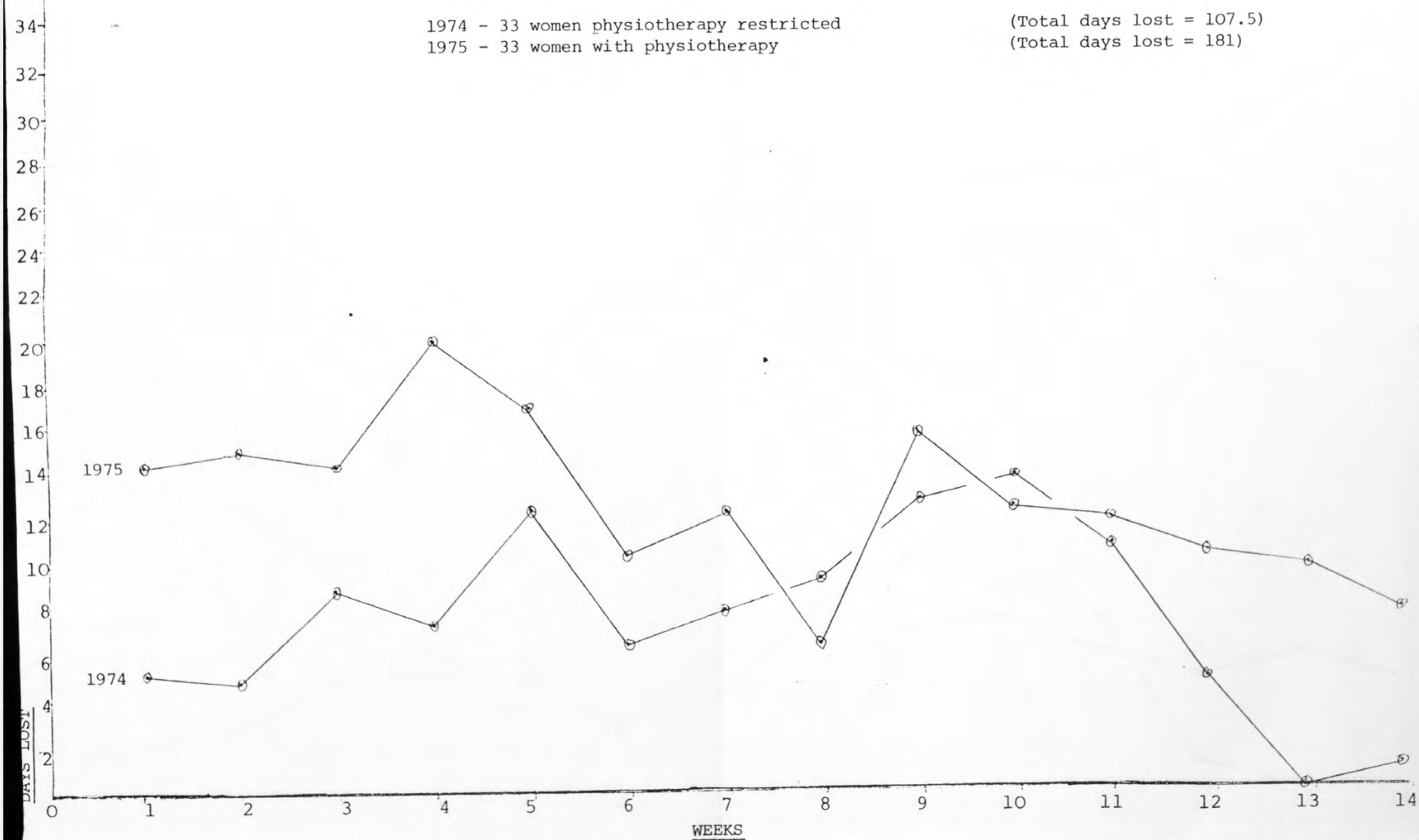
4.2 Female employees

Graphs 5 and 6 in the text and A5 to A7 in Appendix 7 compare sickness absence between the October to December 1974 and October to December 1975 populations each of 33 female employees. They are, apart from graphs 5 and A9 subdivided into injury categories. Thus graph 6 represents a comparison between eleven women in 1974 with back injuries with eleven women in 1975 also with back conditions.

Of the 33 women 22 had injuries or illness other than of the back and a comparison of their sickness absence is shown in

GRAPH NO 5

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975



GRAPH NO 6

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 11 women physiotherapy restricted (Total days lost = 63)
1975 - 11 women with physiotherapy (Total days lost 86.5)

BACK INJURIES ONLY

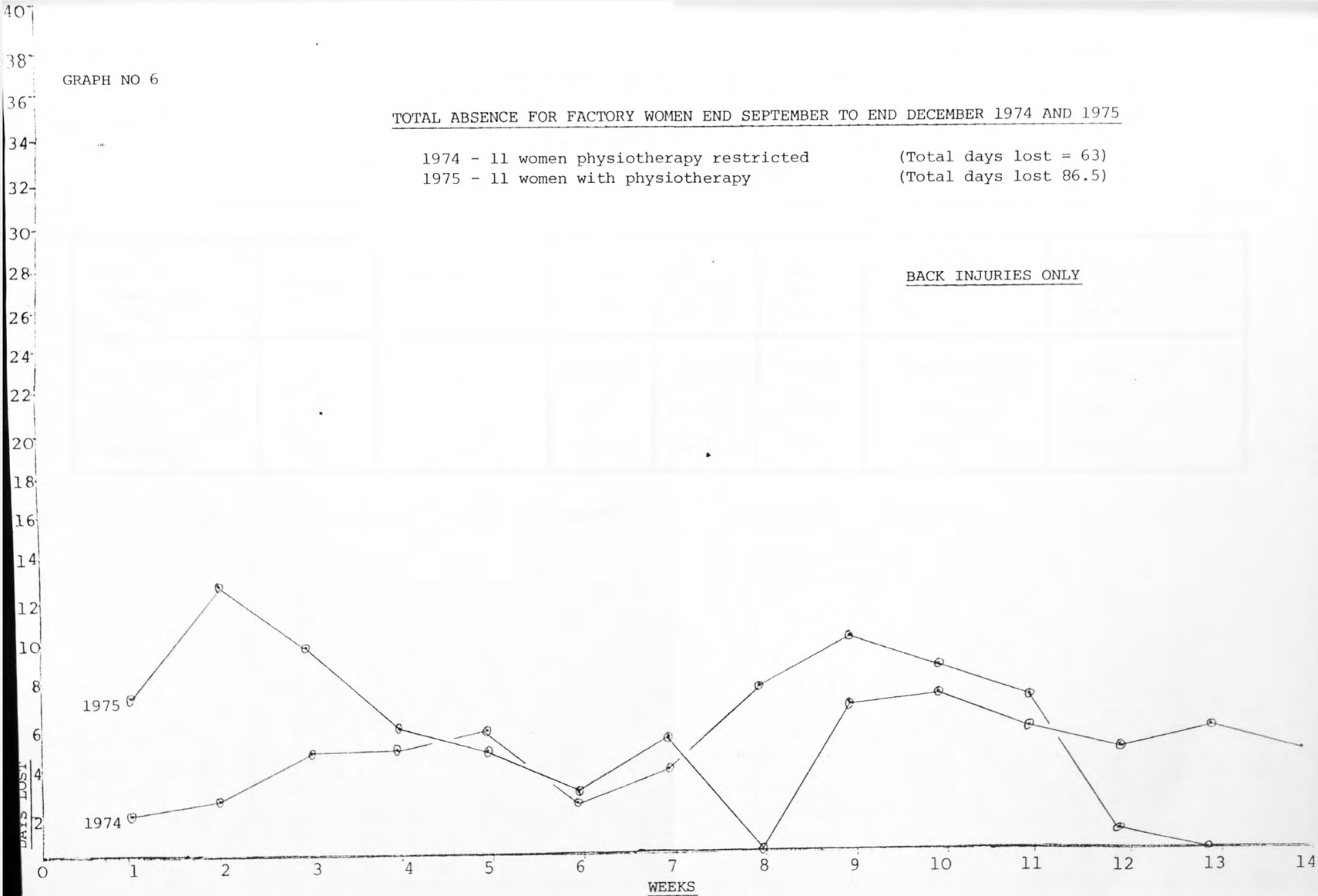


TABLE 29

TEST OF SIGNIFICANCE ON FEMALE PHYSIOTHERAPY ABSENCE DATA USING THE t - TEST
ALL ABSENCES INCLUDED

Site of injury or illness	Graph No.	Number in population	Days lost Oct - Dec 1974	Days lost Oct - Dec 1975	Net days lost	Calculated probability	Significance at 0.05 level
All injuries	5	33	107.5	181	73.5	-3.50	Sig.
Back only	6	11	63	86.5	23.5	-1.39	n.s.
Non-back	A8	22	44.5	94.5	50	-3.54	Sig.+

+ Population variance significantly different.

graph A8.

Weeks 1 to 14 represent the same periods as for the male employees.

4.2.1 Total absence and back injury absence analysis

A t-test was performed (similar to that done for males) for each of the two populations or sub-populations. The results are given in Table 29.

Table 29 shows that the null hypothesis (that there is no difference between the two populations in terms of sickness absence) cannot be rejected. Therefore the alternative hypothesis (that there is a difference between the two populations in terms of sickness absence) can be adopted. This is the reverse of what one would expect as physiotherapy was less available in late 1974 than in the corresponding period of 1975.

A comparison of absence of the two populations undergoing treatment or referral for back injury shows that there is no significant difference between the 1974 and the 1975 populations. This is also unlike the male population comparisons where there was significantly more absence due to back injuries in 1974 than in 1975.

A comparison of all other injuries (other than back) shows a significant increase in the period of 1975 over the corresponding period of 1974, although the population variances are also significantly different. This is unlike the male absence figures for non-back injuries which were not significantly different.

4.2.2 Absence analysis after exclusion of non-physiotherapy related absences

Table 30 shows the number of physiotherapy treatment sessions given to the two female populations being compared and gives a breakdown of number of sessions received by women sustaining absence and those without absence. The number of days lost

TABLE 30

NUMBER OF PHYSIOTHERAPY SESSIONS RECEIVED AND DAYS LOST

	No. of Women	No. of Physiotherapy Sessions				MEAN PER WOMAN	DAYS ABSENCE	MEAN DAYS LOST PER WOMAN
		OCT.	NOV.	DEC.	TOTAL SESSIONS			
		OCTOBER TO DECEMBER 1974						
WITH ABSENCE	9	22	27	1	50	5.5	44.5	4.9
WITHOUT ABSENCE	24	75	111	34	220	9.2	NONE	
TOTAL	33	97	138	35	270	8.2	44.5	1.3
		OCTOBER TO DECEMBER 1975						
WITH ABSENCE	7	54	35	44	133	19	94.5	13.5
WITHOUT ABSENCE	26	121	91	47	259	10	NONE	
TOTAL	33	175	126	91	392	12	94.5	2.9

TABLE 31

TEST OF SIGNIFICANCE ON FEMALE PHYSIOTHERAPY ABSENCE DATA USING THE t - TEST
- ONLY PHYSIOTHERAPY-RELATED ABSENCES INCLUDED

Site of injury or illness	Graph No.	Number in population	Days lost Oct 1974	- Dec 1975	Net days lost	Calculated probability	Significance at 0.05 level
All injuries	A9	33	58.5	96	37.5	-2.46	Sig.
Back only	A10	11	45.5	71.5	26	-1.67	n.s.
Non-back	A11	22	13	24.5	11.5	-1.49	n.s.

overall and expressed as mean days per woman are also shown. Table 30 shows that there were more treatment sessions in the three month period of 1975 than in the corresponding period of 1974. This is similar to the pattern seen in the male treatment session breakdown. A chi-square test was used to see if there was any significant difference between the two populations in terms of the number of people with absence and without absence. There was no significant difference at the 5% level. Table 31 shows absences for the same categories and populations as in Table 29 except that absences unrelated to referral for physiotherapy are excluded. The data relates to graphs A9 to All.

From Table 31 it can be seen that the increase in absence in 1975 over 1974 can be ascribed to there being an increase in absence due to back conditions in 1975 over the corresponding period of 1974 but that absence is not significant in itself. A comparison of absence due to injuries other than to the back shows that the absence in 1975 is not significantly different from absence in 1974.

A further analysis was made of female back injury absence data to determine the cause of the absence in 1975 and in 1974. This was done by breaking down the data so that it was possible to test whether the distribution of works accidents and non-works accidents was related in any way to the absence data. Table 32 gives a breakdown of all females suffering back injury in the two populations under study and shows their respective ages and whether the injury was a works accident or not. There is no difference between the age means; $t = 0.03$ which is not significant at the 5% level. There is also no difference

TABLE 32

FEMALE BACK INJURIES: WORKS ACCIDENT AND AGE DISTRIBUTION

OCT - DEC 1974				OCT - DEC 1975			
Works accident		Work days off	Age	Works accident		Work days off	Age
	NO	27	33		NO	7.5	44
	NO	4	23		NO	5	41
	NO	7.5	54	YES		31.5	37
YES		7	53	YES		2.5	38
YES			28		NO	25	54
	NO		39		NO		19
	NO		40		NO		53
	NO			YES			40
	NO		27		NO		55
	NO		60	YES			40
	NO		46		NO		20
2	9	45.5	$\bar{x}$ = 40.3	4	7	71.5	$\bar{x}$ = 40.09

between the age means of the females who have had works accidents in 1974 and the corresponding group in 1975. Similarly, for the females who have had non-works accidents there is no difference between age means of the 1974 and 1975 populations. There is also no significant difference between the age means of all the works accident females (1974 plus 1975) and between the non-works accident females (1974 plus 1975). Thus the population appears to be relatively homogenous in age distribution.

If the Fisher exact probability test is performed on the absence data of female employees sustaining back injury it is possible to test whether there is any significant difference between the number of women losing time and the number not losing time with respect to their access to physiotherapy ie whether they were in the 1974 or 1975 population. There is no significant difference at the 5% level. There is also no significant difference at the 5% level between the median of the female population sustaining absence in 1974 and that sustaining absence in 1975. Thus the test performed on males sustaining absence where $n_1 = 9$ and $n_2 = 14$ which showed that there was a difference in the median, when performed on females where $n_1 = 7$ and $n_2 = 9$ shows no significant difference.

It thus seems that for female factory employees the data are either too limited to yield results from which conclusions can be drawn or it may be that there is no significant difference between the female populations.

The only trends to emerge on the limited data analysed are that female back injuries appear to be less important in the overall sickness absence figures than for the men.

4.2.3 Discussion of female absence data analysis

A comparison has been made of the sickness absence sustained by two female populations each consisting of 33 factory employees. One population had restricted access to physiotherapy while the other had relatively unrestricted access to treatment. Each employee had been referred for treatment as requiring physiotherapy.

Sickness absence unrelated to physiotherapy referral was excluded in the detailed analysis as were absences where cause of absence was indeterminate.

The populations were originally chosen at random from the total number of female factory employees in the period of 1974 and the corresponding period in 1975.

They then consisted of 50 women in each and a process of matching for site of injury, as described in the text, reduced them to 33 in each.

I have found no significant difference between the number of women losing time and the number not losing time with respect to their access to physiotherapy.

Also, unlike the male population, I have found no significant difference between the median of the female population sustaining absence in 1974 and that sustaining absence in 1975.

The data thus appear to be too limited to draw significant conclusions, and only indications of trends which would need investigation in further research are possible.

6.5 The costs of physiotherapy

The following cost calculations follow the same format and method as for audiometry except that two sets of figures emerge; one for costs in 1974 and one for 1975.

Capital costs

These are given as the 1972 estimated cost of physiotherapy equipment. This is taken as year one in calculating depreciation at 20% per annum.

The costs to the end of 1974 are thus the 1972 total amount minus 2/5th and for the end of 1975 the 1972 total minus 3/5th of this total.

Item	Cost (1972 cost) £
Progressive treatment unit	137.00
U.V. lamp	169.00
Short wave machine series 5	368.00
Accessories	12.50
	13.50
	14.85
Wax bath	90.00
28lb wax per year	2.50
Microwave machine	335.00
Trolley	35.00
Suspension	57.50
Applicators	18.50
	8.00
	7.50
	9.75
Extras: Springs 57p x 2	1.14
68p x 2	1.36
Pulleys 30p x 6	1.80
S hooks 15p x 8	1.20
Single slings 85p x 4	3.40
Single rope 75p x 4	3.00
Double rope 1.45 x 4	5.80

Item	Cost (1972 cost) £	
Four radiant heat lamps	516.00	
Ultrasonic machine	190.00	
Cartons of skin applicant	3.50	
Bicycle	44.31	
Weight boots	9.50	
Set of weights	7.50	
Mat	13.54	
Traction	72.00	
Cervical harness	1.44	
Two trolleys	----	Written off
Five beds	167.50	
Two arm baths	13.00	
One leg bath	12.50	
Five clocks	10.00	
High frequency U.V. machine	----	Bought in 1930's written off
TOTAL	£2357.09	

a) Depreciated at 20% from 1972 to 1974 = £1414.25

b) Depreciated at 20% from 1972 to 1975 = £942.84

Running costs

Doctor's time

All people who undergo physiotherapy are referred by the company medical adviser either directly or by a general practitioner or hospital who recommend treatment which he then approves. I have estimated the worth of the doctor's time as £6000 in 1974 and £7000 in 1975.

With National Insurance and company pension of about £500 per annum this gives a figure of £6500 and £7500 respectively.

a) Doctor's time per hour 1974 (40 hr/wk) = £3.125

b) Doctor's time per hour 1975 (40 hr/wk) = £3.605

Physiotherapist's time

In 1974 two part-time physiotherapists were engaged in the three month period from October to December. One also worked in early 1975. Their cost to the company is given in Table 19. Associated employee costs are estimated at £8 per month for each of the five periods above bringing the costs up to the following:

a) Physiotherapist's time Oct-Dec 1974 = £306.00

b) Physiotherapist's time Oct-Dec 1975 = £146.00

During this period of 1975 the full-time physiotherapist was also working. The cost to the company was £3600 per annum or £900 from October to December including National Insurance and company pension for the three month period giving a total of £900 + £146.00 = £1046.00.

The cost of the physiotherpist's time during 1974 was £2800.

a) above gives the cost of the physiotherapists' for each of the three month periods under study. However the initial comparison involved only two groups of 46 men and two groups of 33 women. Hence to arrive at a cost of physiotherapists' time for these groups I take a proportion of the cost and reduce accordingly.

eg In 1974 the physiotherapists' time costed at £306 for 130 men and 106 women is reduced by 46/130 and 33/106 to arrive at a cost of treating 46 men and 33 women: £34.00.

Similarly in 1975 the physiotherapists' time costed at £1046.00 for 93 men and 54 women is reduced by 46/93 and 33/54 to arrive at a cost of treating 46 men and 33 women: £316.00.

Physiotherapy cards

For 2000 the cost is £10.00.

Employee attendance - men

From an analysis of treatment times given to me by the physiotherapist I estimate an average of 20 minutes surgery treatment per person plus an extra 10 minutes for getting to and from the treatment area. This gives a total of 30 minutes away from work per person.

1974 period

For the sample of 46 men who had a total of 326 treatment sessions in the three months of 1974 the cost of attendance given average earnings of £34.03 per week plus 25% associated employee costs is given by $\frac{326 \times 34.03 + (34.03 \times 0.25)}{40 \times 2} = \underline{£173.33}$

The sample was taken from a population of factory men which in the three month period of October to December 1974 totalled 130 men having a total of 1069 treatment sessions. The cost of attendance is thus £568.00.

Over the whole of 1974, by scaling up, the cost of attendance by factory men = 568 x 4 = £2272.00.

1975 period

For the sample of 46 men who had a total of 501 treatment sessions in the three months of 1975 the cost of attendance given average earnings of £42.45 per week plus 25% associated employee costs is given by $\frac{501 \times 42.45 + (42.45 \times 0.25)}{40 \times 2} = \underline{£332.30}$

The sample was taken from a population of 93 men who had 889 treatment sessions. The total cost of attendance of factory men in October to December 1975 was £589.00.

On this basis over the whole of 1975 the cost of attendance for physiotherapy by factory men was 589 x 4 = £2356.00

Doctor's time at consulting

All patients are referred to physiotherapy by the doctor. For the purpose of this calculation I estimate an average of two to five minutes per patient for referral and consulting time.

