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ACTUARIAL ASPECTS OF LONG-TERM SICKNESS INSURANCE

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PART I—INTRODUCTION

THE development of sickness insurance of the type dealt with in this paper has been a long process, commencing in a tentative fashion, probably a century ago, in Europe. In 1900, E. Hamza, at that time actuary of a Russian insurance company, contributed to the Third International Congress a paper[1] of interesting historical significance which is clearly based on long experience in Germany. In his paper he developed an approach fundamentally different from the traditional British approach. British methods—which can be described with complete adequacy at this stage as a continuation of Friendly Society actuarial technique—have stood the test of time for at least 150 years and it is the purpose of this paper to analyse the two lines of development; to pose the question of their efficacy in the future; and to outline alternative methods depending on modern mathematical techniques.

2. This class of insurance business may be defined as the provision of income whilst the insured is sick (whether expected to recover or not) on a long-term basis. Normally, benefit would not be provided beyond the age of retirement. If premiums are duly paid, a policy cannot be cancelled by the insurance company. Whether these benefits are attached to life policies or not, they come within the scope of the paper. Except in the case of group insurance, premiums are normally on an annual rather than a single premium basis. It is possible, though unusual in the U.K., that the benefit under a long-term policy in respect of a continuous attack is limited by the policy conditions to five years or some shorter period. The policy however can be kept in force, to cover attacks from a different cause, up to the defined expiry date of the policy. Such policies are quite common in North America, and form an important element in the investigation of sickness experience there. They come within the scope of the paper, in contradistinction to short-term policies. For the most part short-term policies not only provide benefits for a strictly limited period (perhaps 52 or 104 weeks) but can be cancelled at any renewal date at the option of the company. There is a large and important market in such contracts, and they involve techniques rather different from those discussed in this paper.

3. Sickness is defined in the policy. The considerations which govern the framing of the definition of sickness were discussed by D. J. Bond in a Students' Society paper.[2] He pointed out that the definition must be tightly drawn, and went on to say that incapacity must be 'total and complete'. The insured must

be unable to follow, even partially, his 'own occupation' or, under some contracts, 'any occupation'. If the definition refers to 'own occupation', the position if the insured engages in another occupation, after total incapacity from following his own occupation, must be laid down. It is important to consider the effect of retirement, for any reason, before the terminating date of the policy. Bond also drew attention to the importance of defining clearly the period for which benefit is paid, and discussed the maximum proportion of normal gross earnings which the policy conditions should allow.

4. Since 1963, when the paper was written, partial disability benefits have been introduced in some United Kingdom policies. Bond was not concerned with practice in other countries; in certain countries partial disability benefits have been provided for many years. It is therefore appropriate to discuss these benefits in the present paper, as well as a further variation of normal income benefits. Lump sum benefits are required in special situations and the principles which should be applied have not, it seems, yet been discussed in actuarial literature.

5. Before embarking on the main theme of the paper, it is helpful to set the scene from the commercial standpoint. Conditions in the U.K. are changing fairly rapidly with the entry into the market of a comparatively large number of life offices within the past ten years or so. In the background is a factor which is of fundamental importance. The history of the business in the United States was disastrous. E. E. Rhodes, in his paper to the Institute in 1932[3] ascribed this to unsatisfactory underwriting in the period immediately before the slump of 1929 including the granting of cover unrelated to earnings. We must remember however that some companies survived in a relatively sound state. Modern conditions in this country provide a considerable safeguard—in contrast to the state of affairs in the U.S.A., a continuous medical record of the proposer is almost invariably available and the standard of reporting is, from the insurer's point of view, high. Underwriters now know what to look for, and write the business with skill sharpened by experience. There remains nevertheless the overall risk associated with the underwriting picture—economic depression on a widespread scale. The result of depression, in particular a high unemployment rate, is that some of those who are just about fit to resume gainful employment after a period of sickness cannot do so; the distinction between unfitness for work on medical grounds (especially nervous or psychosomatic disability) and unfitness on social grounds is blurred. Simultaneously, in a slump the margins on the assets side of the insurance operation dwindle. The correct attitude to fears of a repetition of such conditions is not to dismiss them, but to recognize the extent to which they were ignored when disaster struck the business before. Thus if the actuary takes it upon himself to provide against the contingency of economic depression, which many would consider rather less severe as economic sophistication develops, there is less hesitation to begin operations. It should be mentioned that it is the practice to exclude war risks. There is a further safeguard which can be applied for group single premium business: it is customary to guarantee the scale of premiums for only a limited

period, typically five years. The long-term commitment, as will be explained later, would then be limited to claims actually in course of payment on cancellation of the scheme by the employer.

6. It is important to note that Friendly Societies continue to offer cover, as they have done over a very considerable period, under long-term sickness policies. For much the same reasons that influence the treatment of industrial assurance and ordinary assurance separately in actuarial papers, it is not possible to deal adequately with Friendly Society contracts in the present paper. Recent developments in the U.K. market would have been precariously based had actuaries not received training in Friendly Society work, however. And it is essential to draw on the experience of colleagues dealing with practical problems of Friendly Societies to conduct sickness insurance properly.

7. Many of the safeguards inherited from experience of Friendly Societies have now been modified. The 'waiting period' in the Friendly Society sense describes the initial period, of six months or a year after entry, during which a member is ineligible for benefit. In long-term sickness, however, the phrase no longer relates to the machinery of initial selection, but is used by insurance companies in a different sense. Most policies include a condition that the first few weeks, or months, of each attack of disability do not attract benefit. It is the period specified in this condition that is now known as the 'waiting period'. Again, there is in most policies written today no reduction of benefit once so many weeks' benefit have been paid—but Robertson[4] refers to this as a common feature of insurance policies in the 1930s. The intention remains—that the insured should have a financial inducement to resume work if he can. By linking the maximum amount of benefit to the earnings level just prior to disability (or its equivalent after allowing for changes in the cost of living) the object is achieved without the hardship which would undoubtedly be inflicted by reduction of benefit under modern conditions.

8. A most important problem for insurers—and a problem to which past traditions hardly supply the answer—is supervision of claims. Some of the difficulties can arise from bad underwriting, perhaps including a poor assessment of the occupational risk. Bond lists the details of claims procedure and clearly the inquiries he recommends may disclose features which were unexpected at the time the proposal was underwritten. Relations between an insurance company and its policyholders are typically business relationships; but the period of a claim is obviously more testing than the ordinary routine of renewal. Claims supervision requires the enlightened attitude of a professional about his work. Today it may hardly be possible to detect the traces of a 'friendly society spirit', but that is not to say that humanity is lacking, nor that the doubts and difficulties of borderline cases and malingering have disappeared under a tide of scientific medicine.

9. It is clearly to be expected that the expansion of the market will be accompanied by requests for new forms of cover; noteworthy recent developments from the point of view of actuarial technique are renewable single premium group

sickness schemes and medium term contracts providing for a substantial benefit —sometimes a lump sum—to be paid on disability of a key man. Group schemes well illustrate the special responsibilities of the actuary in relation to the business as transacted by an insurance company. It is clear that a single premium scheme—closely analogous to a group life scheme costed on a single premium basis—is vulnerable to withdrawal. For obvious business reasons, the office must undertake, on withdrawal of the main scheme, to continue paying benefits actually current on the day the 'healthy' lives are withdrawn. Benefits continued on this basis cease at the end of the current attack. The 'key man' contracts, though unusual, may be considered as the answer to legitimate insurance needs which offer technical difficulties because the demands for such policies are few, but often come from an important source. The problems will be discussed later in the paper.

PART II—THE RESPONSIBILITY OF THE ACTUARY

10. The natural starting point in considering the responsibility of the actuary is the legal position, which has comparatively recently been clarified by the Companies Act, 1967. Section 59(6) has the effect of including sickness and accident policies 'being contracts that are expressed to be in effect for a period of not less than five years or without limit of time . . .' in the class of 'ordinary long-term insurance business'. Thus the provisions of the Insurance Companies (Accounts and Forms) Regulations, 1968, which apply to life assurance also apply to the class of sickness business discussed in this paper. Actuarial valuations are required, at least every triennium, on bases to be specified by the actuary. He must include specific reference to 'the extent to which account has been taken of the nature and term of the assets available to meet the liabilities valued'. The precise adaptations of the forms given in the various schedules to these regulations, to meet the case of sickness business, have yet to be developed more fully by those responsible for making returns under the Act. One question which arose from the wording of the Act concerns contracts issued, for example, under group schemes but covering a group of persons one or more of whom will reach the maximum age specified in the contract in less than 5 years. It is understood that the Department of Trade and Industry would raise no objections to the whole group contract being classified as long-term business.

11. The actuary must examine the adequacy of premiums. This involves ensuring that they cover the following aspects of the risk. First, the possibility that the general future trend of claims will be to increase. It is not possible to give statistics drawn from insurance companies' experience to show the trend, but the phenomenon is mentioned in the Report by the Government Actuary on the Financial Provisions of the National Insurance (No. 2) Bill, 1969 (Cmnd. 4074), which states:

> The increase in sickness claims during the past six years has been referred to in the reports on previous National Insurance Bills. The extent of the increase may be broadly illustrated by

comparing the costs of sickness benefit year by year, after eliminating the cost of increases in rates of benefit and of earnings-related benefits.

The following table is extracted from this part of the Report:

Year	Percentage change in cost over previous year if rates of benefit had not changed
1962–63	+3
1963–64	+2
1964–65	+2
1965–66	+7
1966–67	−2
1967–68	+7
1968–69	+3 (provisional)

One cannot deduce that insurance companies, which concentrate on benefits payable after a waiting period, often of six months, would be guided much by the absolute values of these figures. The same factors are at work but may have a different effect. Influences which tend to increase claims are (i) the increasing financial security of the individual (benefits in earlier days having been less than adequate for comfort in illness), inducing a tendency to postpone resumption of work in convalescence; (ii) reduced mortality, which adds to the disabled population because some of the lives saved after suffering a serious accident or illness do not fully recover, and which has the further effect of maintaining the disabled population at a higher level after benefit has started; and (iii) in the case of employed persons, greater insistence by employers on good standards of health among their staff. Counterbalancing tendencies are (i) improving medical techniques which may work in the opposite direction to (ii) above by aiding recovery; (ii) better working conditions; (iii) advances in underwriting experience which have improved the selection of risks; and (iv) inflation, which tends to diminish the attractiveness of prolonged dependence on fixed benefits.

12. An aspect of the premium scale which needs consideration on lines special to this business is the cost of administration of claims. Selection will combine with a comparatively long waiting period to delay maturity of a new portfolio for a number of years. As new business—maybe on an increasing scale—is added to the business in force the cost ultimately attributable to claims tends to be masked. The true situation must be discerned in advance—if new business diminishes or disappears, then as selection wears off and income falls the crude expense ratio attributable to claims administration will rise. Thus one would expect the revenue account of a new portfolio to convey a misleading impression of the cost of administration.

13. The valuation of sickness business on lines discussed by D. J. Bond requires a high degree of actuarial skill. He considered, in the main, a net premium valuation based on a Friendly Society method, using for example adjusted

Manchester Unity tabular rates of sickness[5] combined with a modern mortality table. He said that sickness and mortality bases for valuation could reasonably be identical with the bases for premium calculations. But the actual and expected sickness claims have first to be compared because, if the actual rates significantly exceed the expected, the valuation basis will need amendment. Similar considerations apply to mortality. The rate of interest used must not be more than that used in the calculation of the premiums, and a loading loss may indicate that the valuation basis is too stringent.

14. Actuaries are in short supply; this is particularly true, in relation to the volume of business transacted, in North America. For this reason, perhaps, opinion outside the U.K. seems to have been influenced by American arguments that 'current attack' reserves should be set up in relation to each life actually entitled to draw benefit at the valuation date, and 'future attack' reserves should, in addition, be set up for all policyholders. These reserves are somewhat misleadingly called 'disabled life reserves' and 'active life reserves' respectively. The arguments for the system are first, that it stems from the historical development of the business in U.S.A., and second, that it follows what is actually happening. It is hoped to clarify these claims for the system later in the paper. It may seem inappropriate to include the present remarks on the American system in the context of a brief discussion of valuation aspects. However, the main purpose of published American investigations is to set up minimum valuation standards; the American actuary is constrained to approach the problem in the light of tables designed for valuation purposes, just as, under present conditions, the British actuary is constrained to follow methods evolved for Friendly Society work.