1974 period

		MINUTES	
		2	5
For 46 men doctor's time	= 46 x 2 x £3.125/60 =	£5	- £12
For 112 men doctor's time	= 112 x 2 x £3.125/60 =	£12	- £29
For the year scaling up	= £12.00 x 4 =	£48	- £116

1975 period

For 46 men doctor's time	= 46 x 2 x £3.605/60 =	£6	- £14
For 93 men doctor's time	= 93 x 2 x £3.605/60 =	£11	- £28
For the year scaling up	= £11.00 x 4 =	£44	- £112

Employee attendance - women (also 30 min/treatment)

1974 period

For the sample of 33 women who had a total of 270 treatment sessions in the three months at the end of 1974 the cost of attendance given average earnings of £27.30 per week plus 25% associated employee costs is given by -

$$\frac{270 \times 27.30 + (27.30 \times 0.25)}{40 \times 2} = \underline{£115.00}$$

In the three month period at the end of 1974 the sample of 33 women was chosen out of a total of 106 factory women treated. These 106 had a total of 857 treatment sessions which gives an attendance cost of £365.00.

Over the year the total cost is 365 x 4 = £1460.00

1975 period

The average wage was £37.30 per week and for the sample of 33 women the attendance cost is given by the number of treatment sessions $\frac{392 \times 37.30 + (37.30 \times 0.25)}{40 \times 2}$ = £228.00

The sample of 33 was chosen out of a total of 54 factory women who had received physiotherapy from October to December 1975 and who had 633 treatment sessions.

The attendance cost is thus £369.00.

Over the year the total cost is 369 x 4 = £1476.00.

Doctor's time at consulting

An average of two minutes per patient is used for the calculation

1974 period

	MINUTES 2	5
For 33 women doctor's time = 33 x 2 x £3.125/60 =	£3.5 -	£8.6
For 106 women doctor's time = 106 x 2 x £3.125/60 =	£11 -	£28
For the year scaling up = £11 x 4 =	£44 -	£112

1975 period

For 33 women doctor's time = 33 x 2 x £3.605/60 =	£4.0 -	£10
For 54 women doctor's time = 54 x 2 x £3.605/60 =	£6.5 -	£16
For the year scaling up = £6.5 x 4 =	£26.0 -	£64

Allocation for heat, light, power, accommodation and general overheads

This allocation is done on the basis of the proportion of area used in square feet in relation to the total surgery area. The room used and an apportionment of the corridor space = 1200 square feet. The total surgery area for which accommodation is charged is 5803 square feet. Thus the physiotherapy service represents 20% of the total surgery area.

The surgery accommodation cost for 1974 was £9018 and for 1975 £10,614. Twenty percent of these sums may therefore be taken as physiotherapy accommodation charges: £1803 in 1974 and £2123 in 1975 and for the three month periods being compared a quarter of these sums is used; £450 and £531 respectively.

5.1 Total cost summary

The cost summary below attempts to cost the physiotherapy service on three levels; 1) the costs as worked out for the matched populations of 46 men and 33 women, 2) the cost of physiotherapy for all men and women treated during the last three months of 1974 and 1975, and 3) by extrapolating from 2) to arrive at an approximate cost of physiotherapy for the year as a whole in 1974 and 1975.

The cost difference can then be compared with the difference in absence between the two populations.

		1974 £	1975
Capital costs		1414	942
Running costs			
Physiotherapists' time	1.	34	316
	2.	306	1046
	3.	1224	4184
Physiotherapy cards		10	10
Employee attendance:			
factory men	1.	173	332
	2.	568	589
	3.	2272	2356
Doctor's time	1.	5 - 12	6 - 14
	2.	12 - 29	11 - 28
	3.	48 - 116	44 - 112
factory women	1.	115	228
	2.	365	369
	3.	1460	1476
Doctor's time	1.	3.5 - 8.6	4 - 10
	2.	11 - 28	6.5 - 16
	3.	44 - 112	26 - 64
Accommodation	1 or 2	450	531
	3.	1803	2123

		Total Costs £	
Costs of treating sample populations	1.	2204-2216	2369 - 2383
Costs of treating Oct-Dec populations	2.	3137-3170	3504 - 3531
Estimate for yearly costs:	3.	8275-8411	11161-11267

6.6 The benefits of physiotherapy

It has been shown in this chapter that in the first eight to ten weeks of the two three-month periods being compared there appears to be a saving in sickness absence for the sample male population. It has also been shown that, for the male population, once absence occurred the population with less restricted access to physiotherapy returns to work significantly quicker than the population with more restricted access to physiotherapy. Further subdivision of the population into matched categories showed that the data then becomes too limited to draw significant conclusions.

A comparison of female populations in the two population groups showed no significant difference in terms of sickness absence, or, if a difference was significant this could be accounted for by one or two individuals who contributed most to the absence figures. The data for comparison of female employee populations were too limited to draw significant conclusions and only indications of possible trends which would need further investigation are possible. In the paragraphs below an attempt is made to estimate the magnitude of the savings in sickness absence, quantify them in monetary terms, and set them against the cost of provision of the service.

6.1 Quantification of savings in absence and cost of savings

The difference between the days lost by the sample male population in the two three-month periods is 67 days. This figure refers to the populations where other extraneous absence data was discounted. Thus there was, through the provision of extra treatment sessions in the period of 1975, a saving of 67 man-days for the population of 46 men, (with a minimum of six days and a maximum of 128 days using 95% confidence limits).

If the total number of factory men being treated during this period is considered (93 factory men) a saving of twice this amount for this period is likely; 134 days. If this is valued at the average wage, in 1975, of £42.45 per week then the saving over the three month period is worth £1138. Over the year this saving is worth £4552. This must be compared with the cost of physiotherapy in 1975 of £11,315. However, this total cost covers treatment not only of factory men, but of office men and management. The cost also covers treatment of all women employees. It thus seems that this saving is on the low side in that savings in absence in the treatment of management if of the same magnitude will be worth much more to the company due to the presumed higher worth of management employees. There may also be a higher saving in the treatment of factory men than indicated here. The saving calculated here is arrived at by monitoring changes in availability of treatment sessions. It may be that if physiotherapy had been restricted much more severely in the period of 1974 or even not provided at all then the absence may have been much higher. The 67 days which were lost in 1974 are worth £456 at 1974 average wage costs (average earnings = £34.03 per week). The cost of providing the extra physiotherapy sessions in order to achieve this saving are calculated by working out the cost of providing 501-326 sessions = 175.

The cost figures used below have already been worked out earlier and are summarised here.

Physiotherapist's time

To estimate the time taken to give 175 treatment sessions I have estimated (from data collected from April 1974 to June in 1974) that this number of sessions can be given in two and a half days.

Cost to company of 2½ days = £19.00

Employee attendance

For 175 sessions at 30 minutes each and a cost of £35.03 per week plus 25% associated employee costs =

$$\frac{175 \times 34.03 + (34.03 \times 0.25)}{40 \times 2} = \underline{£93.00}$$

Doctor's time at consulting

The number of sessions, 175 must be converted to the number of patients seen by the doctor. From Table 7 the number of treatments per man with absence in 1974 was 9.3. One hundred and seventy five sessions thus corresponds to 19 men at two to five minutes each with the doctor = 19 x 2 x £3.125/60 = £2-£5

The total extra cost to achieve a saving of 67 days in the period of 1974 would have been 42 + 93 + 2 = £137.00

6.2 Quantification of company sickness payments

Depending on length of service the company will for a period of time "top up" the State sickness benefit payments to give a sick worker a percentage of his basic wage.

This percentage also depends on length of service with the company. In the three month period to the end of 1974 the company has made a total payment, to the sample of 46 men, of £609.28. For the same period of 1975 for less days absence, the company paid out to 46 men a total of £730.63. This increase in payment for less days absence is due to increased basic wage costs from 1974 to 1975. The saving that would have occurred to the company are the payments made out on the difference in days lost between 1975 and 1974; 67 days.

This is given by 67 x £609.28/223 = £183 for the 46 men.

6.3 Quantification of State sickness payments

During 1975, the 46 men who had absence in the sample population had a total payment of £471.41 and during 1974 the corresponding sample population received £764.08. Given a saving of 67 days absence in 1974 the monetary saving to the State would have been 67 x £764.08/223 = £229.00

The administrative and manpower savings that would have occurred in not paying out this sum are beyond the scope of this project but are certainly worthy of further investigation.

7. General discussion

In the preceding sections it appears that a decrease in the number of treatment sessions led to an absence of 67 days by a population of factory men. This resulted in a loss to the company of time worth £546 calculated from 1974 average earnings.

The absence also resulted in sickness payments by the company of £183 and by the State of £229. Thus the loss to the company was a minimum of £639.

The cost of providing extra treatment sessions which would have eliminated this absence has been calculated as £137.00. This initial outlay would have prevented a payment of over five and a half times this amount by the company and over two times this amount by the State in the form of sickness benefits. The research has thus shown that a restriction of physiotherapy services results in greater costs being borne by the company and by the State than the saving which is incurred by limiting the service. The wider questions which arise as a result of this work are put forward as suggestions for further research.

8. Further research

Questions which are raised by the research so far include:

1. To what extent are the results obtained here representative for the factory male population as a whole?
2. Is it justifiable to assume that similar if not greater savings are achieved in treating staff and management employees?
3. What implication do these results have for physiotherapy services in industry as a whole?

9. Conclusions

1. For male employees there were significantly more days lost in the population where physiotherapy was restricted than in the population where physiotherapy was relatively unrestricted.
2. The restriction of physiotherapy appeared to have resulted in absence of 67 extra days of which the cost to the company was over five and a half times the saving achieved by the restriction of physiotherapy.
3. The cost to the State in terms of sickness benefit payments was over twice the saving achieved by the company in the restriction of physiotherapy.
4. Once absence has occurred men with relatively unrestricted access to physiotherapy return to work significantly quicker than men with restricted access to physiotherapy.
5. A trend which emerges tentatively indicates that male back injuries are responsible for a large proportion of the sickness absences.
6. There is an indication that back injuries account for proportionately less absence in females than in males.

CHAPTER 7

7. Pre-employment medical examinations

7.1 Introduction

The role of occupational health services has been said by Wright (1973) to be essentially preventive in nature. This preventive aspect is perhaps best exemplified by pre-employment medical examinations. However, these examinations as well as other periodic and routine medical examinations have been criticised as being a misallocation of medical resources on the grounds that, for the amount of time spent, there is relatively little benefit. The following paragraphs briefly review statements made about the limitations of pre-employment and periodic medical examinations with specific reference to the food industry.

Taylor et al (1973) have said that a substantial proportion of routine medical examinations are performed by occupational health services on grounds that would not withstand a critical analysis in terms of costs and benefits. They must therefore be reviewed regularly both for their purpose, and cost effectiveness.

Taylor (1968) carried out a study of 194 men with contrasting sickness absence experience in a refinery population and concluded that the pre-employment medical examination proved in retrospect to have been of little predictive value.

Periodic medical examinations have been criticised on five major grounds; (Wade et al, 1962):

1. the yield of "significant" disease is low
2. there is no proof that the course of disease so found is changed by virtue of the earlier diagnosis

3. truly life-threatening disease is usually discovered between examinations
4. the patient is likely to be lulled into a false sense of security by the physician's assurances and ignores otherwise alarming early symptoms
5. the emphasis of the examiner is inevitably upon disease rather than upon health, thus encouraging, if not actually producing, hypochondriasis.

There may be truth in all of these allegations and although many papers and reviews have been published, for example by Schneider (1960), Hanks (1962) and Taylor (ibid), the issues are still unresolved.

In the Civil Service, pre-employment examinations were, up to 1949, a common feature of the entrance procedure. Since that time the extent of pre-employment examination has been progressively curtailed as various committees and study groups reported on the undue time involved and small proportion of unsuitable applicants detected, (Thomson, 1974). Since 1969, suitability for employment on medical grounds, in the majority of cases, has been determined on the basis of a detailed health questionnaire which is in the first instance scrutinized by trained civil servants. The general conclusion within the Civil Service is that pre-employment medical examinations for the great majority of entrants are not justified though there are some exceptions and safeguards.

Pre-employment medical examinations can be referred to as well person screening, that is, the application of one or more tests to a supposedly healthy population in order to identify individuals showing early signs of illness.

Parkes (1971) said that after an appropriate interval of time has elapsed any operation in industry should be evaluated to determine whether or not it is adequately performing the role for which it was originally designed. He went on to say that it may not be possible to apply cost effectiveness techniques but that if the objectives have been correctly stated and analysed it should at least be possible to match these against the achievements.

Hands (1972) stated that all prospective food handlers should undergo a screening test at a company's medical centre by a competent nurse experienced in methods of hygiene and control in the food industry.

Among the conditions which, he said, cause rejection are perforated ear drums or infected ears, boils, carbuncles, severe acne, infected skin or hair as may occur with scabies or pediculosis, severe rashes including psoriasis and ichthyosis, ill-cared for and cut hands, bitten finger nails, severe dental caries and poor personal hygiene. Once the applicant has passed the medical examination the personnel department, according to Hands, usually agrees to the applicant's employment.

Lowbury (1975) has said that although there is no direct evidence incriminating nail-biters and heavy smokers, it seems reasonable to regard persons whose hands show signs of poor hygiene care as being more prone than those with clean well cared for hands to contaminate food with pathogens if such people are employed as food handlers. Also, food handlers held responsible for staphylococcal enterotoxin outbreaks, according to Lowbury, often have a history of skin infections, including boils, carbuncles, whitlows, ulcers and eczema.

Craven et al (1975) reported an outbreak of Salmonella infection that was traced to contaminated chocolate. The source of contamination appeared to be cocoa beans which had been purchased from Ghana where the techniques of harvesting, fermenting and drying of beans allows, as in other countries, free access of humans and animals to exported beans. Thus a pre-employment medical examination would not have prevented this outbreak.

Hall et al (1976) drew attention to the risk of transmission of faecal parasites by food handlers. In an examination of a single faecal specimen from each of 201 employees, 32 potentially pathogenic parasites were found in 27 (13%) of the staff. All but two of the employees were immigrants from either Africa or the West Indies. He went on to conclude that these results confirm the desirability of screening food handlers. However, the fact that these people were employed initially, before the stool testing, suggests that the pre-employment medical examination did not detect the presence of parasitic pathogens. This could only be achieved if stool tests were performed on all applicants who were to be employed as food handlers, or at least, on these results, on immigrants specifically. This would probably be more of a political than a medical decision.

At Cadbury's a pre-employment medical examination is usually carried out on prospective employees and the decision to employ or reject such applicants may rest on the result of the examination. Fcr the employer the fundamental objective is to ensure that the employee is medically fit to perform the tasks required in order to achieve management's objectives without damaging the health of the individual or creating health hazards to others; (Harte, 1974).

The following paragraphs describe the purposes of the pre-employment medical examination and its use at Cadbury's.

7.2 Purposes of the pre-employment medical examination

These purposes were, according to the medical adviser at Cadbury's, as recommended by Norman (1960).

1. To ensure that the applicant is fit for the job for which he has applied, without endangering the health or safety of others.
2. The pre-placement assessment of disability and advice on any limitations the applicant may have.
3. To ensure that the applicant is not suffering from any condition which may endanger his own health and safety in the occupation concerned.
4. Examinations under statutory requirements.
5. For the requirements of particular occupations. The detection of skin infection in food handlers, for example, would be important.
6. If the findings at the pre-employment medical examination are adequately recorded and preserved, they form a baseline record of certain aspects of the individual's health which may be of diagnostic value later in his life.
7. An opportunity for health education is available at the pre-employment examination.
8. From the national point of view, pre-employment examinations may have some value as a screening procedure for detecting disease and disability in the applicant population examined.
9. To assess the probability that the applicant may experience excessive sickness absence and consequent payment during sick leave.

7.3 The practice of pre-employment medical examinations at Cadbury's

3.1 Administrative procedure: pre examination

A pre-employment medical examination is required of all prospective factory personnel and all other personnel who either might come into contact with food or food processes or who give indication of some problem of health during any pre-employment interview. Other personnel such as sales representatives or directors may also have a pre-employment medical. Applicants for work are asked upon arrival at the employment office to fill in a standard form which gives a history of the applicant's previous employment (Appendix 8). Applicants for office work or other work not involved in food handling departments are considered for work if there is no obvious health problem brought to light as a result of the initial questionnaire.

In some cases the employment office may reject an applicant for apparently medical reasons but without medical examination; for example, nail biters or people with heavily nicotine-stained hands.

This rejection is justified on the grounds that an examination in the surgery would have resulted in a similar outcome and thus saves the surgery staff time. In other cases applicants are told to come back for a medical examination when their condition has improved.

Persons applying for work in the canteen, factory, or other work which may involve food handling are then asked to present themselves to the surgery reception for a more detailed questionnaire.

People applying for work not involving food handling but who have expressed reservations about their health also fill in the detailed questionnaire.

Upon arrival at the surgery the applicant is given a form to complete (Appendix 9), the colour of the form being determined by the nature of the application; a white form for permanent work, blue for seasonal work for men and pink for seasonal work for women.

The applicant is asked to fill in one side of the form and then one of the nursing staff completes the reverse side on the basis of questions and physical examination. The surgery clerical staff usually measure height, weight and visual acuity of the applicants.

3.2 Examination procedure

The following paragraphs examine aspects of the medical examination and the reasoning behind the testing procedure.

Test for visual acuity

This test is important in jobs where accuracy of vision plays a major role; for example fork lift truck drivers and other drivers are usually given a test of the visual field.

Persons with monocular vision are not recommended for work where there may be a hazard to their eyesight. The employment office and safety office are informed where appropriate and suitable safety spectacles may be provided. With such people it is advised that the wearing of protective glasses is important so as to minimise the risk to the remaining eye.

Ear conditions

The ears are examined primarily to exclude persons with discharging ears and perforated eardrums where the employment of such persons would constitute a potential food contaminating situation or food hazard. All new male applicants are now sent for an audiometric examination within one or two months of commencing employment.

This technique is not yet part of the standard pre-employment medical examination for all applicants. Audiometry has been discussed in more detail in the section on Audiometry.

Mouth

The main consideration is the exclusion of persons who may be food contaminators due to an unhealthy oral cavity, for example; persons with bad teeth are not recommended for food handling work. Usually applicants will have to have treatment before being accepted to work in a food handling situation. Applicants with throat infections may also be excluded from food handling situations.

Upper limbs

The condition of the nails and nail beds comes under close scrutiny as being one of the areas where a source of infection may come into direct contact with food. Persons with bitten nails may be told to give up the habit and to return after a week or two for a re-examination of the nails.

Nicotine stains on the fingers are also grounds for exclusion from food handling work. It is said that the smell of nicotine could be picked up by the chocolate during handling. This is one of the reasons why smoking is prohibited in the factory. Such persons are told to eliminate these stains from their fingers before they will be accepted as food handlers.

The hand grip is tested subjectively by asking the applicant to grip the hand of the examining sister. Persons with a poor grip are not recommended for work where grip at work is a significant part of the job or where the condition causing the poor grip may be aggravated. The cause of a weak grip would need to be understood and investigated (by the occupational health sister) before suitable work can be recommended.

Skin

A healthy skin is considered essential for food handling. Persons with skin abnormalities such as flaking and eczema, are not readily considered for food handling work except where the skin can be covered satisfactorily. Persons with a history of dermatitis and skin allergies will probably have restrictions placed on the work available to them. The recommendations depend on the nature and site of the condition and whether it can be covered or whether the condition is infectious, or would be worsened by contact with substances at work such as sugar, cocoa etc.

Lower limbs and back

Since a lot of work involves a considerable time in walking, standing, bending and lifting, abnormalities of the lower limbs and back may be grounds for exclusion of applicants from such work.

Thus applicants with varicose veins, ankle swelling or back injuries and pains are recommended jobs where there is a limitation on the physical demands of the work in terms of standing, lifting, bending and pulling.

Abdominal conditions

Applicants are asked to give details of abdominal operations or conditions which may have a bearing on lifting or other work.