PART III—ACTUARIAL MODELS—A BRIEF HISTORY

15. Two streams of development of sickness insurance can be traced back to the early stages of the industrial revolution, one in Britain and the other in the continent of Europe. The British actuarial story starts with Dr Richard Price who, probably in 1789, enunciated a working hypothesis that the proportion of members of a Friendly Society unable to carry out their work was 1/48 up to age 32; from 32 to 42 this proportion increased by a factor of 25%; from 43 to 51 by 50%; from 51 to 58 by 75%; and was doubled (i.e. 1/24) for ages 58 to 64. Neison[6] asserted that the hypothesis was based on the assumption of a close relationship between the sickness risk and the rate of mortality. The interesting fact is that the first sickness function produced was the proportion sick. It is not entirely fanciful to suppose that, in a fully mature computer age, this function once again may occupy a central place in the actuarial scene, and the wheel will then have turned full circle. For if the actuary of the future is able to monitor the exposed to risk and claims at very short intervals by computer, the proportion sick is the link which will indicate the trend of claims.

16. The function 'weeks of sickness per member per annum' seems to have evolved from British investigations which began by comparing actual and

expected sickness according to the Price hypothesis. It certainly appears in a standard table compiled by F. G. P. Neison (the elder) and published in 1846. Neison's experience, curiously enough, was adopted as a standard by the French Government in 1849 but continental thought subsequently does not seem to have developed along the same lines as British.

17. Watson's Manchester Unity experience[5] can, in the light of history, be regarded as a monumental reconstruction and buttressing of an ancient edifice. The main product of Watson's work which is no longer relevant is, naturally, the mortality investigation. It is essential to use the most modern table available when considering what mortality rates to combine with sickness functions. But the detailed investigation of occupational differences in morbidity rates has, unfortunately for the modern actuary, also been overtaken by secular changes; it is almost a miracle, considering the extent of those changes, that any useful rates have survived. The one surviving product of the investigation is the table of sickness rates for the three groups of occupations with the lightest sickness experience—the AHJ rates reproduced for convenience and comparison in Appendix 1 to this paper.

18. One might suppose that Manchester Unity rates refer to a bygone age, and that with modern advances in medicine claims today would be lower. A comparison with the latest figures for the National Insurance Experience, also shown in Appendix 1, serves to demonstrate why many actuaries still consider AHJ rates as a reasonable point of departure. The published figures for the National Insurance Experience 1967–68[7] have been supplemented by figures showing the proportion of days of sickness benefit which relate to the first 168 days of a period of interruption of employment. Those figures, kindly supplied by the Government Actuary's Department, have been used to derive the appropriate columns in the table of Appendix 1. As in all National Insurance statistics, the data for married women relate only to those who were themselves contributing. The 168 days (representing 28 weeks in benefit terms) is related to the earnings-related supplement to sickness benefit which can be paid for 26 weeks after the first two weeks of a period of interruption of employment. There are no earnings-related benefits for the self-employed.

19. Continental thought is historically linked, it would seem, to the idea of disability pensions as distinct from sickness benefits terminable on recovery. Hamza traced the main stream. During the second half of the nineteenth century, miners' provident societies in Germany and Austria had developed sufficiently to form the subject of actuarial investigation, and it was natural that the actuarial function studied was the rate of sickness (i.e. probability of becoming sick) i_x. Corresponding to Dr Richard Price in British history is the German actuary Heym whose graduation formula was based on an arbitrary rate of (permanent) sickness of approximately 1 per mille at age 20 and unity at age 79, so that his 1863 formula was

$$i_{20+x} = 0.001 + \tfrac{1}{50,000}s^x \text{ where } s^{59} = 50,000$$

It follows that the rate of mortality of disabled lives was studied separately in order to derive sickness annuity values. It should be noted that multiple decrement techniques were unknown in 1863, so that the function i_x is a representation of the dependent probability of becoming sick at age x last birthday.

20. The German actuary, Johannes Karup, published a paper in 1876 entitled 'Die neue Theorie der Invaliditäts-Berechnung'.[8] This laid the foundations on which continental developments were based. As mentioned by Bailey and Haycocks,[9] Makeham's 1874 paper developed the fundamental notions of multiple decrement tables and no doubt Karup was indebted to the same great mathematicians as Makeham, if not to Makeham himself. However, the publication of Karup's work coincided with the emergence of the first sickness policies issued by insurance companies in Germany. These were intended to cover the risk of permanent incapacity, and therefore the appropriate model, which Karup's paper set out in detail, involved two decrements, death and invalidity, operating for active lives, and mortality only for disabled lives. The annuities payable to those disabled continued throughout life. There were no improvements however on the techniques applied by the provident societies until Hamza codified the system in 1900.

21. Double decrement methods employed by Hamza were based on the assumption that q_x^I, the probability that an invalid age x will die within a year, is independent of the age at falling sick; he nevertheless recognized the phenomenon of sickness selection and recommended that statistics should be accumulated for studying it. The somewhat heavy algebra in Hamza's paper need not obscure the basic structure which, using a slight modification of the original notation, can be appreciated from Table 1 (the figures are adapted from Hamza's paper, p. 193).

Table 1

	DOUBLE DECREMENT TABLE			SUPPLEMENTARY FUNCTIONS	
	Active lives				
Age	living at exact age x	dying within 1 year	becoming sick within 1 year	Disabled lives living at exact age x	(Aggregate) value of annuity to disabled life from age x
x	l_x^{aa}	d_x^{aa}	$l_x^{aa}i_x$	l_x^{ii}	$\ddot{a}_x^{i}$
20	100,000	623	20	—	9·006
21	99,357	613	23	19	9·252
22	98,721	600	27	39	9·495
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	
DERIVED COMMUTATION FUNCTION	D_x^{aa}			D_x^{ii}	

It should be noted that reverse selection, that is, an increased chance of surviving a further year as a disabled life at age y (say) as the duration of disability already passed increases, was responsible for the phenomenon of sharply increasing annuity values in the last column. The values did not commence to diminish with age until age 43; the underlying aggregate mortality rates decreased with age until age 56. It is important to notice that the value of $\ddot{a}^{i}_{x}$ has no connexion with the values of l^{ii}_{x} because the latter function includes increments as well as decrements.

22. Hamza's formula for the present value to an active life of an annuity of 1 per annum commencing on disability was derived for convenience of calculation rather than to reveal the basic principle; it is as follows:

Let $D_x = D^{aa}_x + D^{ii}_x$ and $\ddot{a}_x = (\Sigma D_x) \div D_x$, etc.

then the required present value for an active life age x, assuming the annuity payments commence at the end of the year in which sickness occurs is

$$\frac{1}{D^{aa}_x}\left(D_x\ddot{a}_x - D^{aa}_x\,\ddot{a}^{aa}_x - D^{ii}_x\,\ddot{a}^{i}_x\right) \quad . \quad . \quad . \quad \text{(i)}$$

In words, the present value provides

an annuity to all lives who survive
less an annuity to active lives who survive as such
less an annuity to those who survived from ages below x as invalid lives.

We require however to ignore this somewhat clumsy result and express the result in the following approximate form:

$$\frac{1}{D^{aa}_x}\sum_{t=0}^{\omega-x} v\,D^{aa}_{x+t}\,i_{x+t}\left(1-\frac{q^{i}_{x+t}}{2}\right)\ddot{a}^{i}_{x+t+1} \quad . \quad . \quad . \quad \text{(ii)}$$

where the use of $q^{i}_{x+t}/2$ implies that deaths and invalidities are uniformly distributed over the year. Hamza used the expression (ii) to demonstrate his formula (i) above, but it was later developments which render expression (ii) the more significant outcome of his work.

23. The initiative passed to the U.S.A. in the early 1900s. Although in America the non-life companies had been transacting sickness insurance for some time, there appear to have been no actuarial studies of their experience prior to this period. Arthur Hunter investigated the experience of fraternal orders; 'The first legal standard for reserves was Hunter's Disability Table and naturally the premiums were based thereon' (Ref. 10, page 6). Dr Hunter was a distinguished actuary; his attainments are summarized in the History of the Faculty of Actuaries[11]—he was a Fellow of the Faculty. The reserves and premiums

referred to are related, however, to benefits attached to life policies, and it is noteworthy that standard tables in the U.S.A. were for many years based on investigation of waiver of premium and disability income benefits attached to life policies. Moreover, the most recent standard table, the 1964 Commissioners Disability Table, still preserves elements of earlier experience although the studies on which it is based and the business to which it applies include disability income benefits issued as a separate class.

24. It is appropriate to consider why it was that double decrement techniques developed by Hunter and others led to valuation procedures which hardly required modification when recoveries were allowed for. Though it is obvious that the 'active' and 'disabled' lives reserves can be valued separately if both classes are only subject to decrements, it is by no means self-evident that a similar procedure is likely to be satisfactory when recoveries complicate the problem. The procedure was however evolved in a gradual fashion. In the first place, the original condition that sickness should be permanent was watered down by competition. In 1929, this was officially recognized by the National Convention of Insurance Commissioners who recommended that disability benefits should be allowed, whether disability was undoubtedly permanent or not, when total disability had continued for a definite period—not less than four months and not more than one year. It was recognized that recoveries would be comparatively frequent, and this led to an investigation of termination rates for disabled lives, whether termination of benefit was due to death, recovery or expiry of the term. In some cases of more recent date, benefit terminates after five years, or even two years, of disability. Long use of active and disabled life reserves, and the relatively inexpensive benefits provided as an addition to life policies, inhibited the application of radically new methods. A great number of entries and reversals would have been necessary to identify the active lives, so that an active life reserve was calculated for both active and disabled lives. It is, of course, theoretically essential to provide some form of 'future attack' reserves for lives currently disabled but subject to a force of recovery and then 'future attacks'. The method just described does provide such a reserve. In addition, a reserve must of course be set up for the remainder of the current disability in respect of disabled lives.

25. Practical difficulties forced the American actuaries to develop as quickly as possible a select table of disabled life annuities; this involved termination rates mentioned in the last paragraph. Because monthly benefits were common, a notable problem is the breakdown of the usual approximation $\ddot{a}_x^{(m)} = \ddot{a}_x - [(m-1)/2m]$ for annuities payable $m$thly when the annuity relates to disabled lives and termination rates are varying rapidly with age. The way in which the problem was tackled was to use termination rates for very short intervals in the initial period, followed by termination rates for longer intervals. Originally, after suitable tests, monthly termination rates were used for the first year, and the deferred portion of the annuity was based on annual rates with the ordinary approximation, so that in symbols

$$\ddot{a}^{i(12)}_{[x]} = \frac{1}{12}\left(\sum_{n=0}^{11} v^{n/12} \cdot {}_{n/12}p^{i}_{[x]}\right) + a^{i}_{[x]} - \frac{11}{24} v p^{i}_{[x]}.$$

The modern development of termination rates will be described below.