Diarrhoea

Applicants with a history of frequent attacks of diarrhoea and other such conditions need careful consideration before being allocated to food handling work. Persons working in food handling situations may experience these conditions and must report this to the surgery, especially when returning from holiday abroad. They are then sent home. Relatives or lodgers who work in food handling may also be sent home. Stool specimens are sent to Selly Oak hospital for examination and the person is re-admitted to work only upon three successive tests of the specimens yielding negative results eg absence of salmonella.

General urinary conditions

This is ascertained by asking the applicant about his history of urinary conditions. Urine tests may be necessary for some jobs or as a result of previous medical conditions. Tests are done on applicants for Heavy Goods Vehicle Licences, graduate trainees and other management applicants.

Menstruation

Women applicants are questioned whether they are taking the contraceptive pill. This is because applicants on the pill with perhaps swollen legs may be prone to thrombosis if subjected to too much standing work. Other factors about which applicants may be questioned include period irregularities, heavy bleeding, severe pain or regular time off work.

Nervous stability

This is mainly assessed by general observation during the interview. Applicants may be asked whether they are taking pills for any nervous conditions. If so then work of a demanding nature such as piece work may not be recommended.

This would depend on the nervous condition and the person's reaction to it. Usually a trial period is recommended and it may be that liaison with the employment office would be necessary to find a specific suitable job.

Fitness for work

Applicants upon completion of the medical examinations are then classed as fit, unfit, or fit with reservations. The sister or doctor notes this categorisation on the reverse side of the applicant's initial form together with any reservations. It was stressed by the nursing staff who conducted the examinations that very often it is a borderline decision whether to pass as fit or unfit any particular applicant. More often than not it was a subjective and very difficult decision. Applicants classed as unfit may be giv ı the opportunity to see the company's medical officer. It was emphasised that it was not the nursing staff's responsibility to classify a patient as unfit - that decision was left to the medical officer. Nevertheless they felt that the doctor needed to see only a very few applicants.

A basic feature of the pre-employment medical examination is said to be the concept of checking for "normality". Specific illnesses are not usually looked for except in so far as they represent a food hazard. The aim of the examination is to ensure that people are capable of doing the work that might be asked of them without risk to themselves, other people or the product.

3.3 Administrative procedure - post examination

Once the employment form has been completed by the nursing staff it is sent directly to the employment office who usually act in accordance with the medical recommendations although

they may question their necessity or implications.
The pre-employment medical forms completed by the applicant and by the nursing staff or doctor are kept in a file in the surgery until the employment office informs the surgery clerical staff that the applicant has been engaged. The clerical staff then make out a personal file for the employee and place in it the pre-employment medical form. Thus at the end of the year the remaining pre-employment medical forms consist of those applicants who, for one reason or another have been unsuccessful in obtaining employment.
The employment office also keeps separate files of those persons who have been unsuccessful in obtaining employment. They record the total number of medical examinations performed in each week on factory applicants and the number of people subsequently taken on. Since many people either leave soon after starting or never arrive for work the number of people taken on is only an approximation.
These figures are totalled at the end of each month and at three-monthly intervals.
These records also show the number of applicants in any given week, the number interviewed, the number to start work and the applicant's source of information in enquiring for the job. These records are gleaned from a more detailed register also kept by the same clerical worker in the employment office. This register, for men only, (the women's details are supplied by the women's employment officer's staff) shows details of name, age, nationality and in most cases the results of the medical examination and any reasons for non-employment.

All applicants including those successful in obtaining employment are recorded here.
This register used in conjunction with the files of unsuccessful applicants enables one to ascertain the way in which the employment office acts upon the surgery recommendations.
For example, the surgery staff may mark an applicant's pre-employment form as "fit with reservations" and may comment on the reservations. The employment office may reject the applicant for medical reasons, bearing in mind the job applied for and the reservations, and mark the form "medical reject". They may reject the applicant for reasons other than medical and thus mark the form "reject". The applicant may be placed on a waiting list or told to come back for a medical re-examination after a particular condition has been seen to. Subsequent to this the applicant may either not come back and his form is marked DNC (did not come) or he may withdraw by telephone or letter.

7.4 A method to assess the benefits of pre-employment medical examinations

The preceding paragraphs have described the pre-employment medical examination at Cadbury's and have shown that applicants are classified into three major groups:

A. Applicants classed as fit and then employed

B.1 Applicants classed as fit with reservations and then employed

2 Applicants classed as fit with reservations and then not employed

C. Applicants classed as unfit and not employed.

The categories B2 and C represent those applicants who, as

a result of the medical examination, are not employed because the restrictions placed on their employment cannot be met at the time. In my discussions with the personnel officer I was told that the labour situation at any particular time may affect the number of applicants who, although reservations are expressed about them, are employed. For example, if there is a severe shortage of labour, applicants about whose health the surgery staff have reservations will be employed. Conversely, when few jobs are available any sort of restriction may count unfavourably towards an applicant's employment.
In 1974, 1,356 female applicants had a pre-employment medical examination and of these 273 or 20% were categorised as B2 and C, the majority in B2. Of 905 male factory applicants 202 or 22% were similarly categorised in this period.
This figure reflects the non-financial cost to these individuals of the pre-employment medical examination. The determination of the magnitude of the social cost was outside the scope and time limitations of the research. These particular groups cannot be used directly in estimating benefits of the medical examination because, obviously, as they have not been employed, they are unavailable for monitoring procedures.
However, as the numbers were so large in proportion to the total number of examinations an analysis of reasons for their categorisation in B2 and C would yield useful information about the type of medical conditions and their relative frequency. This could be useful in subsequent selection of B1 applicants for monitoring and then comparing with control groups selected from group A applicants.
The following paragraphs show my proposed framework for assessing

the benefits of the pre-employment medical examination.

4.1 <u>A suggested benefit assessment framework</u>

The hypothesis that is being put forward for testing is that there is no difference between the applicants classed as fit with reservations and employed (B1) and those applicants classed as fit and employed (A).

One or more criteria must be selected for testing whether there is a difference between groups B1 and A - these may be variations in sickness absence, frequency of surgery attendance and the number of accidents.

If it is found that, for example, group B1 personnel have significantly more sickness absence than group A this could mean that the surgery staff were successful in identifying those applicants needing medical supervision. It could mean that although these individuals have been identified, medical supervision is ineffective because there is still significantly more sickness absence in this group. On the other hand, without medical supervision there may have been even more sickness absence than has been recorded.

If it is found that there is no significant difference between the sickness absence of group B1 and group A this could indicate that:

1. there is no difference between the two groups and a medical examination would not have been necessary
2. that the surgery recommendations have resulted in the applicants being placed in suitable work.

It could be that there is less sickness absence in the group classed as fit with reservations than in the "fit" group.

Once the criterion of measurement has been chosen the sample populations, if the whole population is not being used, must be selected from both groups. Usually some degree of matching for age, sex, marital status and other factors is desirable as these may affect the indicator being measured. In an industrial context the total population from which samples are taken is sometimes not very large so that adequate matching may be difficult. An adequate control group might difficult to select from workers which include factory men working day and night shifts, factory women who may work full-time or part-time, in the evening or only on a seasonal basis.

Once the sample and control groups have been selected monitoring must be done, at periodic intervals, of the chosen indicators. The groups must be large enough so that employees leaving employment, and hence the groups being monitored, will not affect the overall result.

Once these difficulties have been overcome the hypothesis can be tested.

The following sections describe the first stage in this analysis - an assessment of the categorisation and reasons for rejection of groups B2 and C.

7.5 An assessment of the categorisation and reasons for rejection of some applicants classed as unfit or fit with reservations

The following paragraphs and Table numbers refer to factory men and women applicants who were unsuccessful in obtaining employment and who were initially classed by surgery staff as unfit or fit with reservations. These have been classified according to diagnosis, showing single conditions only, or multiple conditions and their relative frequency of occurrence.

Subsequent Table numbers show how the employment office and the applicant reacted to the surgery recommendations.

The figures in most of the Tables were arrived at by a process of continually working back and revising previously collated figures. The reasons for this were numerous. For example in some cases male applicants had filled in female forms or vice-versa and this was only discovered later. Or applicants for whom no apparent employment form existed were found to be office staff applicants who were not marked as such and thus were included in the initial analysis. Office staff employment forms are filed in a different section of the employment office from the factory personnel forms.

5.1 Diagnostic classification of factory men classed by the surgery as unfit or fit with reservations and then not employed

The total number of factory men applicants classed as unfit or fit with reservations in 1974 and who were not subsequently employed was 203 out of 905 applicants examined, or 22.3% of those examined. This total excludes male junior applicants. The majority of these factory men are diagnostically categorised Table 33. Table 34 shows how the employment office acted upon the recommendations of the surgery with respect to these applicants. The lists in Tables 35 and 37 complete the diagnostic classification and the resultant employment office actions are shown in Tables 36 and 38.

5.2 Diagnostic classification of factory men refused by employment office on "medical" grounds

Three people were not included in Table 39 but should be added to the applicant total. They were diagnosed as; bad teeth and nails, shortened arm, only one kidney. The total number of male applicants, rejected by the employment office on "medical" grounds was 98.

Table 40 summarises the results of the medical examination

TABLE 33

DIAGNOSTIC CLASSIFICATION OF FACTORY MEN CLASSED BY THE SURGERY AS UNFIT OR FIT WITH RESERVATIONS AND SUBSEQUENTLY NOT EMPLOYED - 1974

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	DIAGNOSTIC TOTALS
1. NAILS	22		2	1	11										36
2 BACK TR.		5													5
3 TEETH			30	1	11	4									48
4 H/AS/B				11		3		1	2			1			20
5 NICOT.					6	4									32
6 SKIN						20	5								36
7 VISION							5	2							12
8 VV								1							4
9 D/G									3						5
10 UNFIT										2					2
11 HEART											1				1
12 EAR												10		1	12
13 DEP/N													3		3

KEY

1. Nail conditons = bitten nails, nail infections
2. Back trouble = spinal injuries, history of back pain
3. Teeth = 'bad' teeth
4. H/AS/B = hay fever, asthma, bronchitis
5. Nicot = nicotine stained fingers
6. Skin = skin conditions; eczema, psoriasis, rashes, warts
7. Vision = monocular, colour blind, lazy eye
8. VV = varicose veins
9. D/G = diarrhoea, gastroenteritis, recent and past
10. Unfit = unspecified
11. Heart = heart condition
12. Ear = ear trouble, discharging ear, excess wax
13. DEP/N = depression and neurosis history; nervous breakdown
14. - = One of the above plus any other condition or conditions other than 1 to 13

TABLE 34

EMPLOYMENT OFFICE AND APPLICANT (FACTORY MEN) ACTION SUBSEQUENT TO PRE-EMPLOYMENT MEDICAL EXAMINATIONS

CONDITION	EMPLOYMENT OFFICE ACTION - NUMBER AND PERCENTAGE OF TOTAL					
	MED. REJECT	DID NOT COME	REJECT	WITHDREW	MISCELLANEOUS	TOTAL
1	17	16	1		2	36
2	5					5
3	33	12	2		1	48
4	14	4		1	1	20
5	15	17				32
6	26	9		1		36
7	9	3				12
8	4					4
9	4	1				5
10	2					2
11	1					1
12	10	1	1			12
13	2	1				3

TABLE 35

NUMBER OF APPLICANTS AND DIAGNOSIS WHERE 3 OF THE CONDITIONS OF TABLE 33 OCCUR TOGETHER

APPL.	NUMBER	DIAGNOSTIC CONDITION
1	1	NAILS, VISION, EXCESS DRINKING
2	1	SKIN, TEETH, BRONCHITIS
3	1	NICOTINE, SKIN, DRINK
4	1	NICOTINE, TEETH, DRINK
5	1	NAILS, NICOTINE, TEETH, BACK
6	1	NICOTINE, TEETH, HEART
7	1	NAILS, SKIN, NICOTINE
8	1	VARICOSE VEINS, DEPRESSION, BRONCHITIS
9	2	NAILS, NICOTINE, INFLAMED THROAT

TABLE 36

SUBSEQUENT EMPLOYMENT OFFICE OR APPLICANT ACTION

APPL.	MEDICAL REJECT	DID NOT COME	REJECT	MISC.
1	x			
2	x			
3	x			
4				x
5	x			
6	x			
7	x			
8			x	
9		xx		
	TOT. 6	2	1	1

TABLE 37

(IN LIST FORM) CONDITIONS OTHER THAN THOSE IN TABLES 33 AND 35

Here there are an assortment of medical conditions such as:

diabetes, obesity, hernia etc.

The breakdown on outcomes is in Table 38.

TABLE 38

SUBSEQUENT EMPLOYMENT OFFICE OR APPLICANT ACTION

MEDICAL REJECT	DID NOT COME	WITHDREW	MISCELLANEOUS
14	6	1	2

TABLE 39

DIAGNOSTIC CLASSIFICATION OF FACTORY MEN APPLICANTS REJECTED BY EMPLOYMENT OFFICE WITHOUT A PRE-EMPLOYMENT MEDICAL EXAMINATION

CONDITION	1	2	3	4	5	6	7	8	9	DIAGNOSTIC TOTALS
1 NAILS	66		1	1		5	1		3	77
2 BACK TROUBLE		1								1
3 SPEECH DEFECT										1
4 NICOTINE				1		1				3
5 EAR TROUBLE					3					3
6 LONG HAIR							1		1	8
7 SKIN TROUBLE							8			10
8 DEP/NEUR.								2		2
9 SMOKING										4

Three people were not included in the above table but should be added to the applicant total. They were diagnosed as: 1. Bad teeth and nails, 2. Shortened arm 3. Only one kidney. The total number of male applicants rejected by the employment office on "medical" grounds was 98.

TABLE 40

NUMBER OF MEDICAL REJECTS IN RELATION TO OTHER CATEGORIES - MALE APPLICANTS

	OUTCOMES					
CONDITONS	MEDICAL REJECT	DID NOT COME	REJECT	WITHDREW	MISCELLANEOUS	
TABLE 6a	108	51	4	2	4	
TABLE 7a	6	2	1		1	
TABLE 8a	14	6	1	2		
TOTAL	128	59	6	4	5	202
% of G. TOTAL	63.5%	29%	3%	2%	2.5%	G. TOTAL

and subsequent action from Tables 34, 36 and 38.

5.3 Diagnostic classification of factory women classed by the surgery as unfit or fit with reservations and then not employed

The total number of factory women applicants classed as unfit or fit with reservations in 1974 and who were not subsequently employed was 273 out of 1,356 applicants examined; 20% of those examined.

The majority of these, 215, are shown in Table 41. Table 42 shows how the employment office acted upon the recommendations of the surgery with respect to these applicants. The lists in Tables 43 and 45 complete the diagnostic classification and the resultant employment office actions are shown in Tables 44 and 46.

The paragraphs following the Tables explain the interpretation of the classification system devised for this purpose.

The figures in Table 41 represent the number of times that a particular condition or combination of conditions occurred. Each column and row is summed down and across to give the total in the far right hand column. These totals represent the number of times or the number of persons who had that particular row condition and includes multiples of it.

For example in row six, skin conditions, the figure 32 represents 32 people being declared unfit or fit with reservations as a result of a skin condition only. The figure two in row six column seven represents two people with a skin condition and a vision abnormality. The figure one in column six and row five represents one person with a skin condition and nicotine stains. Summing down column six and along row six gives a total of 46 which represents the number of people who had a skin condition only and those having a skin condition and another condition as

TABLE 41

DIAGNOSTIC CLASSIFICATION OF FACTORY WOMEN CLASSED BY THE SURGERY AS UNFIT OR FIT WITH RESERVATIONS AND SUBSEQUENTLY NOT EMPLOYED (215 WOMEN IN 1974)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	DIAGNOSTIC TOTALS
1 NAILS	26		1	2	6	1		1				2		2	41
2 BACK TR		24		1		1		1						1	28
3 TEETH			15		5	1						2		1	25
4 H/AS/B				10		2		3							18
5 NICOT					4	1						1			17
6 SKIN						32	2				1	2		3	46
7 VISION							7							2	10
8 VV								6						1	12
9 D/G									8					1	9
10 Anaem										3				2	5
11 HEART											2				3
12 EAR												22			29
13 DEP/N													7		7

KEY

1. Nail conditions = bitten nails, nail infections
2. Back trouble = spinal injuries, history of back pain
3. Teeth = 'bad' teeth
4. H/AS/B = hay fever, asthma, bronchitis
5. Nicot = nicotine stained fingers
6. Skin = skin conditions; eczema, psoriasis, rashes, warts
7. Vision = monocular, colour blind, lazy eye
8. VV = varicose veins
9. D/G = diarrhoea, gastroenteritis; recent and past
10. Anaem = anaemia
11. HEART = heart condition
12. EAR = ear trouble, discharging ear, excess wax
13. DEP/N = depression and neurosis history; nervous breakdown
14. - = One of the above plus any other condition or conditions other than 1 to 13

TABLE 42

EMPLOYMENT OFFICE AND APPLICANT (FACTORYWOMEN) ACTION SUBSEQUENT TO PRE-EMPLOYMENT EXAMINATION

	EMPLOYMENT OFFICE ACTION - NUMBER AND PERCENTAGE OF TOTAL								
CONDITION	MEDICAL REJECT		DID NOT COME		REJECT	WITHDREW	WAITING LIST	MISCELLANEOUS	TOTAL
	NO.	%	NO.	%					
1	8	19.5	18	44	5	3	3	4	41
2	26	93					1	1	28
3	15	60	8	32	1			1	25
4	12	66.7	5	27.8				1	18
5	2	11.8	10	58.8	2	1	2		17
6	23	50	16	34.8	1	2	4		46
7	4	40	2	20		1	2	1	10
8	9	75	2	16.7		1			12
9	2	22.2	4	44.4	1	1	1		9
10	3	60				1	1		5
11	3	100							3
12	19	65.5	5	17.2		3	1	1	28
13	4	57	1	14.3		1		1	7

well. In row six and column 14 the figure three represents three people who had a skin condition and another condition excluding those from 1-13, for example, a skin condition and diabetes and/or any other condition.

This tabulation does not enable one to represent multiples of three from conditions 1-13 or any other condition if it is not linked to one of those from 1-13. These are shown in list form in Tables 43 and 45 respectively.

Table 42 shows how the employment office and applicants acted upon the surgery recommendations. The applicants marked as "miscellaneous" are those about whom it was not possible to make a firm and positive categorisation.

The diagnostic conditions in Table 42 correspond to those in Table 41. Table 42 is interpreted as follows: In diagnostic condition one, for example, of the 41 people about whom reservations are expressed by the surgery, eight or 19.5% of the total in that diagnostic category were rejected by the employment office for medical reasons. Of the total of 41, 18 or 41% were told to come back when their condition had improved but did not do so.

In diagnostic condition two, back trouble, nearly all persons about whom reservations were expressed were rejected for medical reasons, 93% in total. This is probably because the employment office personnel will not employ people with possible back trouble in a job where there is likely to be considerable lifting or bending involved.

To some extent this rejection shows the lack of alternative work for people in this category.

TABLE 43

NUMBER OF APPLICANTS AND DIAGNOSIS WHERE THREE OF THE CONDITIONS OF TABLE 42 OCCUR TOGETHER

APPL.	NUMBER	DIAGNOSTIC CONDITION
1	1	NAILS, NICOTINE AND VISION
2	1	HAB, NAILS AND TEETH
3	1	HAB, NAILS AND NICOTINE
4	1	HAB, VARICOSE VEINS AND BACK TROUBLE
5	1	NICOTINE, NAILS AND TEETH
6	1	VARICOSE VEINS, NAILS AND EARS
7	1	SKIN, TEETH AND VARICOSE VEINS

TABLE 44

SUBSEQUENT EMPLOYMENT OFFICE OR APPLICANT ACTION

APPL.	MEDICAL REJECT	DID NOT COME	WITHDREW	MISC
1				x
2		x		
3			x	
4	x			
5	x			
6	x			
7	x			
	TOTAL 4	1	1	1

TABLE 45

(IN LIST FORM) CONDITIONS OTHER THAN THOSE IN TABLES 42 AND 43

There are fifty one assorted diagnostic conditions in this category ranging from elastoplast allergy, mastectomy, hysterectomy, thyroid conditions to blood pressure abnormality etc.