26. Hunter and Phillips were at great pains to distinguish the modern method (the 'pension fund' method in their terminology) from the Hamza method; but this was occasioned purely by the needs of the practising actuaries for commutation functions in a convenient form. We can today forget the American development of the Hamza method functions as it proved a blind alley. The 'pension fund' method was originally applied as an alternative to Hamza's method, without changing the aggregate form of the disability annuity. As later developed, it restated Hamza's result (ii) in select form. It is this form which has persisted to modern times, and is based on two modifications, namely (a) to allow for benefits commencing immediately on qualifying as 'disabled', and not deferred until the end of the year in which disability occurs, and (b) to allow for monthly benefits. The restated form of expression (ii) in select form is thus:

Present value to an active life aged x of an annuity of 1 per annum commencing on disability and payable monthly

$$= \frac{1}{D^{aa}_{x}} \sum_{t=0}^{\omega-x} v^{\frac{1}{2}} D^{aa}_{x+t} \, i_{x+t} \, \ddot{a}^{i(12)}_{[x+t+\frac{1}{2}]} \qquad . \quad . \quad . \quad \text{(iii)}$$

27. The practising actuary will find various commutation functions in recent American publications (e.g. the descriptive matter of the 1964 Commissioners Table) which enable different types of benefit to be valued. The disadvantage of reproducing them here will already be apparent to present-day readers: the notation I have so far used is not a standard one, and does not properly tie in with international actuarial notation (*J.I.A.* **75**, 121). Although the Society of Actuaries has a standard notation, it was devised before the present international notation had been agreed and no doubt would have been different if the order of publication had been reversed. No standard notation exists in the U.K. for sickness business.

28. It is of interest to restate the classical formulae in continuous form, as integrals. A full discussion of the problem is given in a paper to the Students' Society by K. Medin.[12] The notation of his paper has been modified to bring out clearly the use of select functions, and the important expressions have been derived in Appendix 2. They relate to the value of benefits, and the net premiums are in practice valued on the same basis as would apply to life assurance premiums. The mortality for this purpose is assumed to be the same for active and disabled lives. The expressions derived in Appendix 2 are as follows.

29. If l^{aa}_{x} denotes the number of active lives living at exact age x, $\bar{a}^{i}_{[y]}$ the value of an annuity payable to a life who has just become disabled at age y, and μ^{ai}_{x} the force of falling sick for an active life aged x, then the analogue of expression (iii), § 26, is

Present value to an active life aged x of a continuous annuity of 1 per annum commencing on disability

$$= \bar{\bar{a}}_x = \frac{1}{l_x^{aa}} \int_{t=0}^{\omega-x} l_{x+t}^{aa} \, \mu_{x+t}^{ai} \, \bar{a}_{x+t}^{i} \, e^{-t\delta} \, dt \quad . \quad . \quad . \quad \text{(iv)}$$

Later on, if the initial population was l_x^{aa} active lives and they have now reached age z (or become disabled or died) the value of the benefits, in respect of future disability, to the active population is

$$l_z^{aa} \, \bar{\bar{a}}_z \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(v)}$$

Suppose there are now l_z^{ii} disabled lives. We have to divide them up into small groups of $l_{z,\theta}^{ii} \, d\theta$ lives who became disabled at exact age $x+\theta$ ($\leqslant z$), and the present value of an annuity payable to the end of the current attack (the disabled life reserve) is

$$\int_{\theta=0}^{z-x} l_{(z,\theta)}^{ii} \, a_{[x+\theta]+z-x-\theta}^{i} \, d\theta \quad . \quad . \quad . \quad . \quad \text{(vi)}$$

If μ_x^{ia} denotes the force of recovery at age x, we obtain as the 'future attack' reserve for those now disabled the expression

$$\int_{\theta=0}^{z-x} \int_{u=z}^{\omega} l_{(z,\theta)}^{ii} \, \frac{l_{[x+\theta]+u-x-\theta}^{i}}{l_{[x+\theta]+z-x-\theta}^{i}} \, \mu_u^{ia} \, e^{-(u-z)\delta} \, \bar{\bar{a}}_u \, du \, d\theta \, . \quad . \quad \text{(vii)}$$

30. In a real fund, one would be able (on assumptions discussed in the following paragraphs) to value the 'true active life reserve,' i.e. expression (v), accurately for the actual active population but the advantage of calculating the 'expected' population, according to some chosen initial state of the fund, would be outweighed by the practical disadvantages of complex formulae and a host of underlying assumptions. The disabled life reserve given in expression (vi) is a very important component of the reserve, and similar remarks apply. The reserve for future attacks of disabled lives, expression (vii), is a very small component, depending on future recovery before any further benefits can take effect. It is also too complicated for any but the most general approximations to be used. In practice, the American actuaries use an overstatement of (vii), viz. $l_z^{ii} \, \bar{\bar{a}}_z$. Since l_z^{ii} is the actual disabled population on the valuation date and it is difficult in practice to calculate the 'expected' population arising from the chosen initial state of the fund, the analysis of surplus is a complex task compared with the procedure for Friendly Society methods.

31. It is perhaps tempting to suggest that work should be done to derive a suitable standard table of 'active lives' l_x^{aa} from an observed set of data. The practical obstacles are however formidable. There are thought to be three selective forces at work, viz:

medical selection at outset; selection according to length of waiting period; and selection operating from date of disablement (reverse selection).

32. The effect of medical selection at outset is discussed by Bond. 'First, a policyholder who has held his policy for less than say 2 years cannot be claiming in the "after 2 years" period. Secondly, an insured recently medically selected may well be incapacitated by a minor infection soon after effecting the insurance. He is less likely to be incapacitated by a serious complaint'.[2] Bond concluded from an investigation that the aggregate rates should be increased by 5% for short periods of incapacity, increasing to about 10% for long periods of incapacity to obtain the 'ultimate' rates. Selection according to the length of waiting period is believed to operate in such a way that the proportion sick after six months, for example, would be less for those who had never drawn benefit for their current attack (having a six months' waiting period) than for those who had been on benefit, at the same age, for six months (because they were entitled to immediate benefit under their policies). Scandinavian actuaries allow for this phenomenon (see § 47). Because of the nature of American and British investigations, no conclusive evidence has been produced relating to U.S. and U.K. portfolios. The third kind of selection is well established and clearly illustrated in American as well as British investigations.

33. As has already been explained, the history of actuarial investigation in America is closely bound up with additional benefits attached to life policies. The main contract was the life policy and elaborate methods of dealing with the additional benefits were out of place. The l_x of the total population for valuation purposes—and it was valuation purposes which predominated over other considerations—was the l_x of a standard life assurance experience. Double decrement techniques had to be applied without creating a contradiction in the model, so that the fundamental relationship

$$l_x \text{ (total population)} = l_x^{aa} + l_x^{ii}$$

had to be satisfied.

34. Disabled life annuities were also fundamental to the problem of statutory minimum reserves: thus originally the life table and the disabled life table were the two which mattered. Given also the rate of becoming disabled at age x, l_x^{aa} was arrived at by a process of elimination and did not attract the interest of the actuary. The natural development, when recoveries complicated the problem, was to preserve the link with the total population exposed to risk in the life assurance portfolio. Thus observed sickness rates were related to the exposure of active and disabled lives combined. However, a later study, relating to 'experience under certain ordinary disability benefits between the 1930 and 1950 anniversaries' in U.S.A. was based on an 'active lives' study. The rates so derived were applied to an assured lives population for the purpose of calculating reserves.[13] Sickness benefits provided by social insurance in countries with developed long-term sickness cover are based on observation of rates of sickness for the aggregate population. Friendly Society rates in U.K. have always related to an aggregate population.

35. It is important for the actuary to bear in mind that if the total population is used in calculating single premium rates for sickness benefits, annual premiums derived from dividing by the appropriate annuity function need adjustment for the waiver of premium during sickness. See for example Medin's adjustment. If $\bar{\bar{P}}$ is the annual premium without waiver, then the annual premium with waiver is $\bar{\bar{P}}/(1-\bar{\bar{P}})$.

36. With some regret, it must be concluded that multiple decrement techniques are not likely to point the way forward in modern sickness insurance: the mathematical form is inconvenient if one attempts to operate with increments as well as decrements, and there are better techniques which only await a suitable volume of business to enable practical research to be applied. Nevertheless, it is hoped that, by showing the place of multiple decrement methods in the scheme of things, valuable insight into current methods has been gained.

PART IV—CURRENT ACTUARIAL TECHNIQUES

37. In the U.K., most offices adapt the Manchester Unity table to their needs as described in Bond's paper. It is however hoped that a joint morbidity experience will be investigated by a sub-committee of the Institute and Faculty's Continuous Mortality Investigation Bureau. The object of the investigation will probably be, in the first instance, to relate offices' experience sickness rates to a common standard; the Manchester Unity table itself is a likely choice. As an important innovation in this country, it is proposed also to aim at the derivation of 'rates of starting a sickness claim at age x' and values of 'an annuity of 1 per week (or perhaps per month) to a life who started a claim at age x'. This has an obvious application to group business, as well as to individual policies by level premiums.

38. The latter exercise can best be understood by reference to a paper presented to the Munich Congress by Eduard H. Minor.[14] Scandinavian investigations, the latest of which is described by C-G. Dillner[15] are also helpful. Dillner's work is discussed later in the paper. The most important features to note before examining American tables in detail are, it seems, that short-term sickness has been given far more weight in that country than in U.K.; that published tables are intended for control of reserves by the Commissioners of Insurance; and that the length of the select period for disabled life annuities (15 years) may prove in practice an obstacle to readjustment of termination rates which have not been revised in full since they were tabulated in 1952.

39. Dealing with these points in turn, many American policies are sold on the basis of cover for two years' disability. The argument is that it is not worth paying for a benefit which would last to normal retirement age. This is not a view which is generally accepted in Europe. As Minor observes, there is a relatively narrower gap between cancellable and non-cancellable contracts than there used to be (because the right of cancellation is rarely exercised), and he believes that 'it is the cost of the first fifty-two weeks of disability, *in the particular*

company involved, that must set the pattern of disability (premium) rates.' Companies are hungry for experience data relating to the first year, or two years, of disablement. So statistics appear with comparative frequency in the annual Reports issues of the *Transactions of the Society of Actuaries*. It is however very difficult to find new information relating to longer-term claims.

40. The control of reserves has a strong influence on the treatment of the raw data. 'Safe side' estimates are built in to the graduation, and comparisons of actual and expected should be interpreted with this in mind. American actuaries emphasize that the published tables—the 1964 Commissioners Table being the most recent—are not suitable for calculating office premiums. Some reasons given by Minor in his paper are (1) the effect of initial selection; (2) a need to allow for heavy lapses in the first three policy years; (3) the fact that the reserve tables combine males and females, and cover a wide variety of occupations.

41. The select period for a disabled life annuity is incorporated to study reverse selection, the phenomenon described in § 21. Thus if we consider the case of a life aged y and apply the American method, we consult the Basic Continuance Table which has been reproduced in Appendix 3. For 100,000 active lives exposed at each age x, in a population supposed stationary, there corresponds a number, say $\Lambda_{[x]+t}$, of disabled lives whose disability commenced at age x and has persisted for time t, where $x+t=y$. Putting $y=35$ and accepting for illustration the convention that the ages shown in the Basic Continuance Table are exact, we can work out p^i_{35}, the probability of remaining alive for a further year as an invalid at age 35, according to duration of disability. Similarly, we can calculate figures for $y=45$, $y=55$ and $y=65$. The following table shows the results.

Table 2

Age attained	Age at commencement of disability	Duration of disability	Lives surviving and not recovered		
y	$[x]$	t (yr)	$\Lambda_{[x]+t}$	$\Lambda_{[x]+t+1}$	p^i_y
35	22	13	13	12	·93
	27	8	22	20	·91
	32	3	51	44	·86
45	32	13	22	21	·95
	37	8	44	41	·93
	42	3	107	93	·87
55	42	13	51	48	·94
	47	8	120	112	·93
	52	3	319	285	·89
65	52	13	144	134	·93
	57	8	388	357	·92
	62	3	1131	1010	·89

42. Thus the most notable feature of the American experience is that, due to

rapid decrements at young ages among disabled lives, p^i_y varies remarkably little between $y=35$ and $y=65$ for a given duration of disability. But, despite the opinion that a period of reverse selection as long as 15 years has been necessary in compiling the results of the experience, the evidence derived from Table 2 is not convincing. Doubts have often been expressed by British actuaries about long select periods; it will be interesting to see how the proposed British investigation will affect this attitude. Rolf Sand, a Norwegian actuary, expressed similar views in a paper to the Eighteenth International Congress of Actuaries.[16] It is clear that the compilation of a new experience table becomes much more difficult if such a long period of selection is studied.