TABLE 46

SUBSEQUENT EMPLOYMENT OFFICE OR APPLICANT ACTION

MED. REJECT	D.N.C.	REJECT	WITHDREW	WAIT. LIST	MISC.	TOTAL
30	5	2	7	3	4	51

Conditions other than those in Tables 42 and 43

There are fifty one assorted diagnostic conditions in this category ranging from elastoplast allergy, mastectomy, hysterectomy, thyroid conditions to blood pressure abnormality etc.

Table 46 categorises the action taken by the applicant or the employment office subsequent to the medical examination.

The figures in Table 42 do not give the total number of medical "rejects" when added up. The reason is that the figures represent diagnostic conditions and if a person has more than one condition, any pair in Table 41, then that person will be represented twice in Table 42. For example, a person with a skin condition and bad teeth will in Table 42 be represented once under condition six and once under condition three.

Table 47 shows the true number of medical rejections in relation to the other outcomes possible as a result of the examination. The figures in Table 47 show that of the factory women who were labelled unfit or fit with reservations by the surgery staff in 1974 and who subsequently did not obtain employment; over half, 55%, did not do so because of medical reasons and almost a quarter, 24%, did not return for a re-examination.

5.4 Diagnostic classification of factory women refused employment by employment office on "medical" grounds

During the collation of figures presented in Tables 41 and 45 it became apparent that many more women were being refused employment for medical reasons than at first realised.

The pre-employment forms had medical diagnoses noted on them such as nail conditions, bad teeth and back trouble and there

TABLE 47

NUMBER OF MEDICAL REJECTS IN RELATION TO OTHER CATEGORIES - FEMALE APPLICANTS

	OUTCOME						
CONDITION	MEDICAL REJECT	DID NOT COME	REJECT	WITHDREW	WAITING LIST	MISCELLANEOUS	
TABLE 1a	116	59	8	11	14	7	
TABLE 2a	4	1		1		1	
TABLE 3a	30	5	2	7	3	4	
TOTAL	150	65	10	19	17	12	273
% OF G. TOTAL	55%	24%	3.5%	7%	6%	4.5%	GRAND TOTAL

appeared to have been no pre-employment medical examination in the surgery. Further investigation revealed that the employment office was acting as a filter in that people who in the employment officers' judgement would probably "fail" on the medical were being refused employment apparently on these grounds.

The majority of conditions falling into this category were those most readily observable, for example, nail biters or people with infections of the nails.

The surgery staff were apparently aware of this procedure and justified it on the grounds that if all these people were sent to them then the workload would be more than the staff could cope with. The conditions discovered such as nail biters, are ones that the surgery staff would pick up anyway and are such that other personnel, in this case the employment officer, can detect. However, what happens in practice is that the employment office rejects these applicants. This probably occurs when the problem, as judged by the employment office personnel, appears particularly severe.

Table 48 shows the diagnoses as detected by the employment office.

7.6 Pre-employment examination priorities: product safety and employee welfare aspects compared

It is now possible to calculate the relative proportions of people rejected for medical reasons or who have reservations expressed about them to see which proportion predominates in the pre-employment medical examination - the safe product strategy; primarily done for the employer's benefit, or the employee fitness strategy which is an employee benefit. The data used in compiling Tables 41, 43 and 45 have been re-

TABLE 48

DIAGNOSTIC CLASSIFICATION OF FACTORY WOMEN APPLICANTS REJECTED BY THE EMPLOYMENT OFFICE WITHOUT A PRE-EMPLOYMENT MEDICAL EXAMINATION

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
1 NAILS	48		1		2	1			1				1	6		60
2 BACK TROUBLE		2													1	3
3 TEETH			8											3		12
4 NO LIFTING				4												4
5 NICOTINE					2									1		5
6 SKIN TROUBLE																1
7 OVERWEIGHT							3	1								4
8 VARICOSE VEINS											1					2
9 TOO SMALL									3							4
10 UNHEALTHY										2						2
11 NO STANDING											2					3
12 EAR TROUBLE												2				2
13 DEP/NEUR																1
14 HANDS														5		15

Six people could not be classed above. Their written diagnoses were

1. Heavy figure, odd green eye
2. Overage

These descriptions were probably to aid identification

3. Overage and wants light job
4. Hands, nails and nicotine
5. Slight speech defect, looks backward
6. Arthritic neck

This made a total of 106 applicants
Column 15 miscellaneous refers to any other condition paired with any condition from 1 to 14

TABLE 49

A COMPARISON OF THE RELATIVE NUMBER OF APPLICANTS ABOUT WHOM RESERVATIONS WERE EXPRESSED IN TERMS OF PRODUCT SAFETY, EMPLOYEE FITNESS OR BOTH AND WHO WERE NOT EMPLOYED

		NUMBER OF APPLICANTS			TOTAL NUMBER APPLICANTS
	TABLE	PROD. SAFETY	EMP. FITNESS	BOTH	
WOMEN	1	129	73	13	215
	2	1	1	5	7
	3	1	45	5	51
	TOTAL	131	119	23	273
MEN	6	124	30	14	168
	7	1	1	8	10
	8	1	24		25
	TOTAL	120	55	22	203
EMP. OFF. W.	4	82	22	2	106
M.	9	92	5	1	98
	TOTAL	174	27	2	204
	WOMEN TOTAL	213	141	25	
	MEN TOTAL	218	60	23	
	GRAND TOTAL	431	201	48	680

analysed to show the numbers of applicants who have reservations expressed about them solely as a safe product risk, solely as an employee fitness risk or both. This is shown in Table 49. The figures shown represent men and women applicants who were declared unfit or fit with reservations and then, for one reason or another, were not employed. For the men, data from Tables 33, 35 and 37 was re-analysed to give the tabulated results. The Table also includes a categorisation of employment office diagnoses since these result indirectly from the action of the medical department.

Table 49 shows that women applicants have an almost 1:1 ratio of product safety to employee fitness diagnoses, (131:119 respectively). With male applicants, 126 have reservations in respect of product safety and 55 for employee fitness; a ratio of 2.3:1. The employment office exclude applicants primarily for product safety; a ratio 3.7:1 of product safety to employee fitness for women and a ratio of 18:1 respectively for men. This difference could be accounted for in various ways. The pattern of work applied for probably varies in the amount of contact with food processes between men and women. Men may suffer from more conditions which are detrimental towards product safety than women.

Whatever the explanation it appears that, overall, at least for those applicants who are unsuccessful in obtaining employment, the pre-employment medical examination and its indirect effects on the selection by the employment office is aimed towards product safety by a ratio of about 2:1.

7.7 <u>Cost of pre-employment medical examinations in 1974</u>

The total number of men and women factory applicants in 1974 was 1,356 women and 905 men

= 2,261

Each examination takes about 15 minutes and is performed by one of the Sisters in the surgery

$\therefore$ Total time = 2,261 $\div$ 4 = 565¼ hours

Cost of Sister's time

The Sister's salary in 1974 was £1500 plus 25% associated employee costs giving a total of £1875 as cost to the company, or 90p per hour

Cost of Sister's time = 565¼ x 0.90 = £508.73

Doctor's time

Some applicants are referred to the doctor for examination: Of the 475 applicants who did not gain employment ten were seen by the doctor.

This I scale up proportionally ie ten is 2.1% of 475

$\therefore$ 2.1% of 2261 = 47 applicants.

This would probably be a maximum figure as the ten applicants that were recorded as being seen by the doctor originate from the population most of which were categorised as fit with reservations. The rest of the population were probably "fitter" from the point of view of the pre-employment medical examination.

Each of these applicants spends about 15 minutes with the doctor at £3.125 per hour doctor's time which includes National Insurance and company pension the cost is 47/4 = 11.75 or £36.72.

Employment Office Costs

The employment office staff have additional work as a result of referring and taking note of the results of the pre-employment medical examination.

I estimate that of the time spent per applicant by the employment office staff five minutes per applicant examined will be spent on aspects concerned with the medical examination. For the 2261 applicants this equals 188.4 hours.

The time of the employment officer and clerical staff is valued as an average of £1 per hour plus 25% associated employee costs and thus the total cost of employment office staff is 188.4 x 1.25 = £235.50.

This is probably a minimum figure because employment office accommodation costs which would be difficult to apportion here are not included. The main reason for their exclusion is that they would still have to be met if pre-employment medical examinations were discontinued and thus their apportionment is somewhat arbitrary and artificial.

Cost of surgery clerical staff

The clerical staff normally carry out a test of visual acuity and also weigh the applicant. They are also responsible for the administrative work involved in filing such as periodically removing from the immediate surgery records those applicant's files who had a medical then left Cadbury's. These are then refiled in a separate room.

I estimate a maximum of five minutes of clerical staff time for each applicant tested. For the 2261 applicants this gives a figure of 188.4 hours.

The time of the clerical staff is valued at 75p per hour plus 25% associated employee costs giving a figure of 94p per hour.

The total cost of clerical staff time dealing with pre-employment medicals is thus 188.4 x 0.94 = £177.00.

Accommodation costs and general overheads

The examination is normally carried out in the surgery library which has facilities for use as a consulting room and has an area of 183 square feet. An apportionment must also be made for a part of the accommodation costs of the clerical staff work area and the open area where vision tests and weight tests are performed. However, since the main area where the examinations are carried out is also used for other activities this extra accommodation has not been included. The total surgery area for which accommodation is charged is 5803 square feet. Thus the area of 183 square feet represents 3% of the total surgery area.

The surgery accommodation cost for 1974 was £9018.00. Thus 3% of this figure may be taken as the apportionment for pre-employment medical examinations

= £270.50.

Cost of medical forms

These forms are printed by Cadbury's own printing department.

Cost per 1000 including overheads	= £5.00
Total cost for 2261	= £11.25

7.1 Total cost summary in 1974 for 2261 examinations

Cost of Sister's time	£509
Doctor's costs	37
Employment office costs	235
Cost of surgery clerical staff	177
Accommodation plus overheads	270
Cost of medical forms	11
	£1239

7.8 Discussion

In section 2 I have listed the objectives of the pre-employment medical examination.

It appears that objective one is the primary aim of the pre-employment medical examination - that is:

> "to ensure that the subject is fit to undertake the job without risk to himself or to his colleagues, or in certain circumstances to the general public".

It appears that the 'certain circumstances' to which the statement above refers to pertains to the situation at Cadbury's in that the factory processes are involved in the manufacture of a food which is on sale to the general public. Thus there are components to the pre-employment medical examination which are used to eliminate from the manufacturing processes applicants who might be a risk to the general public, for example, by contaminating the chocolate with organisms or foreign matter so that there is a public health risk or in some cases adverse publicity. The following list shows the type of conditions that are thought to be associated with the safe product strategy: nail biting and nail infections, either through handling food or transferring germs from the mouth via the fingers onto the food; bad teeth, presumably transferring germs from the mouth to the food in some way; nicotine stains on fingers, said to result in chocolate picking up the smell of nicotine if the chocolate is handled; skin conditions such as eczema, psoriasis, flaky skin and acne which may result in foreign matter dropping into the food; ear conditions such as runny or discharging ears said to be a food risk through transfer of infections from the ears to the food; and diarrhoea and gastro-enteritis where there is a known food poisoning hazard if these bacteria come into contact with food. All other medical conditions may be said to belong primarily to the employee fitness for work strategy as opposed to the product safety strategy. The following paragraphs summarise the discussion that took place between Mr Norman Brown the Quality Control Manager at Bournville, me and one of Cadbury's bacteriologists who was present. The discussion centred round the necessity for the product safety aspects of the pre-employment medical examination. Apparently three people are employed on testing food for light extraneous matter (LEM) for food products destined for the USA. This is a requirement of the US Food and Drugs Administration.

Concern in the US and in Canada more recently appears to be oriented towards the hazards of Salmonella.

Nail biters apparently give cause for concern because of possible foreign bodies such as nail parings falling into the chocolate.

There may also be a transfer of germs from the mouth to the food. Certain staphylococci are normally present in the healthy mouth. In cases of dental caries their transfer to food may constitute a food hazard.

If gloves were worn they would have to be changed every hour and the subsequent cost, I was told by the surgery staff, would be prohibitive.

On the question of nicotine stains the Quality Control people were unaware of the reasons for excluding such applicants. When told that it was thought that chocolate takes up the smell of nicotine from nicotine stained fingers Mr Brown thought that this was unlikely for blocks of dry chocolate. It was mentioned that many people working at Cadbury's are smokers and there have been no complaints so far about the smell of nicotine from chocolate.

Hand checks are being initiated because about five times a year finger dressings which have fallen into the chocolate are returned by the public. These incidents are apparently the chief source of complaints from the public. Hand checks for nicotine stains may be undertaken by the supervisors and people with stained hands may be sent to the surgery for the staff to decide whether these people can continue working. Skin conditions are a hazard due to scales of skin falling into the food. It is also considered that viruses from warts may be transferred onto food.

During my discussion with Mr Brown I was told of a case of potential food poisoning involving Salmonella which was once experienced at Cadbury's.

Apparently an employee had been allowed back to work packing chocolates after her stool specimens had been cleared by Selly Oak hospital. After a few days the hospital contacted Cadbury's to say that the initial bacterial growth which at first looked negative was in fact positive. The employee had in the mean-time worked for two successive days packing chocolates. All chocolate from this line was then recalled and random samples taken to detect any possible contamination. None was found and the rest of these chocolates were allowed through. It is not possible to generalise from this example except to say that even where a known hazard exists there is an unknown number of casual links before the hazard may manifest itself as food poisoning.

It was emphasised at the end of our discussion that even if there appears to be no evidence supporting the product safety components of the pre-employment medical examination it was still worth doing in that one erred on the side of safety.

7.9 Conclusions

1. The initial step towards providing a framework for the assessment of the benefits of pre-employment medical examinations has been made by analysing the reasons for rejection of applicants in the year 1974.
2. The analysis has shown that the pre-employment medical examination comprises two functional aspects; a product safety function and an employee welfare function.
3. In 1974 a total of 2261 pre-employment medical examinations were performed at a cost of £1239.00.
4. Of the 1356 women applicants examined 273 or 20% were subsequently not employed.
5. Of the 273 women applicants not employed about half had medical reservations about product safety and half about employee welfare.
6. Of the 905 male applicants examined 203 or 22% were subsequently not employed.
7. Of the 203 male applicants not employed a product safety categorisation was given almost two and a half times more than an employee welfare categorisation.
8. Employment office personnel were found to be acting in a pre-employment medical capacity in that they expressed "medical" reservations about 204 applicants who were later not employed.
9. Overall the number of reservations expressed about applicants on product safety was twice that expressed on employee welfare.
10. This emphasis on product safety was found to be due to a willingness by the personnel involved to "err" on the side of caution in view of the perceived potential risks of food contamination.

11. This analysis has shown that any benefit assessment scheme must take into account the perceived and actual probability of food contamination as well as the costs of such contamination.

12. Once this is done the benefits and costs of the pre-employment medical examination can be expressed in terms of product safety and employee safety.

CHAPTER 8

8. Summary and Conclusions

The approach I have taken in the thesis is to obtain evidence to test the proposal that the provision of occupational health services as arranged at the present time represents a misallocation of resources.

In looking at the activities of a large Midlands occupational health service in a food factory I have analysed the difficulties and suggested a resolution to the definition of occupational health. The most commonly used definition is the statement of the aim of occupational health arrived at by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950.

This definition has the disadvantages in that it represents a global representation of the activities of occupational health and as such it is difficult to bring out specific objectives which can be measured. I have taken the approach of attempting to identify specific objectives or benefits of occupational health activities so that it is possible to assess how far these objectives are being achieved.

In this context I have looked at three aspects of occupational health: audiometry, physiotherapy and pre-employment medical examinations.

These three activities embody crucial concepts which are common to all activities in an occupational health programme. They have claims made about them which have not previously been adequately tested in the field - these especially relate to savings in sickness absence; they are accepted by some practitioners and not by others on the basis of poorly-defined

objectives; these objectives have not been tested to see whether and to what extent they are being achieved.
The activities for analysis were selected out of the complex of services provided because they are representative of most of the other activities undertaken by the medical department. It has been possible to adopt a three category classification such that physiotherapy, pre-employment medical examinations and audiometry are examples within each category. I have called the categories personnel therapy, personnel input screening and personnel throughput screening respectively.
The resources devoted to these activities are represented by the monetary outlay in which the company, the employee and the State are involved as a result of these activities. In economic terms these resources should be expressed as opportunity costs; that is, the value of resources in their best alternative uses. In the thesis I have used money cost as an alternative to opportunity cost because these are the costs that were available.
A misallocation of resources can be viewed on two levels; locally and nationally, or on the micro- and macro-economic level. On the micro-level a misallocation of resources occurs if these resources could be better spent on alternative activities by the company. Circumstances may differ between companies so that a misallocation of resources in one company might not be so in another context. On the national or macro-economic level a misallocation of resources occurs if a redistribution of national medical resources would lead to an improvement in social welfare. The techniques used to determine whether any misallocation of resources exists are cost-

effectiveness and cost benefit analysis.
In strictly economic terms once costs and benefits have been enumerated an investment criterion is used to rank alternatives in terms of "social profitability".
The criterion used is that the project or activity which offers the highest net present value of benefits (present value of benefits minus present value of costs) should be ranked highest and the others ranked accordingly. Where benefits and costs, although quantifiable in numerical terms, cannot be measured in monetary terms, use is made of a benefit/cost ratio (becasue the net present value criterion cannot be used). In practice many social costs and benefits are not capable of measurement and it has been necessary for the purposes of this research to supplement the numerical analysis with a descriptive statement of the relative social repercussions involved. It is then the task of the decision-makers to make a value judgement based on the evidence available.
The evidence on which the proposal (that the provision of occupational health services as arranged at the present time represents a misallocation of resources) could be rejected can be seen on the micro and macro level. On the micro level if the marginal benefits are equal to or greater than the marginal costs of providing the occupational health service then the proposal may be rejected.
Similarly on the macro level, there are many difficulties in defining and quantifying relevant benefits. The sort of data which needs to be collected includes sickness absence data, cost data and information on the effectiveness of medical techniques.

In the thesis two types of tests were applied to the data in order to test the proposal: a descriptive test where the activity was analysed and described in terms of whether it fulfilled its objectives; this was applied to audiometry and pre-employment medical examinations. With physiotherapy a null hypothesis was stated: that there is no difference in sickness absence rates due to physiotherapy in industry. I then set out to collect observations to apply the descriptive tests and to test the null hypothesis.

I conclude that for audiometry the only identifiable benefit was that three individuals gained some improvement in hearing. In view of the resources spent and the stated objectives of audiometry I submit that I have not shown audiometry to be cost-effective.

The evidence that I have presented from my observations of the physiotherapy service leads me to reject the null hypothesis that there is no difference in sickness absence rates due to physiotherapy in industry. Indeed I have shown that the savings in averted sickness absence payments by the company and the State are in each case more than the cost of the increased level of provision of the physiotherapy service.

With pre-employment medical examinations I have shown that the service is product safety oriented and that although benefits are extremely difficult to identify the service is likely to continue due to the company's need to be seen to be providing a service which may at some time identify and isolate sources of food contamination.

I find therefore that I cannot reject the proposal that the mix of occupational health services as provided at the present time represents a misallocation of resources.

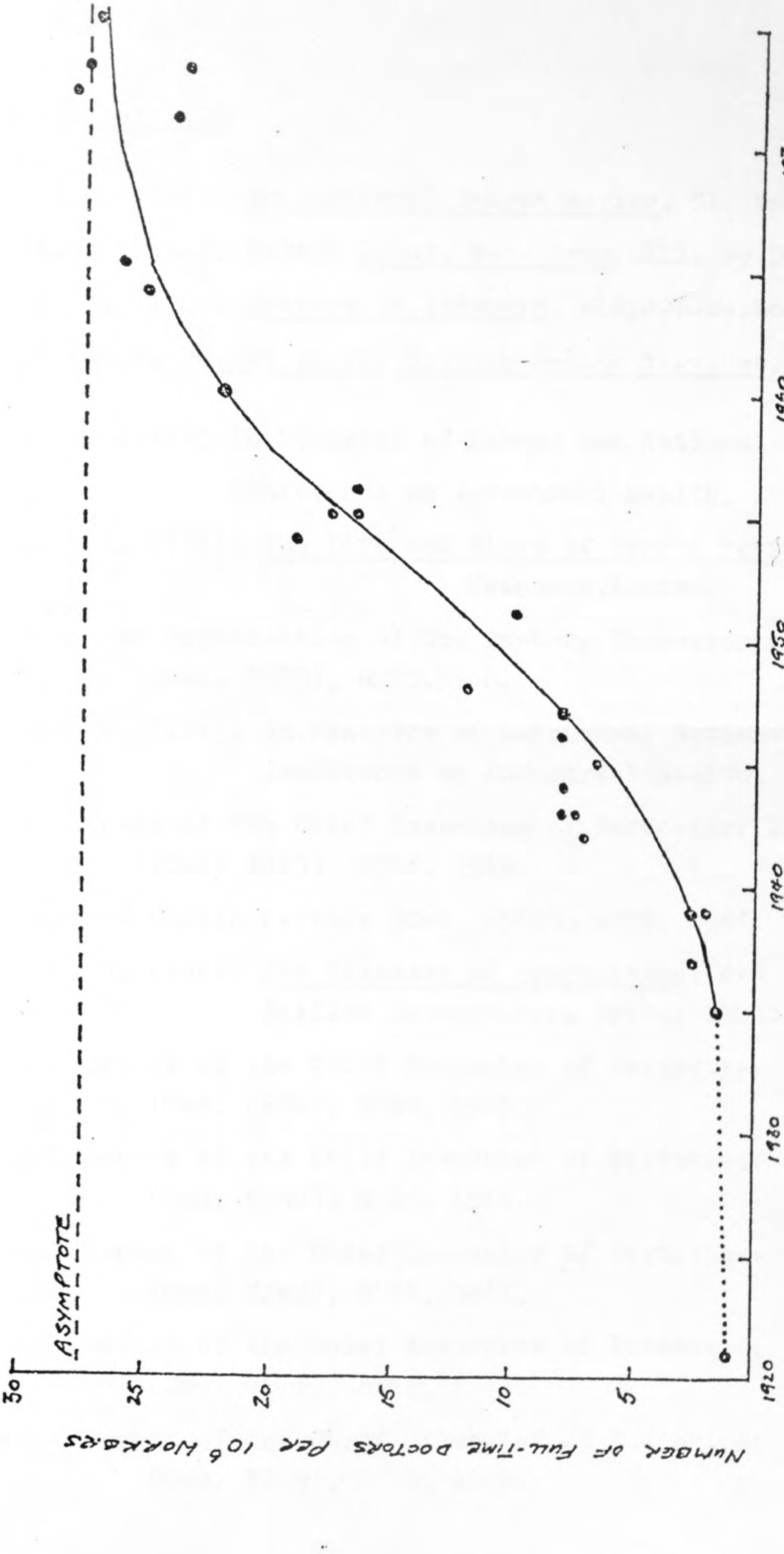
APPENDICES

APPENDIX 1

Table 20: Employment of Doctors in Industry

YEAR	SOURCE	DOCTORS		NURSES
		Full-time	Part-time	
1921	1	20	–	–
1935	2	25	–	–
	3	30	–	–
1937	4	50	–	–
1939	5,1,6	50	250	1,500
	7	40	–	–
1942	1	150	550	–
1943	1	164	637	3,500
	8,9	174	744	8,385
1944	10	175	700	–
	11	176	750	–
	12	180	890	7,800
1945	13	143	903	–
1946	14	161	918	–
1947	15	164	962	4,021
1948	16	239	856	–
1951	17	230	–	–
1954	18	450	–	–
1955	19	400	–	–
	20	421	–	–
1956	21	400	1,100	–
1960	3	500	3,000	–
1964	19	636	–	–
1965	19	660	–	–
1971	22	600	2,000	–
1972	23	700	–	–
1973	24	600	–	–
1975	25	700	–	–

Figure 4: Number of Doctors Employed Full-Time in industry per 1,000,000 workers (1920 - 1975)



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APPENDIX 2

As part of the Company's general policy on risk prevention, noise is a significant factor. It is increasingly recognised that excessive noise in industry because of the possible duration of exposure, can be an important element in the aural health of the employed population. However, there is a balance to be maintained as natural defects and the result of disease can also contribute to the poor quality of individual hearing. The quality of noise is a matter of a personal and subjective assessment of sound and must be distinguished from its physical effect in medical terms.

It is the Company's policy:-

1. to reduce noise in areas where people are regularly employed to levels which are generally recognised as being acceptable.

2. to provide appropriate personal protection where noise reduction is not possible for technical reasons or because cost factors are prohibitive. Noise hazardous zones must be clearly identified and warning notices displayed.

3. to provide personal protection for employees who are asked to work intermittently in areas of excessive noise where people are not regularly employed.

4. to establish agreements that the use of suitable protective devices by employees working in noise hazardous zones is a condition of employment, or that a refusal to accept the use of such devices is properly recorded.

5. to conduct audiometric tests on employees in the following circumstances:-

   (a) New Employees (for permanent employment)

      i) all employees engaged to work in a defined noise hazardous zone.

      ii) all employees over 40 years of age engaged to work in a factory.

      iii) other employees at the discretion of the Company.

   These tests will be carried out as soon as possible after starting employment and the acceptance of testing will be a condition of employment. Seasonal employees would only be tested at the discretion of the Company.

   (b) Permanent or Established Employees

      i) all employees transferred to work in a defined noise hazardous zone.

      ii) regular tests on employees working in noise hazardous zones at the discretion of the Company.

      iii) other employees at the discretion of the Company - e.g. employees attaining the age of 40.

Company Personnel
June 1973

DRAFT

NOISE CONTROL

TRAINING AND EDUCATION

As an aspect of the normal safety/risk prevention training, it is important that noise control should now form an integral part. There are basically four separate elements in the introduction of noise control training:-

1. as a module in the apprentice or initial training of skilled craftsmen, draughtsmen/designers, and professional engineers.

2. as part of the standard programme for line management training.

3. as part of the training for shop stewards.

4. the need to retrain existing managers, engineers, etc.

The content of each training programme should essentially be the same but the structural emphasis must inevitably vary according to practical need and ability to absorb e.g. the degree of technical information required by a professional engineer will be different from that appropriate to a line supervisor. It should depend on the demands of their respective jobs. The following set down a possible pattern:-

(a) National legislation (if any), Objectives, emphasis on codes of practice, common law cases, how it fits in with broader risk prevention management, the Robens Report.

(b) Company policy on noise prevention - emphasis on people, balance between practice and theory.

(c) Technical problems - what are main sources of noise, how is it measured, what steps can be taken to reduce it, etc.?

(d) What are the effects of industrial noise on people ? - physical/psychologi

(e) What are management's direct responsibilities? - education, consultation, policy implementation, maintenance, administration/records, etc.

The method of presentation may also vary but considerable emphasis needs to be placed on practical demonstrations and examples. For the time being, training is likely to be internal to the Company until outside bodies have developed relevant courses.

Company Personnel
22 February 1973

NOTES ON GUIDANCE FOR LINE MANAGEMENT AND ENGINEERING STAFFS

The engineer and architect have the direct technical responsibility to reduce industrial noise to acceptable levels both in the long term and the short term. They should therefore consciously consider noise as an ever present factor in design and maintenance both in respect of the particular piece of equipment involved and the environment in which it is to be or is being used.

The following notes are for general guidance only and involve basic common sense considerations. Detailed guidance is available from professional and technical publications (e.g. The Code of Practice issued by H.M.S.O.) for both architects and engineers and these sources should be used. Where adequate advice does not appear to be available, help should be sought from the Company Accident Prevention Manager who will seek out suitable sources of information. Unless otherwise advised, the use of outside consultants should not be encouraged in view of the obvious cost but mainly because of the specialised nature of our requirement, the very varied quality of the advice likely to be received and the need to establish clear standards across the Company as a whole.

1. It is becoming more acceptable in the U K and is already current practice in the U S to measure industrial noise on the "A" scale of a standard sound level meter at slow response. This gives what is sometimes referred to as a subjective reading and whilst it will undoubtedly be necessary for engineers to carry out octave band analyses when considering detailed characteristics of plant and machinery this elaboration is not necessary when surveys are carried out. It is proposed that these standards are adopted.

2. Engineers should consider the categorisation of noise, e.g. vibratory noise, impact noise, compressed gas noise, transmission noise, structure or air borne noise and recreational noise such as "Music while you work".

3. Acceptable noise levels should be written into specifications for new machines which take account of the environment in which they are to be be installed bearing in mind:

   (a) the upper limit for 8 hours exposure is 90 DBA
   (b) the cumulative effect of a number of noise sounds
   (c) the increased noise emission possible as machines deteriorate.

   The readings should be taken adjacent to the noise source but at approximately 3 feet distance or in the position in which any person at risk might be.

4. Vibratory machines should be insulated from the surface on which they are mounted. This can be done in the simplest way by the use of flexible buffers on pads.

5. Impact noise can only be mitigated normally by re-consideration of the activity that generates the noise, but since this form of noise is very damaging consideration should be given to enclosure of such noise sources.

6. Compressed gas exhausts should always be fitted with silencers.

7. Transmission noise is more likely to be a product of manufacture and maintenance rather than design. It is important that the adequacy of bearings and gear trains and their lubrication systems should be checked.

8. Structure borne noise is likely to be associated with the need for insulation and architectural design.

9. Machine covers/guards can either reduce or increase noise depending on design; particularly when made from sheet metal, they can act as resonance chambers and reflectors; consideration needs to be given to stiffening and mounting of such structures. In some cases wire mesh covers may be better where there is no noise containment problem. The design of guards should be examined on all new machines with this point in mind.

10. Fan noise, compressor noise and resonance from the associated duct work is a particular problem. Axial flow fans are, of course, noisier than centrifugal fans but are cheaper and often produce a better layout. The use of attenuators in the ducting can often overcome fan problems whilst it is important to see that ducting is suitably stiffened to avoid any drumming. Consideration may need to be given to limiting air velocities.

11. When plant layout is considered, known noise sources, which it is expected will be above the acceptable level, should be grouped together or isolated so that they can be effectively silenced by enclosure.

12. Consideration might be given to the practicality of some form of accoustic hood or booth inside which an operator can carry out sufficient of his work to enable him to limit his total exposure to harmful noise to acceptable limits.

13. Enclosures of noisy plant should be designed with minimal openings and of materials which are capable of being cleaned in a normal way whilst remaining sound absorbent. The openings will allow the passage of less noise if they are made in the form of a tunnel, on the length of which depends the amount of noise escaping. As a general guide materials used in baffles are more effective the greater their mass.

14.. Noise baffles which can be portable in the form of screens should be considered where machines are only marginally above the intensity limit, and where noise cannot easily be suppressed.

15. The quality of tyres on internal factory transport needs careful consideration and co-operation with architects to determine the best types of flooring where this type of transport is frequently used.

16. Planned maintenance schedules should take account of the fact that inadequately maintained machinery is likely to generate more noise than is necessary because most machinery as it wears becomes progressively noisier.

17. Recreational noise can normally only be dealt with by the provision of volume control devices. When associated with an already noisy process, it may be impossible to provide at a level which enables employees to hear adequately without exceeding reasonable limits over a period of time. Alternatively there may be sound psychological reasons why it should be provided intermittently during working hours to reduce monotony whilst not exceeding the permissable limits of exposure.

18. Where, as a result of the impracticality of reducing noise levels on existing machines or on new equipment to an acceptable extent, "noise zones" should be established where it is mandatory for employees to wear adequate ear protection when exposure is likely to be above the permissable limits.

9. <u>Noise Exposure Guide</u>

6

The following is a simple ready reckoner for permissable noise exposures:

Duration per day (hours)	Sound level (dBA)	CODE of PRACTICE
8	90	90
6	92	
4	95	93
3	98	
2	100	96
$1\frac{1}{2}$	102	
1	105	99
$\frac{1}{2}$	110	102
$\frac{1}{4}$ or less	115	105

There is also a simple rule of thumb which is a tighter standard but may be used as a guide. An increase of 3 dBA reduces exposure time by half e.g. 90 dBA - 8 hours, 93 dBA - 4 hours, 96 dBA - 2 hours.

19. (cont)

When the daily exposure to noise is composed of two or more periods of exposure at differing levels the combined effect should be considered. If the calculation:-

$$\frac{\text{Total exposure time 1}}{\text{Total permitted exposure time 1}} + \frac{\text{Total exposure time 2}}{\text{Total permitted exposure time 2}}$$

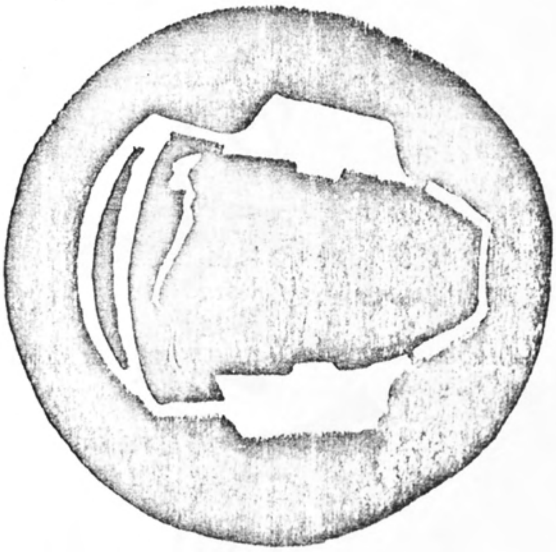
indicates a resultant greater than unity then the permitted exposure limit value has been exceeded.

The main implication of these notes of guidance apart from the purely technical considerations is the need to establish a high degree of co-operation between the engineer/architect, line management and shop floor representation in determining the standards to be applied. Cost considerations are extremely important but the Company is likely to have a legal duty to provide necessary protection. Even where the legal duty is not statutory, the effect of court decisions in common law claims may make non-observance of the above criteria very expensive indeed.

Management has the prime responsibility for ensuring that standards are adequate, satisfactorily maintained and properly observed.

APPENDIX 3

Sign No. 1 ... The Head with Ear Muffs



Sign. No. 2 ... Man with Fingers in Ears

APPENDIX 4

NAME

DEPT.

CHECK NO.

Age

Departments worked in:

Acquired perceptive deafness.

Due to measles.
(Pure tone audiogram) The curve slopes gently downwards to the right.

evel

E.N.T. History

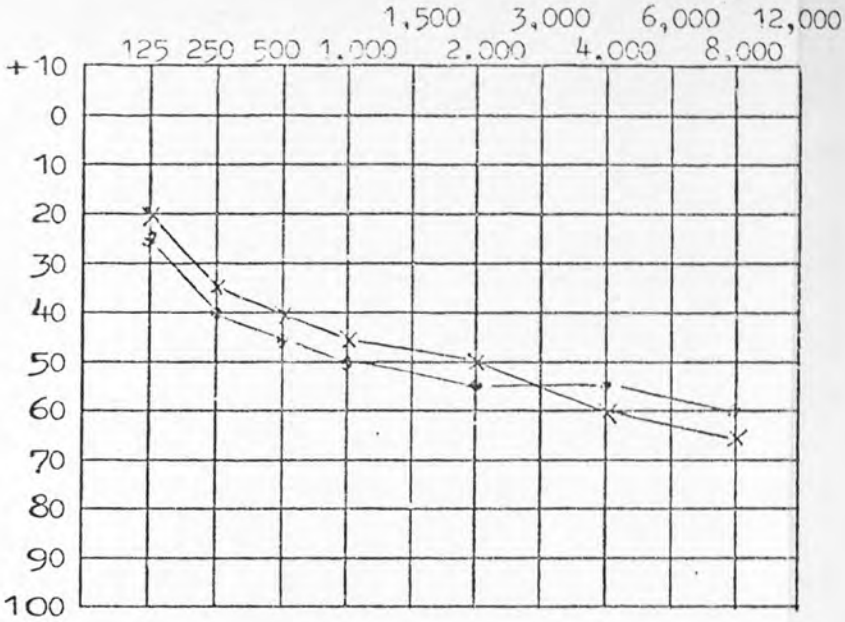
Other noisy employment

Hobbies

Action

Retest

Recorded By



Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

NAME

DEP

Aquired perceptive deafness.

Age

Dat.

Due to meningitis.
(Pure tone audiogram.)
Post-meningitic deafness tends to be extremely severe.

Departments worked in:

Date

d Level

E.N.T. History

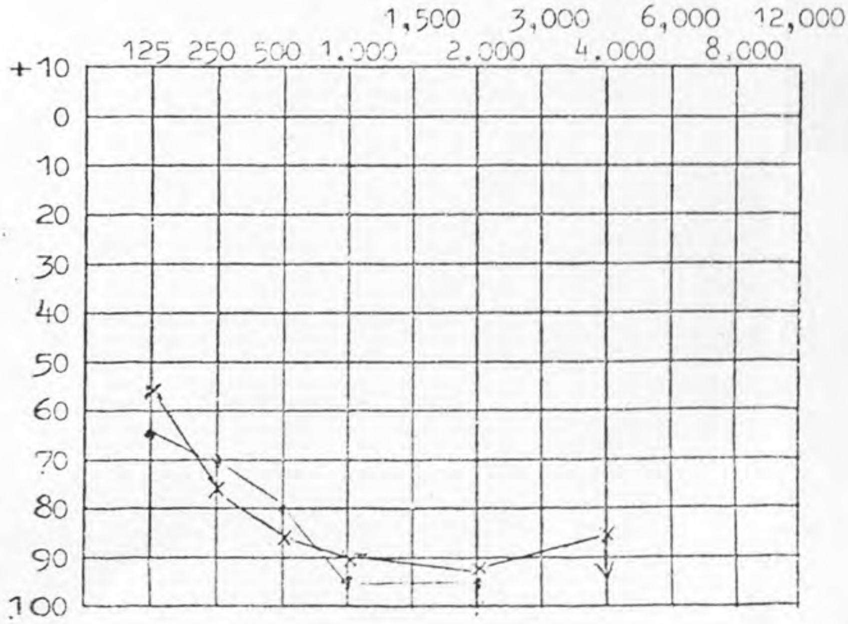
Other noisy employment

Hobbies

Action

Retest

Recorded By



Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

NAME

Age

Departments worked in:

E.N.T. History

Other noisy employment

Hobbies

Action

Retest

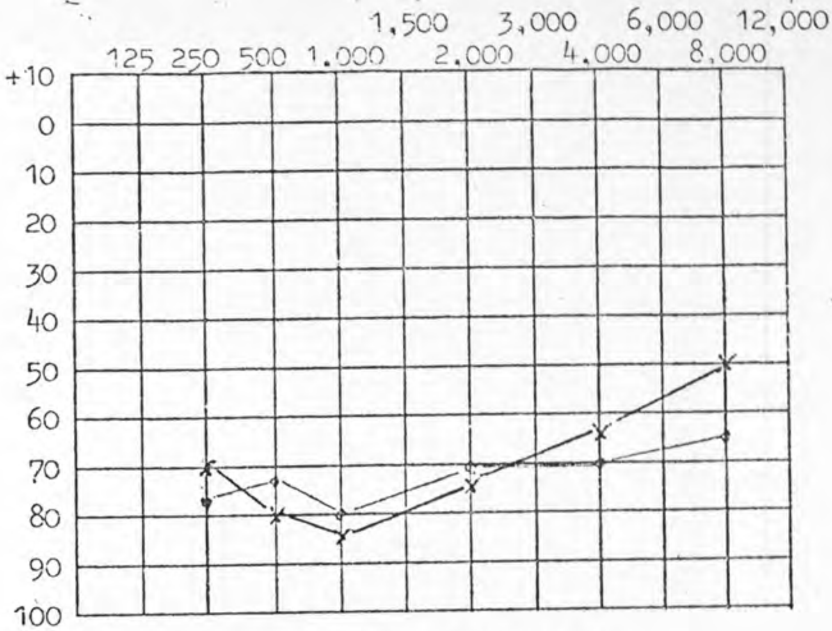
Recorded By

Sever aquired perceptive deafness.

Pure tone audiogram.

The patient, director of a large advertising firm, became severely deaf after he had been treated with antibiotic vancomycin, for a liver infection contracted in West Africa.