43. To complete the account of the technique adopted in the U.S.A., it is only necessary to add that the active lives exposed to risk for calculation purposes are represented by an assured lives table—the Commissioners Standard Ordinary (CSO) 1958. Applying survival factors from the basic continuance table and discounting at the tabular rate of interest required (tables had been published at $2\frac{1}{2}$ %and 3%) produces commutation tables on familiar, though somewhat modified, lines. An approximate calculation has been made to show the relative size of 'active life' and 'disabled life' reserves in a simple model office. Suppose 100 policies are issued at age 27, 100 at age 32, and 100 at age 37, each year for a period of ten years. Each policy provides a sickness benefit, subject to a six months waiting period, of 1 per month. The expiry age for each policy is 65. After ten years, of the 3,000 policies issued, assuming no lapses and that mortality (irrespective of whether disabled or not) follows the CSO 1958 table, there will be a loss of about 2% by death, so that we shall have about 2,940 policies in force. Of these about 100 relate to disabled lives. The 'active life' reserve for the portfolio will be about 1,600 (roughly 2 weeks' benefit per life) and the 'disabled life' reserve about 1,200 (roughly one year's benefit per disabled life).

44. It is of interest to outline other mathematical approaches, chiefly due to Scandinavian actuaries, which throw light on the subject. The selection of material is necessarily limited; from the research point of view it is to be regretted that noteworthy papers in other languages have not been translated into English. The main problem, the construction of a self-consistent and realistic statistical model which can be manipulated by altering the parameters, is far from solution. The model, if mathematically sophisticated, will not yield to a convenient method of graduation or numerical computation.

45. Such progress as has been made concentrates on particular sections of the problem. A good example is the now re-published work of Ove Lundberg.[17] This studies the individual risk process, as opposed to the collective risk theory approach. The problem eventually studied was to fit the observed frequencies of the number of claims under sickness policies with short waiting periods (three days) using a simple stochastic process. It should be noted that, in grouping the claims, age was ignored. Lundberg considered it was 'hazardous on the basis of the initial facts when effecting the insurance policy to fix once and for all the

premium . . . it would be preferable to examine each individual risk at certain intervals and to fix the new risk premium with due regard to past history'. He therefore went to considerable lengths to answer the question: 'Given that an individual has made n claims in period 1, what is the frequency of 0, 1, 2 . . . claims in period 2?' A Pólya process was fitted to the observed frequencies because Lundberg wished to analyse two classes of stochastic processes, namely time-homogeneous processes and compound Poisson processes. The Pólya process is a form common to both classes. After pointing out the undoubted theoretical weaknesses of the solution he gave, Lundberg remarked 'thus, on the basis of earlier experience it is possible to calculate a risk premium that better corresponds to the real risk than the risk premium fixed at the time the policy was effected'. This view, in fact, has been translated into practice in Sweden.

46. A variation of this approach is illustrated by Jan M. Hoem.[18] He describes the way in which a time-continuous Markov chain can be adopted as the stochastic process; the model is of considerable theoretical interest but does not appear to lead to a fundamentally new variation of the basic position outlined in §§ 26 to 35. Perhaps this is a satisfactory state of affairs; the practising actuary will not go far wrong if he understands those paragraphs, in relation to sickness annuity techniques.

47. C-G. Dillner[15] describes the most recent graduation formulae adopted in Sweden. Because the force of falling sick is linked with the waiting period, an arbitrary factor $r(k)$, linear in k, was introduced (k being the waiting period). The force of falling sick was graduated by the formula

$$r(k) \cdot \frac{0{\cdot}2535}{l_x}.$$

l_x was the number living according to a life table (Table M64) graduated by a Makeham curve. The factor 0·2535 is an arbitrary constant. The other function introduced was a termination function, better described as a 'survival' function $\lambda_{[x]+t}$ which is the probability that a person who fell sick at age x will remain ill t years later. This function was graduated by the formula

$$\lambda_{[x]+t} = a_x e^{-\alpha t} + b_x e^{-\beta t} + c_x e^{-\gamma t} + d_x e^{-\delta t} + e_x e^{-\varepsilon t}$$

where of course

$$a_x + b_x + c_x + d_x + e_x = 1$$

The 'survival function' is a generalized form of the function p_y^j of § 41 and Table 2. A useful point which Dillner makes is that if one applies a rate of falling sick (i.e. starting a claim) to a mixed population of active and disabled lives, it is important to notice whether, due to paucity of numbers at certain ages, the 'mix' is different from a normally composed insurance portfolio of active as well as disabled persons. It should be noted that there is a good volume of group sickness business in Sweden and the methods used have to some extent been influenced thereby.

48. Let us now consider the statistical measures we can apply, in long-term disability insurance, to control fluctuations. First consider collective risk theory. Medin[12] wrote in 1952: 'very little work has, in fact, been done on the probabilistic methods'. This is still true today. Moreover, there seem to be considerable obstacles in the path. To illustrate the nature of the difficulties, one may apply the method described in a recent paper by A. H. and J. H. Pollard[19] to calculate the standard deviation of sickness annuities, at specimen ages. For this purpose the Basic Continuance Table shown in Appendix 3 was used. As the figures are purely illustrative, it was convenient to make a simple assumption about 'ultimate' exits from the Basic Continuance Table, after duration 15 years. This was that the exits were equivalent to a uniform decrement for a further 10 years.