Level



Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

NAME

Age

Departments worked in:

E.N.T. History

Other noisy employment

Hobbies

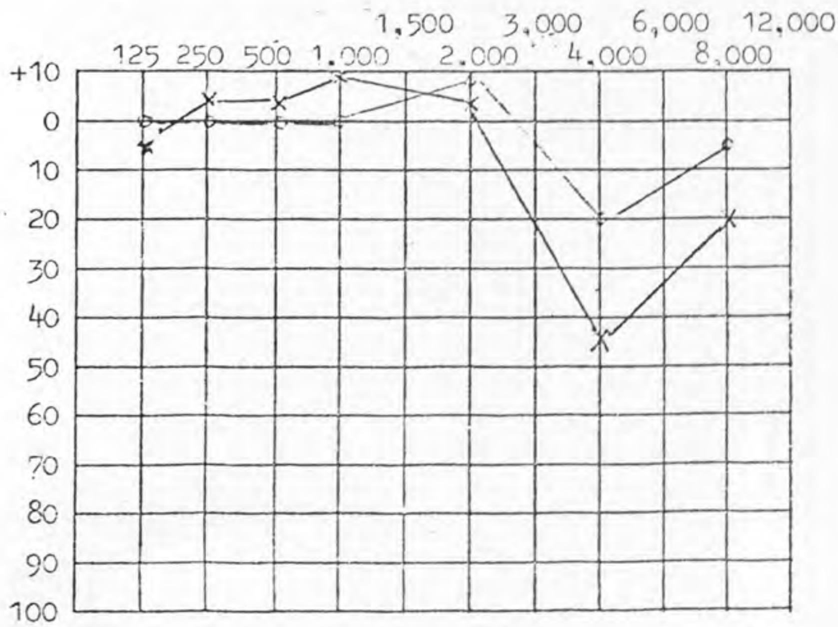
Action

Retest

Recorded By

Acoustic Trauma-pure tone audiogram.

The patient is one of Britain's leading authorities on poliomyelitis, and for many years he has been a keen small-arms shot. The audiogram shows a typical 'dip' at 4,000 c,p,s more marked(in the right-shouldered shot) in the left ear.



Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

Presbyacusis.
Senile Deafness.

Progressive perceptive deafness which comes on and advances, for no apparent reason, with the years. It is due to an atrophy of the auditory nerve fibres in the cochlea, and is most commonly noticed after the age of 60. But a premature onset may be associated with bouts of otitis media in childhood and (particularly) with prolonged exposure to noise throughout a working life. Little is known about senile deafness, beyond the facts that it is progressive. It is characteristically a recruiting deafness.

DEPT. CHECK NO.

Date

rtments worked in: Date of starting Date of finishing Sound Level

Daughter.

T. History

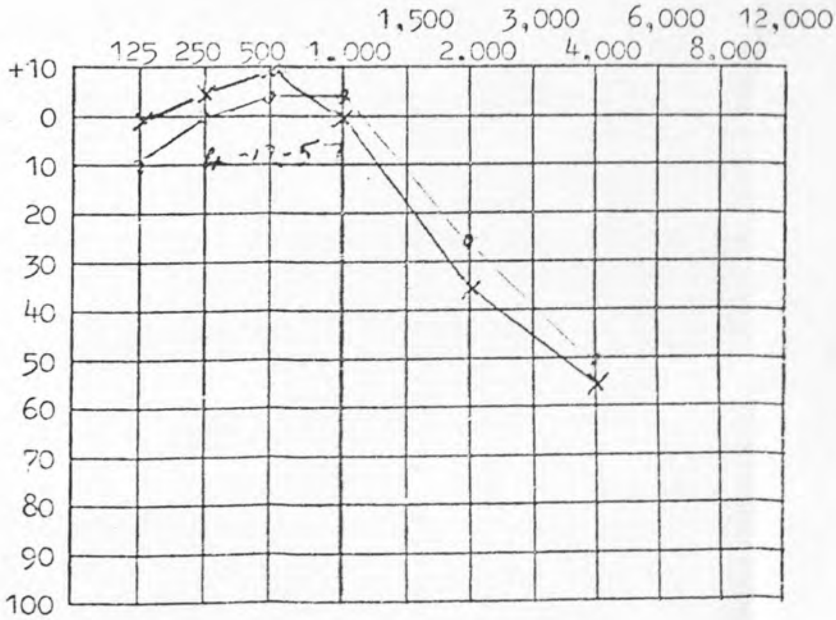
r noisy employment

ies

on

st

rded By



Air conduction: Right O Left X
Bone conduction: Right (Left)

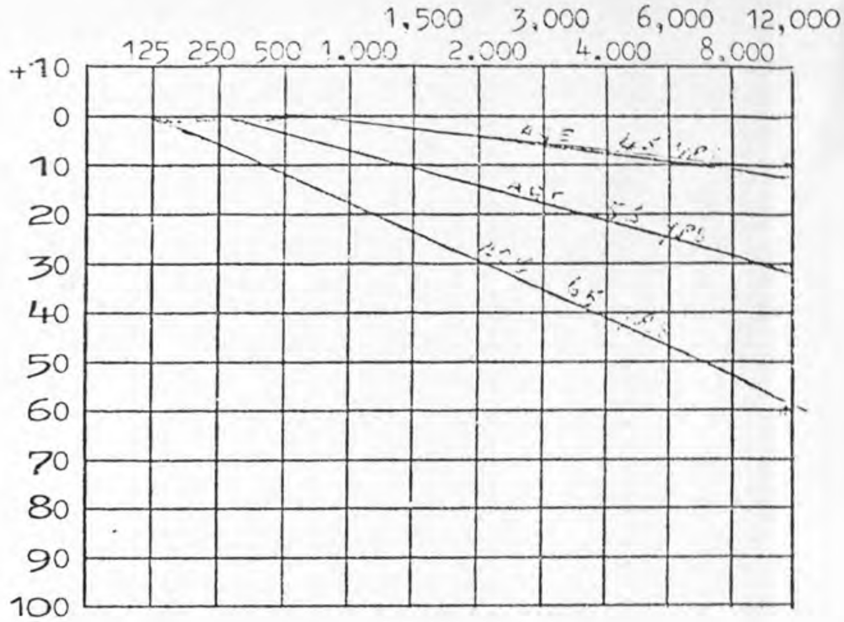
6/72/3000

NAME | DEPT. | CHECK NO.

Age | Date

Departments worked in: | Date of starting | Date of finishing | Sound Level

E.N.T. History



Other noisy employment

Hobbies

Action

Retest

Recorded By

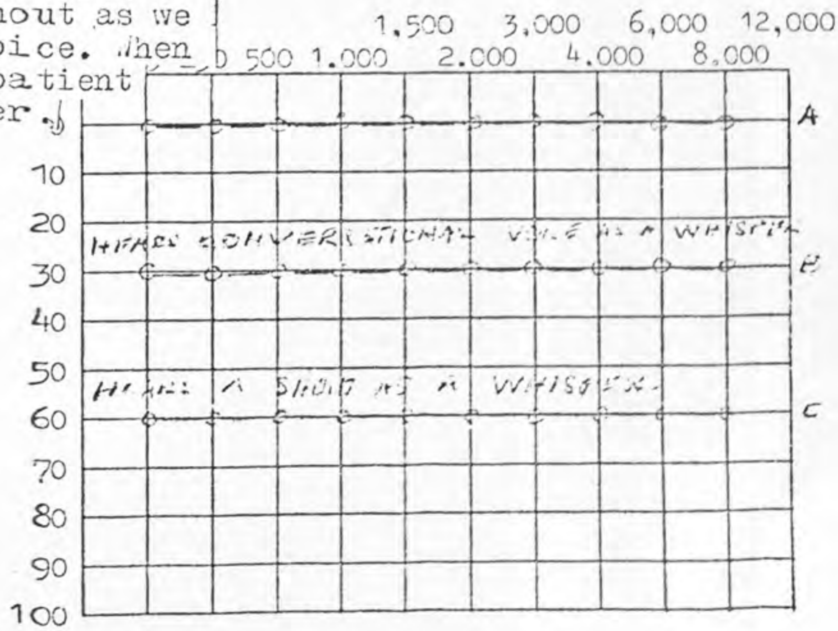
Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

is audiogram records the hearing loss decibels for each separate frequency, d it will be seen that a person with ormal hearing has a loss of 0db (A). will be remembered that a whisper is 30db ove the threshold level, a conversational ice 60db and a shout 90db above it. The tient with a hearing loss of 30db (B) will refore perceive a normal conversational ice as we, with normal hearing, hear a isper; and he will perceive a shout as we ar the normal conversational voice. When e hearing loss is 60db(C), the patient ll hear a shout only as a whisper.

CHECK NO.

arting | Date of finishing | Sound Level



Other noisy employment

Hobbies

Action

Retest

Recorded By

Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

NAME

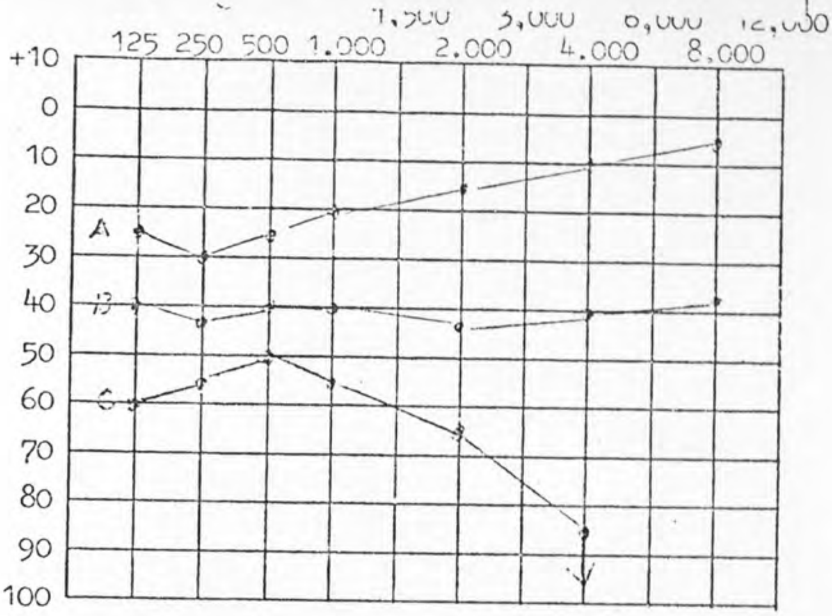
Age

Departments worked in:

Pure tone audiograms in
typical cases of conductive deafness.
A. Slight.
B. Moderate.
C. Severe.

Level

E.N.T. History



Other noisy employment

Hobbies

Action

Retest

Recorded By

Air conduction: Right O Left X
Bone conduction: Right (Left)

6/72/3000

NAME

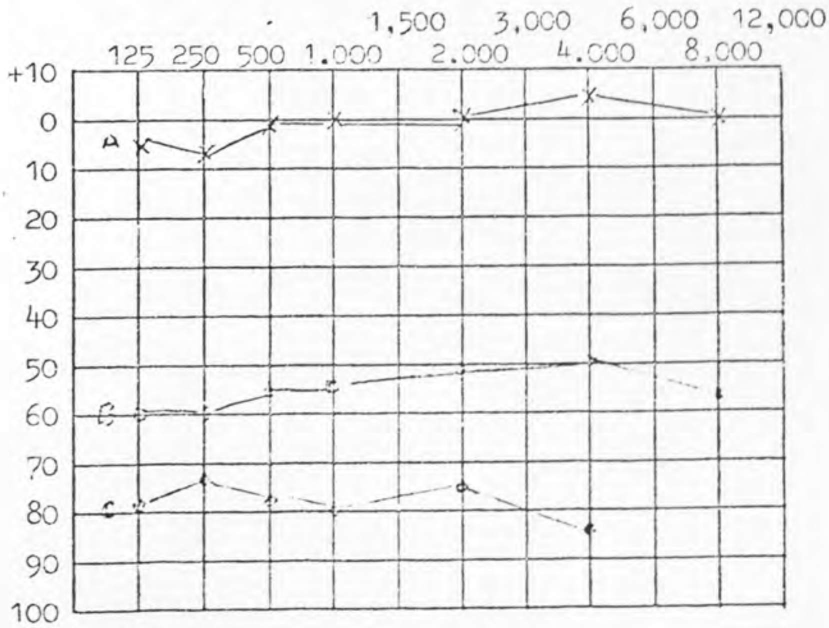
Age

Departments worked in:

Pure tone audiogram of a patient
with severe unilateral deafness.
A. Left ear-normal hearing.
B. Right ear-unmasked-'shadow curve',
C. Right ear-left ear 'masked'.

vel

E.N.T. History



Other noisy employment

Hobbies

Action

Retest

Recorded By

Air conduction: Right O Left X
Bone conduction: Right (Left)

APPENDIX 5

Cadbury Schweppes

FROM Dr C White
Surgery

TO

DATE

HEARING TESTS

Your name has been passed on to me as a person working in a noisy department and I am inviting you to come and have a hearing test in the Surgery. I can then have the opportunity of discussing the results with you, and to suggest any further action that I think is advisable.

I would be grateful if you would return this letter to Nurse Jennings indicating whether you wish to have the test.

Name ....

I wish / do not wish to have a hearing test.

* delete as necessary.

Cadbury Schweppes

FROM Nurse A[illegible]gs TO DATE

Please would you ask..

To attend the Surgery at..................on.......................

for a hearing test.

It is vital that he wear ear muffs all the time he is at work on that day until the time of the test. Earmuffs may be obtained from the Surgery prior to starting work.

APPENDIX 6

GRAPHS OF ABSENCE FOR FACTORY MEN

Factory Men

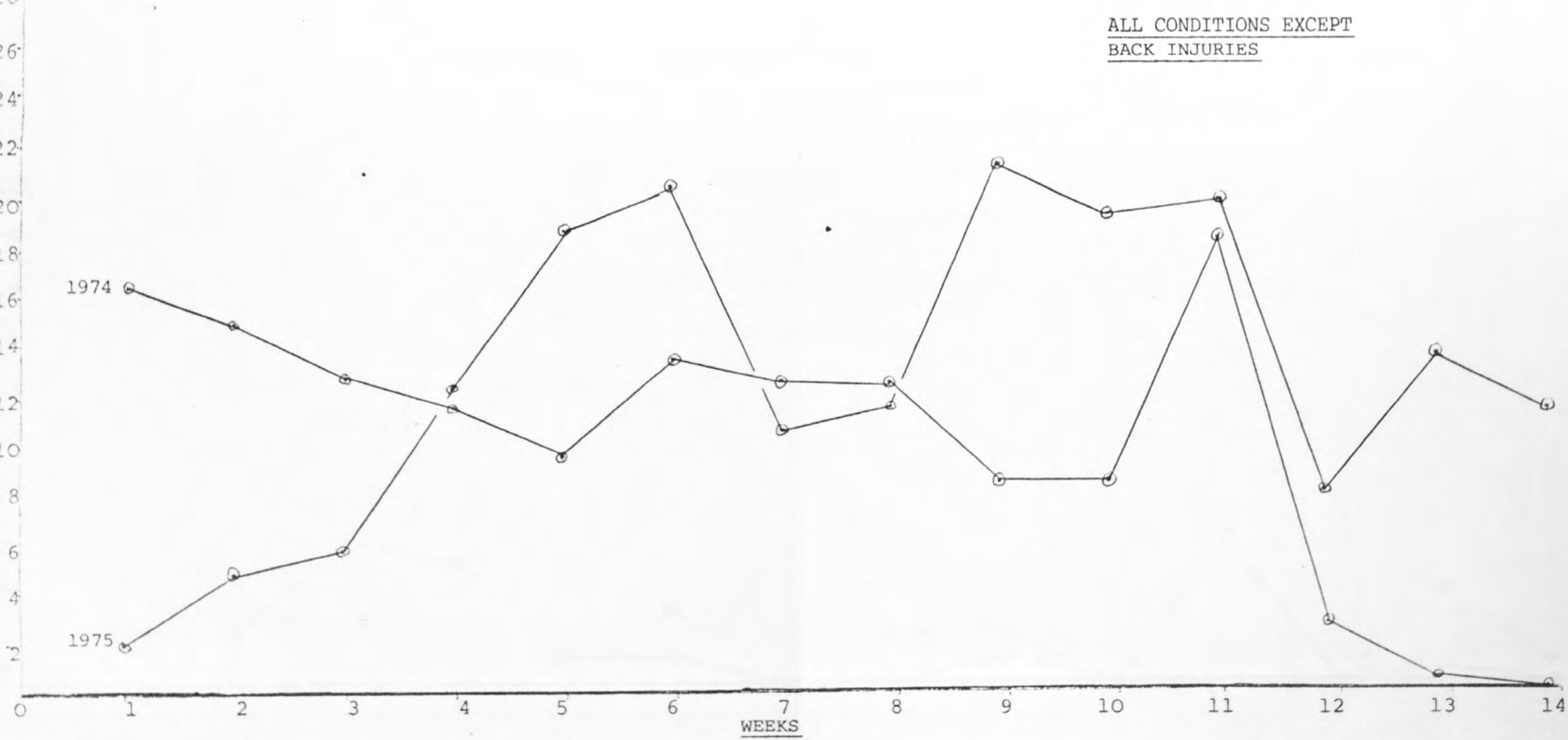
Graph A1-A4		No. of Men
A1	All conditions except back injuries	31
A2	Shoulder injuries only	8
A3	Leg injuries only	10
A4	All injuries except back, leg and shoulder	13

Graph A5-A7 (non physiotherapy related absences excluded)		
A5	All conditions except back injuries	31
A6	Leg injuries only	10
A7	All injuries except back, leg and shoulder	13

GRAPH NO A1

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 31 men physiotherapy restricted (Total days lost = 147.5)
1975 - 31 men with physiotherapy (Total days lost = 185.5)

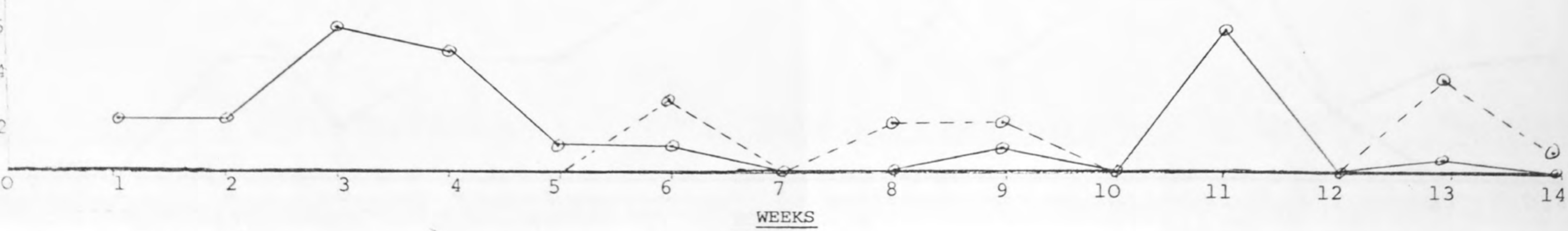


GRAPH NO A2

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

_______ 1974 - 8 men physiotherapy restricted (Total days lost = 24.5)
------- 1975 - 8 men with physiotherapy (Total days lost = 13.0)

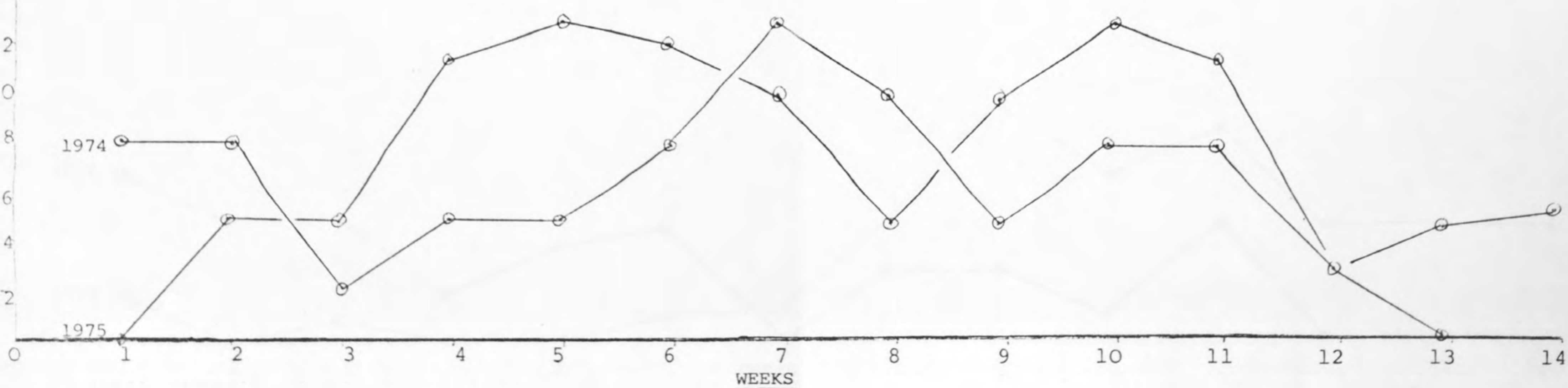
SHOULDER INJURIES ONLY



TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 10 men physiotherapy restricted (Total days lost = 83)
1975 - 10 men with physiotherapy (Total days lost = 110)

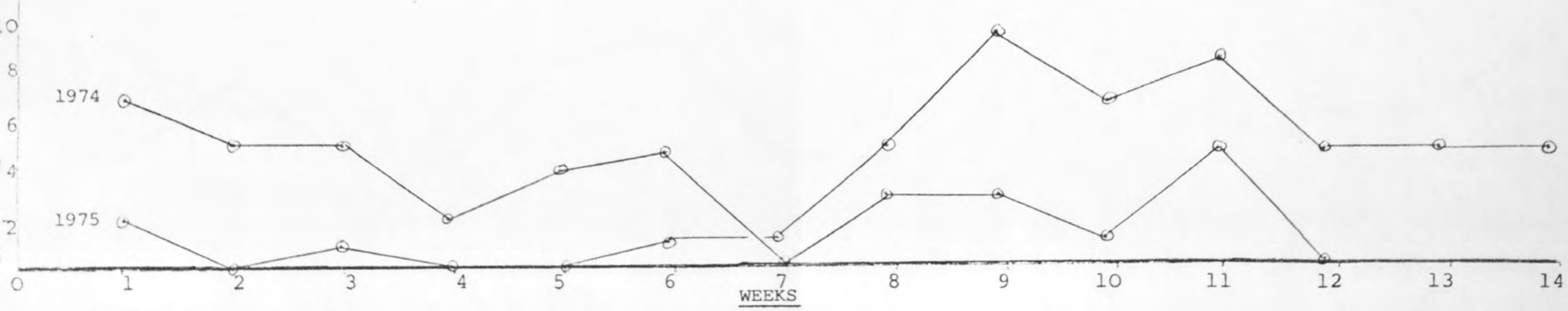
LEG INJURIES ONLY



<u>TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975</u>

1974 - 13 men physiotherapy restricted (Total days lost = 40.0)
1975 - 13 men with physiotherapy (Total days lost = 62.5)

<u>ALL INJURIES EXCEPT BACK, LEG AND SHOULDER</u>

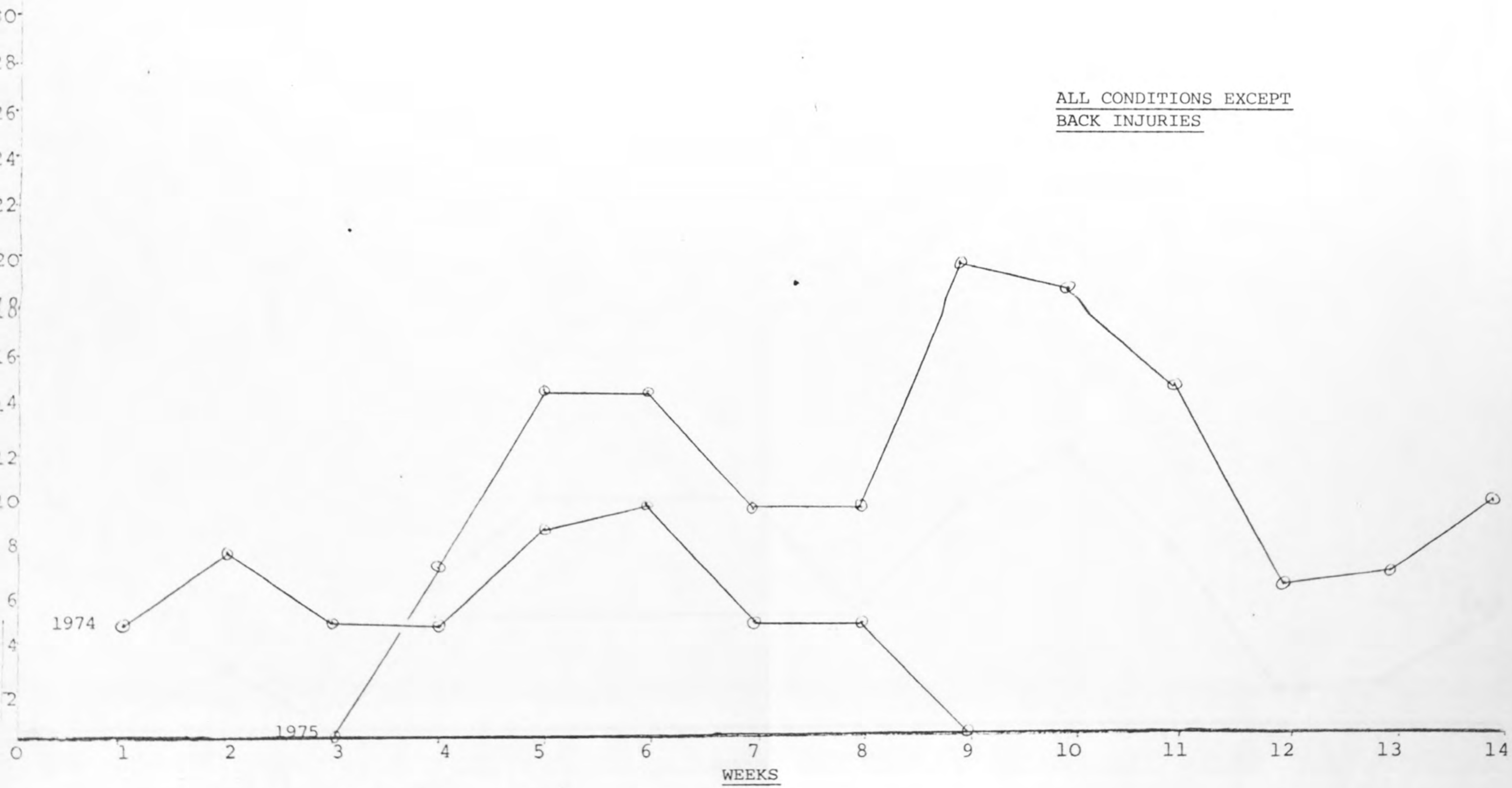


GRAPH NO A5

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 31 men physiotherapy restricted) non-physiotherapy related (Total days lost = 52)
1975 - 31 men with physiotherapy) absences excluded (Total days lost = 133)

ALL CONDITIONS EXCEPT BACK INJURIES

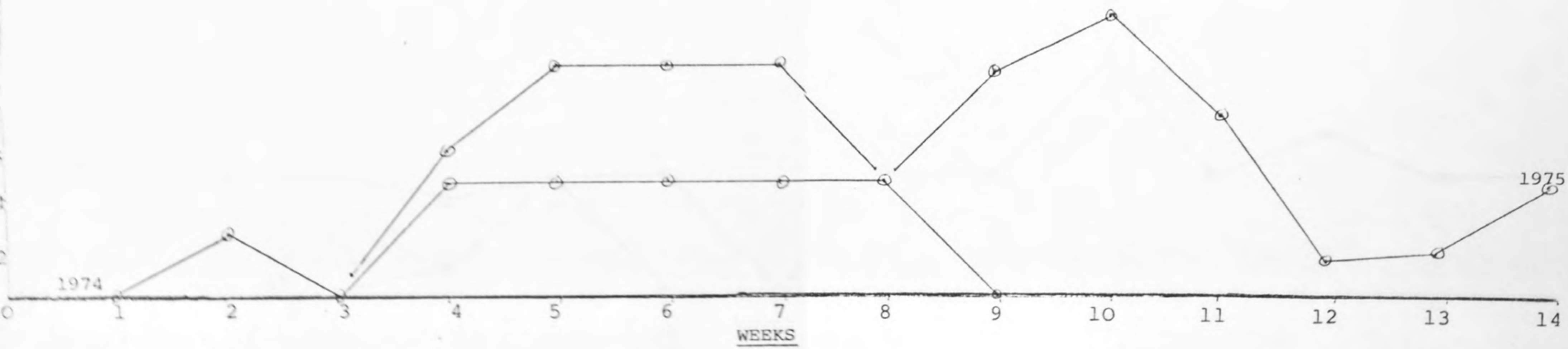


GRAPH NO A6

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 10 men physiotherapy restricted) non-physiotherapy related (Total days lost = 28)
1975 - 10 men with physiotherapy) absences excluded (Total days lost = 80)

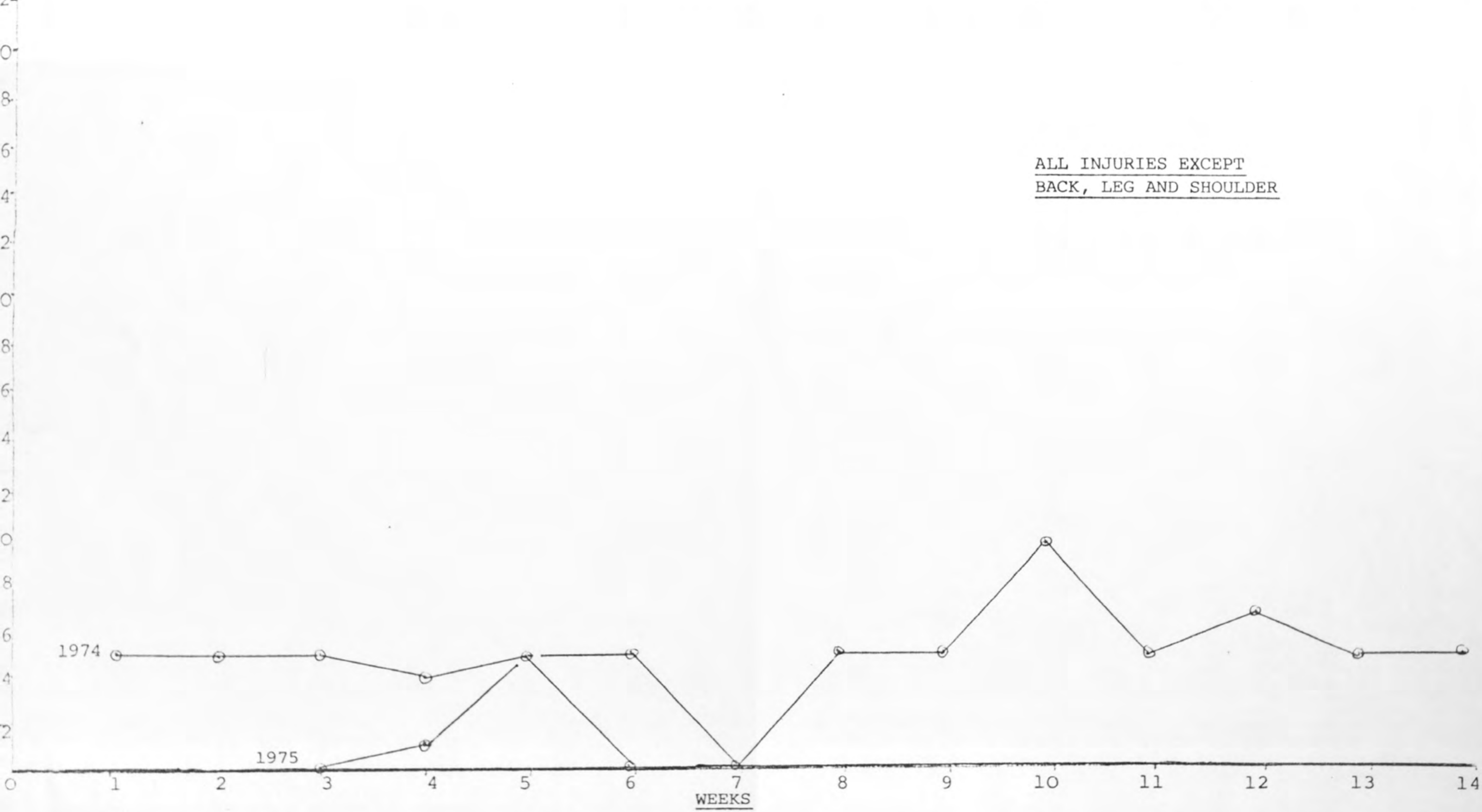
LEG INJURIES ONLY



GRAPH NO A7

TOTAL ABSENCE FOR FACTORY MEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 13 men physiotherapy restricted) non-physiotherapy related (Total days lost = 24)
1975 - 13 men with physiotherapy) absences excluded (Total days lost = 53)



APPENDIX 7

GRAPHS OF ABSENCE FOR FACTORY WOMEN

Factory Women

Graph A8		No. of Women
A8	All conditions except back injuries	22

Graphs A9-All (non physiotherapy related absences excluded)

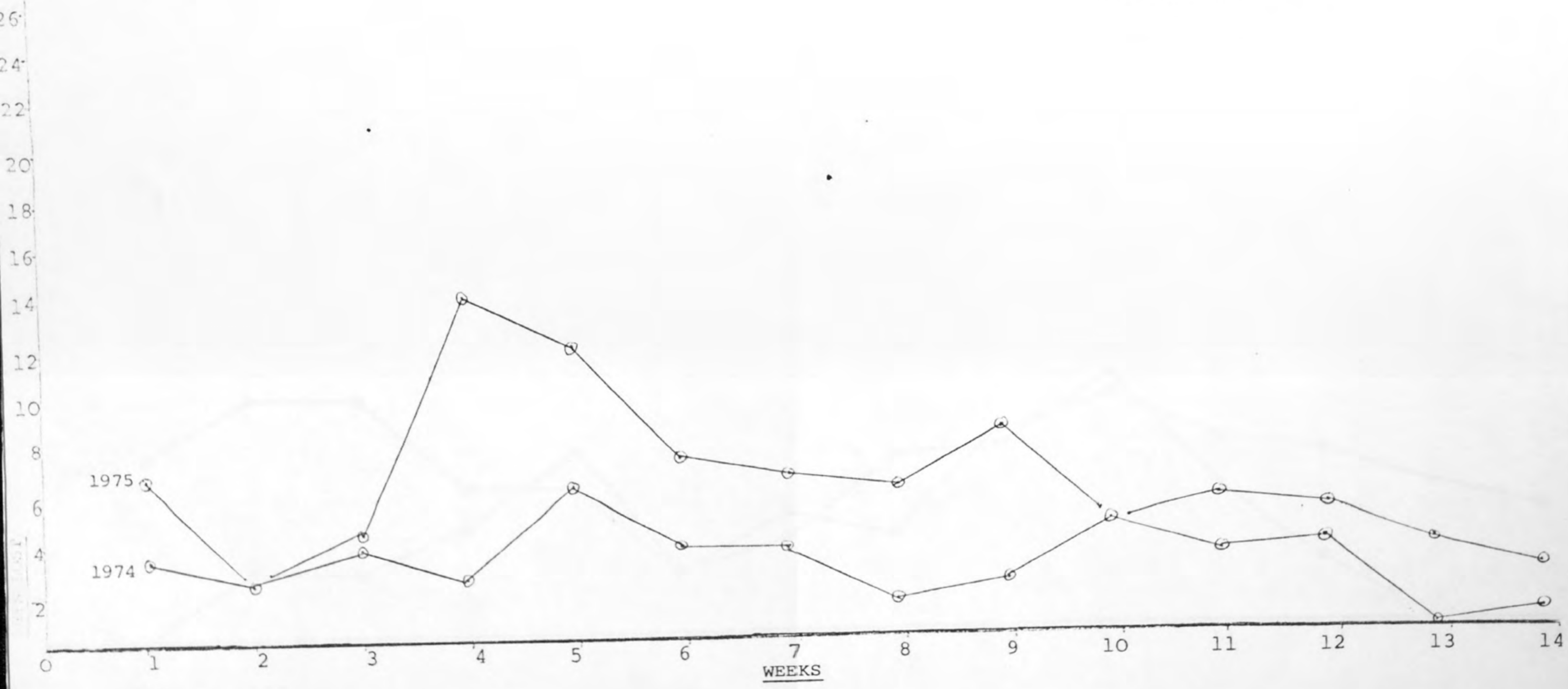
A9	Total absence	33
A10	Back injuries only	11
All	All conditions except back injuries	22

GRAPH NO A8

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 22 women physiotherapy restricted (Total days lost = 44.5)
1975 - 22 women with physiotherapy (Total days lost = 94.5)

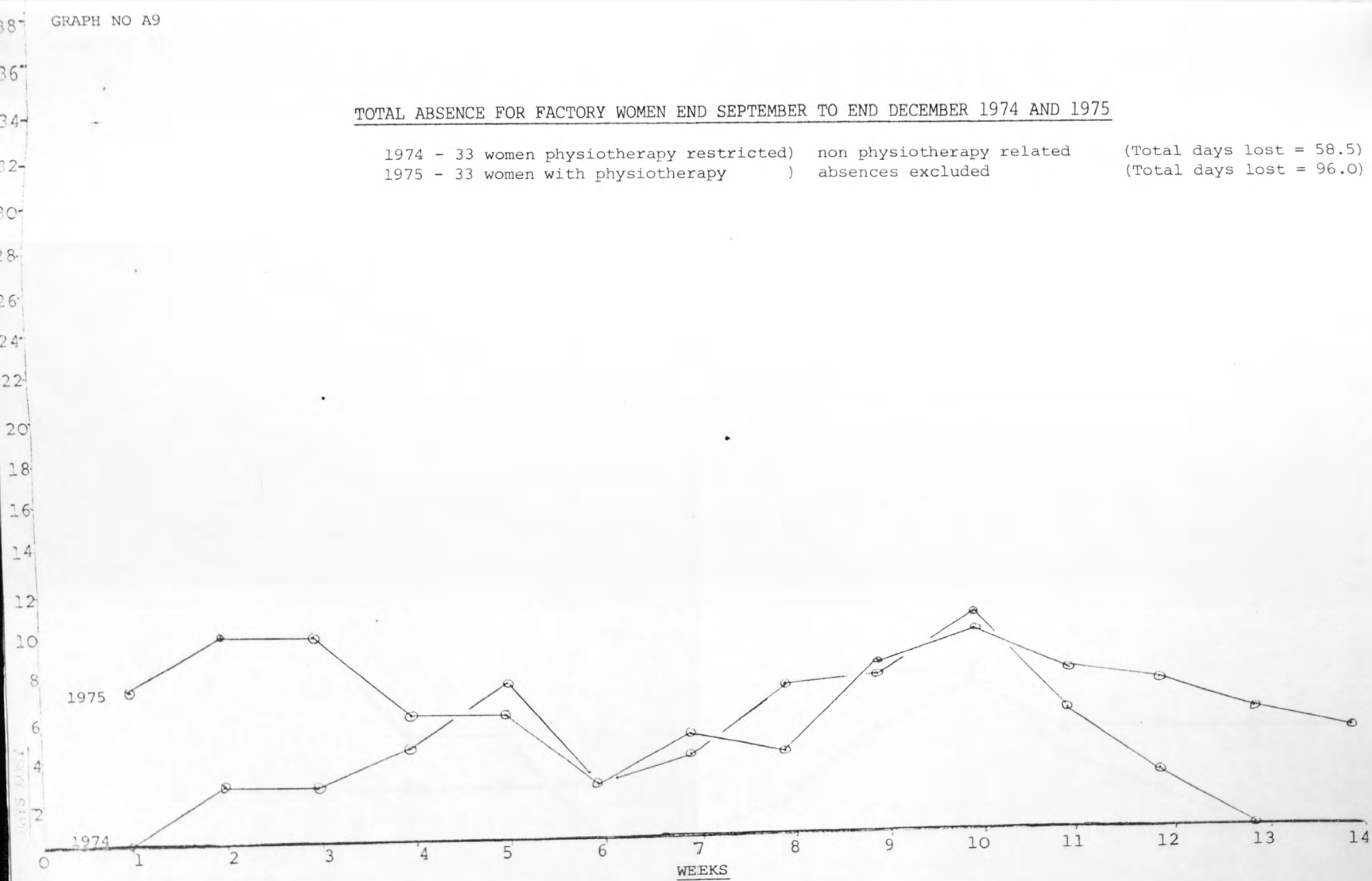
ALL CONDITIONS EXCEPT BACK INJURIES



GRAPH NO A9

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 33 women physiotherapy restricted) non physiotherapy related (Total days lost = 58.5)
1975 - 33 women with physiotherapy) absences excluded (Total days lost = 96.0)

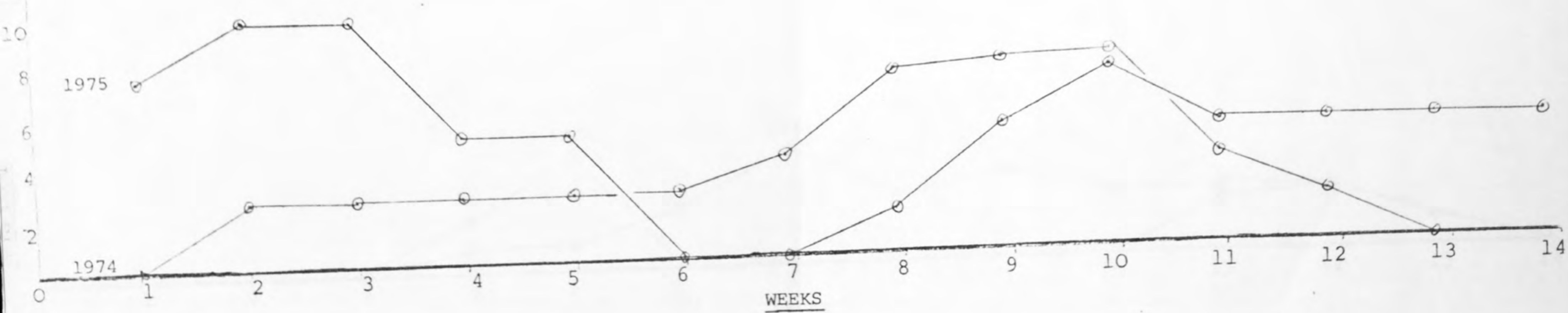


GRAPH NO A10

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 11 women physiotherapy restricted) non physiotherapy related (Total days lost = 45.5)
1975 - 11 women with physiotherapy) absences excluded (Total days lost = 71.5)

BACK INJURIES ONLY

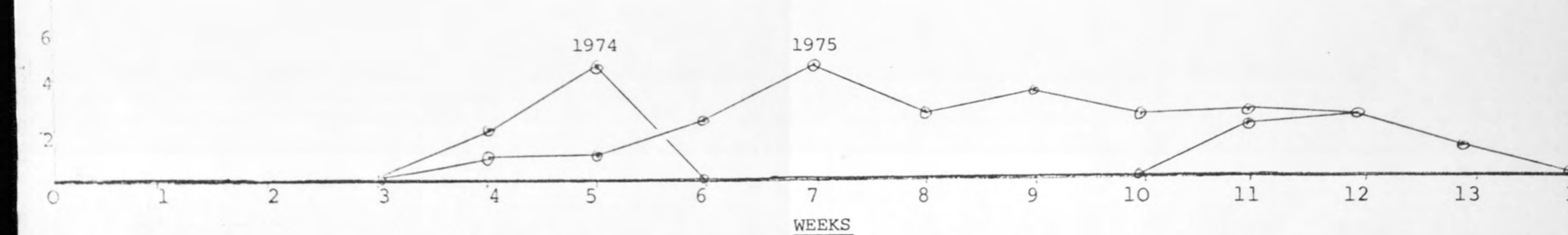


GRAPH NO A11

TOTAL ABSENCE FOR FACTORY WOMEN END SEPTEMBER TO END DECEMBER 1974 AND 1975

1974 - 22 women physiotherapy restricted) non physiotherapy related (Total days lost = 1
1975 - 22 women with physiotherapy) absences excluded (Total days lost = 2

NON BACK CONDITIONS ONLY



APPENDIX 8

CADBURY LIMITED

MEN'S APPLICATION FORM

DATE.. JOB APPLIED FOR..

CHRISTIAN NAMES .... (In capitals) | SURNAME.. (In capitals)

PRESENT ADDRESS .... (In capitals)

HOME ADDRESS .... (If different from above)

Date and year of birth	PRESENT AGE	(production of your Birth Certificate will be required after engagement for Pension Fund purposes)
....	....	

Are you Married, Single or Widower	If you have children give their ages	Nationality
....	....	....

School attended ....

Have you passed any examination or served an apprenticeship? If so give particulars..

....

Are you a Registered Disabled Person?

NATIONAL SERVICE

(1) Were you in the Army, Navy or Air Force?..

(2) For how long?..

(3) Duties and any rank attained ....

PRESENT EMPLOYER	LENGTH OF SERVICE DATES FROM - TO	NATURE OF WORK	REASON FOR LEAVING
....	....	....	....
PREVIOUS EMPLOYER			
....	....	....	....
....	....	....	....

Have you been employed by us before? (Answer Yes or No) ....

	NAME	RELATIONSHIP	DEPT. (If known)
Are any of your relatives employed by this Firm? If so give particulars	....	....	....
	....	....	....
	....	....	....

I certify that all particulars given by me are correct.

Signature ....

FOR OFFICE USE ONLY

Starting	Department	Wages	Nature of work	Index Number
				S 7319 C

SURGERY REPORT

THIS SECTION WILL BE COMPLETED BY OUR OWN DOCTOR

D

SURGERY REPORT (This section will be completed by the Bournville Medical Department) :

This applicant is fit / unfit / fit with reservations for..work

Height..........................ft...........................in. Eyesight L.................... R....................

Weight..........................st. ....lb. With glasses L.................... R....................

Details of reservations (tick any which apply)

No night work	
No shift work	
Part-time work	
Sedentary work	
Semi-Sedentary work	
Light work	
Moderate work	
No close work	
No machine work	
No hot work	

No dusty work	
No belt work	
No lifting	
No trolleying	
No food handling	
No oil handling	
No grease handling	
No glue handling	
No chocolate handling	
No water handling	

Any other comments : ....

....

....

This applicant should / need not be re-examined before transfer to other work

Date.. *Doctor's Signature*..

Please complete this side and sign on the back of the form. **A**

CADBURY LIMITED

FACTORY APPLICATION FORM (Women over 18)

I. PERSONAL PARTICULARS

SURNAME (in capitals) .... CHRISTIAN NAMES (in capitals) ....

PRESENT ADDRESS	HOME ADDRESS (if different)
....	....
Tel. No.	

AGE	Date and year of birth (if engaged by Firm birth certificate will be required)	Married, single or widow
....	....	....

If married, where does your husband work? ....

Ages of children (if any) ....

Have you any relations working at Cadbury Limited. If so, give names and departments

....

Have you been employed by Cadbury Limited previously? If so, state department and date of leaving, and maiden name if married ....

Are you a Registered Disabled Person? ....

II. EDUCATION (part-timers need not complete this section)

Name of school(s) attended .... Age at which you left school ....

Give further particulars, if any, about education, training, experience or spare time interests

....

III. PRESENT AND PREVIOUS EMPLOYMENT Name of Firm	Length of Service Dates From	 To	Job	Wages	Reasons for leaving
1					
2					
3					
4					
5					
6					
7					

FOR OFFICE USE ONLY

WORK for which suitable	Hands	T.U.	Test Results

Interviewer	Decision	Date of Starting	Terms of Employment	Department	Index No.

I certify that all particulars given by me are correct

Date.. Signed..

Please do not fill in below this line.

SURGERY REPORT (This section will be completed by the Bournville Medical Department):

This applicant is fit / unfit / fit with reservations for..work

Height..........................ft...........................in. Eyesight L.................... R....................

Weight.......................st. ....lb. With glasses L.................... R....................

Details of reservations (tick any which apply):

No night work	
No shift work	
Part-time work	
Sedentary work	
Semi-Sedentary work	
Light work	
Moderate work	
No close work	
No machine work	
No hot work	

No dusty work	
No belt work	
No lifting	
No trolleying	
No food handling	
No oil handling	
No grease handling	
No glue handling	
No chocolate handling	
No water handling	

Any other comments:...

....

....

This applicant should / need not be re-examined before transfer to other work.

Date.................................... Doctor's Signature..

V. DENTIST'S REPORT

Condition of teeth ....

Signed.. Date..................................

FURTHER ACTION:

Date	

Please complete this form in your own handwriting

CADBURY BROTHERS LIMITED

JUNIOR APPLICATION FORM (FACTORY)

PERSONAL PARTICULARS

SURNAME (in capitals) .... CHRISTIAN NAMES (in capitals) ....

ADDRESS ....

Parents surname and address (if different from your own) ....

Tel. No. .... AGE .... Date and year of birth ....
(if engaged by Firm your birth certificate will be needed)

Are you a Registered Disabled Person ? ....

SCHOOL(S) Give the name(s) of the School(s) you have attended	Date of leaving
....	....
....	....
....	....

EMPLOYMENT If you are now or have been employed, give particulars here:

Name of Firm	Dates From	Dates To	Job	Wages	Reasons for Leaving
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....

FAMILY

(1) Are any of your relatives employed by this Firm ? If so give particulars ....

....

(2) What is your father's employment ? (If he is not working at Bournville) ... .

OUTSIDE INTERESTS

(1) What games do you play ? (Indicate standard reached, e.g. School, Club teams) ....

(2) What are your main spare time interests ? ....

(3) Give the name of any organisation or club to which you belong

I certify that all particulars given by me are correct.

Date .... Signed ....

FOR OFFICE USE ONLY

Result of I.T. ....
Maths ....
English ....

Work for which suitable	Hands	Rate of pay

Interviewer	Decision	Date of Starting	Terms of Employment	Department	Index No.

DO NOT FILL IN ANYTHING IN THE SECTIONS BELOW, WHICH ARE FOR COMPLETION BY THE FIRM'S DOCTOR AND DENTIST

SURGERY REPORT

SURGERY REPORT (This section will be completed by the Bournville Medical Department) :

This applicant is fit / unfit / fit with reservations for...work

Height..........................ft..........................in. Eyesight L..................... R.....................

Weight..........................st. ....lb. With glasses L..................... R.....................

Details of reservations (tick any which apply)

No night work	
No shift work	
Part-time work	
Sedentary work	
Semi-Sedentary work	
Light work	
Moderate work	
No close work	
No machine work	
No hot work	

No dusty work	
No belt work	
No lifting	
No trolleying	
No food handling	
No oil handling	
No grease handling	
No glue handling	
No chocolate handling	
No water handling	

Any other comments: ....

....

....

This applicant should / need not be re-examined before transfer to other work

Date.. *Doctor's Signature*..

DENTIST'S REPORT

Condition of teeth ....

Signed.. *Date*...............................

SCHOOL REPORT ....

....

....

....

....

....

S 6971 C

FURTHER ACTION:

APPENDIX 9

Personal Health Form
Cadbury Limited

Private and Confidential

Date

Surname (Capitals)

Forenames

Address

Date of birth | Place of birth | No. of years in U.K.

Other countries visited

General Practitioner

Relatives employed on this factory site

Nearest relative and address

Living: in own home/in lodgings
(circle one) in bedsitter/other

Single/Married/Separated
Widowed/Divorced (circle one)

	Live	Died
Father		
Mother		

	No. Live	No. Died
Brothers ..		
Sisters ...		
Boys		
Girls		

Have any of your family suffered these complaints?

	Yes	No
Pulmonary T.B.		
Diabetes		
Epilepsy		
Heart Attacks		
Strokes		
Blood pressure (high)		
Mental illness		

	Yes	No
Do you smoke?		
If no - did you ever		
If yes - is it:-		
Pipe		
Cigars		
Cigarettes		
Less than 10 a day		
10 - 20 a day		
20 - 40 a day		
over 40 a day		
Do you drink?		
Occasionally		
Regularly		
Have you ever worked in:-		
Coal mines		
Other mines		
Metal manufacture		
Foundries		
Chemical industry		
Rubber industry		
A noisy place		
Have you ever worked with:-		
Mineral oils		
Asbestos		
Radio active materials		
Have you ever worked on:-		
Shift work		
Permanent night work .		

HAVE YOU EVER HAD	Yes	No
Allergy (of skin) .		
Anaemia		
Arthritis		
Asthma		
Athletes foot		
Attacks of diarhoea		
Back troubles		
Bilious attacks ...		
Blackouts		
Bronchitis		
Catarrh		
Deafness		
Depression		
Diabetes		
Ear trouble (inflammation or abscess or discharge)		
Easily tired		
Eczema		
Frequent colds		
Gall bladder trouble		
General debility ..		
Giddy spells		
Hay fever		
Headaches		
Heamophilia		

	Yes	No
Hearing trouble		
Heart trouble		
Hernia (Rupture) ...		
Blood Pressure		
Inability to sleep .		
Jaundice		
Kidney trouble		
Malaria		
Mental trouble		
Migraine		
Nose trouble		
Palpitations		
Peptic ulcer		
Piles		
Pleurisy		
Pneumonia		
Rheumatic fever		
Sensitivity to drugs		
Sinusitis		
Skin trouble		
Stomach ache		
Stomach ulcers		
Throat trouble		
Thyroid trouble.....		
Tropical disease ...		
Tuberculosis		
Urinary difficulty .		
Varicose veins		

Do you have any difficulty:

Walking		
Bending		
Sitting		
Standing		
Lifting		
Climbing stairs ...		

Are you at present:-

Attending your doctor		
Attending Hospital		
Registered Disabled		

Signature ....

What fractures, injuries or operations have you had?
....
....
....
....
....

What tablets or medicines are you taking at present?
....
....
....

Body build

Height	
Weight	

Vision

	L	R
Glasses distance		
Glasses close		
No glasses distance		
No glasses close		

Stereosette (Tick = pass
X = fail)

1	2	3	4	5	6	7	8	9

	Yes	No
Colour deficient		
Eyes unequal		
Infection		
Discharge		
Heamoglobin estimate inadequate		

______ % ______ G

Melanin (tick one)

V.Light	Light	Med.	Heavy

Ears

		Yes	No
Drums obscured	R		
	L		
Drums unhealthy	R		
	L		

....

....

Mouth

Ref. to dentist		
Inadequate bite		
False teeth		
Throat unhealthy		
Tonsils absent		

C.V.S.

B.P. ________ Pulse ________

....

....

Resp. X-ray date:- ....

	Pred.	Test
Vital. FEV 1.0		
FVC		

....

....

....

Upperlimbs	Yes	No
Nails bitten		
Nails dirty		
Nail beds unhealthy		
Infection		
Nicotine stains		
Grip poor		

....

....

Spine	Yes	No
Injuries		
Abnormal curves		
Can't touch toes - If 'yes' why?		

....

....

Skin	Yes	No
Abnormal		
Dry		
Any sepsis		
Any disease		

....

Lower Limbs	Yes	No
Step on stool		
V.V's		
Ankle swelling		
Corns		
Bunions		
Deformities		

....

Abdo ....

....

....

....

Diarrhoea	Yes	No
Typhoid		
Paratyphoid		
Dysentry		
Recurrent attacks of diarrhoea		
Gastro-enteritis ...		
Blood in stools		

....

....

G.U.	Yes	No
Urine		
Albumin		
Sugar		
Dysuria		
Frequency		

....

....

Periods	Yes	No
Menarche age		
On Pill		
Painful		
Off school/work with		
Irregular		
Heavy (Clots)		

Date of last ________

....

	Yes	No
Does the applicant seem unstable?		
If 'yes' is there:-		
Nervous twitching ..		
Blushes		
Easy weeping		
Rapid pulse		
Overbreathing		
Wild look		
Faints		
Fits		
Epilepsy		

Reservations	Yes	No
Night work		
Shift work		
Part time work		
Sedentary work		
Semi-sedentary work ..		
Light work		
Moderate work		
Close work		
Machine work		
Hot work		
Dusty work		
Belt work		
Heavy lifting		
Lifting		
Trolleying		
Noisy work		
Oil handling		
Chocolate handling		
Grease handling		
Food handling		
Water handling		

Comments:- ....

....

....

....

Fit/unfit/Fit with reservations for ....

.... work

This applicant must / need not* be examined before transfer to other work. *Unless illness or accident intervene.

Date:- .... Signed:- ....

8/73/5000

SHORT PERSONAL HEALTH FORM

CADBURY LIMITED

Private and Confidential

Surname (Capitals)	Christian/Forenames	Date of Birth
Address	Other countries visited recently	
Next of kin and address	Family Doctor/General Practitioner	

Are you having any treatment, tablets or medicines from a doctor or hospital? Do you take any other tablets or medicines? * Yes / No

If 'Yes' give details:

What fractures, injuries or operations have you had?

Do you have difficulty, or are you likely to have difficulty doing any of the following continuously or for long periods?

*	Yes	No
Walking		
Bending		
Sitting		

*	Yes	No
Standing		
Lifting weights		
Climbing stairs		

Have you ever had any of the following:

*	Yes	No
Allergy to drugs		
Arthritis		
Asthma		
Attacks of diarrhoea		
Back troubles		
Blackouts		
Blood pressure		
Bronchitis		

	Yes	No
Diabetes		
Ear trouble or deafness		
Gall bladder trouble		
Hay fever		
Heart trouble		
Hernia (rupture)		
Kidney trouble		
Mental trouble		

	Yes	No
Palpitations		
Rheumatic fever		
Skin trouble		
Stomach ulcers		
Thyroid trouble		
Tuberculosis		
Varicose veins		

Are there any other matters concerning your health which could affect your work in a food factory? * Yes / No

If 'Yes' please say what at your examination.

Signed Date

* Tick the appropriate box indicating 'yes' or 'no'.

Body build
Height
Weight

Vision

	L	R
Glasses distance		
Glasses close		
No glasses distance		
No glasses close		

Stereosette (Tick = pass X = fail)

1	2	3	4	5	6	7	8	9

	Yes	No
Colour deficient		
Eyes unequal		
Infection		
Discharge		
Heamoglobin estimate inadequate		

_____ % _____ G

Melanin (tick one)

V.Light	Light	Med.	Heavy

Ears		Yes	No
Drums obscured	R		
	L		
Drums unhealthy	R		
	L		

....
....

Mouth		
Ref. to dentist		
Inadequate bite		
False teeth		
Throat unhealthy		
Tonsils absent		

C.V.S.
B.P. ________ Pulse ________
....
....

Resp. X-ray date:- ....

	Pred.	Test
Vital.		
FEV 1.0		
FVC		

....
....
....

Upperlimbs	Yes	No
Nails bitten		
Nails dirty		
Nail beds unhealthy		
Infection		
Nicotine stains		
Grip poor		

....
....

Spine		
Injuries		
Abnormal curves		
Can't touch toes - If 'yes' why?		

....
....

Skin		
Abnormal		
Dry		
Any sepsis		
Any disease		

....

Lower Limbs		
Step on stool		
V.V's		
Ankle swelling		
Corns		
Bunions		
Deformities		

Abdo ....
....
....
....

Diarrhoea	Yes	No
Typhoid		
Paratyphoid		
Dysentry		
Recurrent attacks of diarrhoea		
Gastro-enteritis ...		
Blood in stools		

....
....

G.U.	Yes	No
Urine		
Albumin		
Sugar		
Dysuria		
Frequency		

....
....

Periods		
Menarch age		
On Pill		
Painful		
Off school/work with		
Irregular		
Heavy (Clots)		

Date of last ________
....

Does the applicant seem		
unstable?		
If 'yes' is there:-		
Nervous twitching ..		
Blushes		
Easy weeping		
Rapid pulse		
Overbreathing		
Wild look		
Faints		
Fits		
Epilepsy		

Reservations	Yes	No
Night work		
Shift work		
Part time work		
Sedentary work		
Semi-sedentary work ..		
Light work		
Moderate work		
Close work		
Machine work		
Hot work		
Dusty work		
Belt work		
Heavy lifting		
Lifting		
Trolleying		
Noisy work		
Oil handling		
Chocolate handling		
Grease handling		
Food handling		
Water handling		

Comments:- ....
....
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....

Fit/unfit/Fit with reservations for ....
.... work

This applicant must / need not* be examined before transfer to other work. *Unless illness or accident intervene.

Date:- .... Signed:- ....

12/73/1000 P/200 B

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