49. The calculations refer to a waiting period of three months, and a sickness annuity paid monthly to those who survive 3, 4, 5 . . . months from the inception of disablement. Thus the probability of drawing exactly one month's benefit but recovering or dying before another benefit is due is equal to (number of survivors to the end of three months) minus (number of survivors to the end of four months) ÷ (number of survivors to the end of three months). Denote this by $\pi_{x+3/12}$. Following the method in Pollard and Pollard, a similar probability is calculated for each subsequent period shown in the Basic Continuance Table. To the first batch of survivors, destined to draw only one month's benefit, we attach the annuity value $a^{(12)}_{\overline{3\text{ months}|}} - a^{(12)}_{\overline{2\text{ months}|}}$. The annuity value for those surviving one more month is $a^{(12)}_{\overline{4\text{ months}|}} - a^{(12)}_{\overline{2\text{ months}|}}$ and so forth. In this way, looking at the sickness annuity as a stochastic variable, we can calculate

$$\pi_{x+3/12}\left(a^{(12)}_{\overline{3\text{ months}|}} - a^{(12)}_{\overline{2\text{ months}|}}\right)$$

$$+\pi_{x+4/12}\left(a^{(12)}_{\overline{4\text{ months}|}} - a^{(12)}_{\overline{2\text{ months}|}}\right)$$

$$+\pi_{x+5/12}\left(a^{(12)}_{\overline{5\text{ months}|}} - a^{(12)}_{\overline{2\text{ months}|}}\right)$$

where each π represents a probability and thus $\sum_{\text{All } t} \pi_{x+t} = 1$. For an annuity terminating after one year, for example, all the survivors at the end of the period are taken into account in calculating the probability of drawing benefit to the end of the period. For the continuing annuity, only those who fail to survive to the next payment date would be identified with the payment due at the end of one year.

The calculation thus gives the expected value of the sickness annuity, as shown in Table 3 opposite. The standard deviation is based on the given distribution of survivors.

50. It will be seen that the standard deviation is very large which implies that a large portfolio of homogeneous risks would have to be created before any reliable controls could be devised along these lines. The direct application of the

Table 3

Age (i)	Term after inception of sickness at which annuity ceases (ii)	Number of years paid (iii)	Expected value of sickness annuity (iv)	Standard deviation of annuity (v)	Coefficient of variation (v)÷(iv) (vi)
22	1 year	¾	0·245	0·408	1·67
	15 years	14¾	0·654	1·901	2·91
	lifetime	lifetime	0·710	2·267	3·19
52	1 year	¾	0·315	0·467	1·48
	15 years	14¾	1·450	3·066	2·11
	lifetime	lifetime	1·637	3·697	2·26

theory of risk would be likely to suffer the same practical difficulties: it seems that, from the control angle, the analysis of surplus on the lines described in Bond's paper is so far the best guide for the practising actuary.

51. The standard deviation of the distribution of sickness was discussed by R. E. Beard in a paper to the Students' Society.[20] It should be noted that this analysis is entirely independent of the rate of mortality. The fundamental factors are the probability of falling sick and the duration of claim. The classical expression, derived from G. F. Hardy's investigation of the mean deviation, is

$$\sqrt{(\text{expected weeks of sickness})} \times (\text{a factor})$$

and Beard discusses the various values the factor, which depends on the range of ages in the portfolio, might take. The factor is of the form $\sqrt{m_2(x) \div m_1(x)}$ where $m_1(x)$ and $m_2(x)$ are the first and second moments of the distribution $f(a, x)$. x is the age, and the proportion of claims falling between a and $a+da$ weeks is denoted by Beard as $f(a, x)da$ so that $\int_{a=0}^{\infty} f(a, x)da = 1$ for any given value of x. The method recommended is to calculate the moments $m_1(x)$ and $m_2(x)$ about $a=0$ from a standard table, for various values of x, and to weight the expected claims by m_2/m_1, in age groups. Hardy's value of the mean deviation was independent of age; he arrived at a factor which is equivalent to the value $m_2/m_1 = 2{\cdot}5$. Beard points out that other estimates of the factor differ widely from this figure, which is why the method of grouping by age is put forward.

PART V—SINGLE PREMIUMS, LUMP SUMS, PARTIAL DISABILITY—THE PROBLEMS

52. We have reached the point at which the problems described in § 9 can be discussed further. The first of these problems is the question of single premium group sickness business. At first sight, it might be thought that a disabled life annuity combined with a rate of falling sick is a straightforward concept, almost ready for application to group single premium costing. The single premium at age x would be derived from the basic continuance table described by Minor by estimating, in the notation of § 41,

$$\frac{1}{100{,}000}\int_{t=w}^{65-x} v^{x+t}\,\Lambda_{[x]+t}\,dt$$

where w = the waiting period (expressed in years) and the annuity ceases at age 65.

53. This approach involves the following difficulties. First, the basic continuance table is derived by studying rates, to be applied to the 'active' population: in practice, one would not collect premiums in respect of lives on benefit. The 'active' population for the purpose of costing a scheme should be, so to speak, an 'expected active population', the actual figures being perhaps too much influenced by sick lives in the scheme. But even if we applied the rates described by Minor to the whole population actually at risk, although the above formula for the net single premium is theoretically correct, it would still be difficult to be sure whether this adequately provides for the risk of discontinuance of the scheme. On discontinuance, benefits in course of payment would go on until the end of the current attack—maybe for some years. Should a number of schemes be withdrawn simultaneously—e.g. following a change in legislation—the office would lose its premium income and would need to be sure that the possibility of adverse fluctuations in claims had been adequately provided for. Another difficulty is that the expression given above ignores the lives who are already passing through the waiting period and the lower limit of the integral is not correct for those lives. The American tables, as Minor remarked, do not allow for initial selection and males and females are combined. Thus only a broad guide can be expected from them, and they are not likely to reflect U.K. experience.

54. As an alternative guide, we might analyse the implications of using the friendly society rate $s_x^{26/\text{all}}$ applied as a net single premium to a scheme with a 26 weeks' waiting period, to provide benefits for the lives aged x. Again, the function relates to the aggregate population. The position in the first year is quite wrong, for the rate would allow one to pay the current year's benefits in respect of lives whose attack commenced earlier: such lives would not of course be admitted into insurance. On discontinuance of the scheme, one would, if this occurred at the first renewal date, have a balance in hand but this would in no way relate to the sum required to continue payments for those actually on benefit at that time.

55. The solution demands an attempt to split the function $s_x^{26/\text{all}}$ into first six months of benefit, second year, third year and so forth. In this way, the second year benefit at age $x+1$, the third year benefit at age $x+2$, etc., can be combined to give an approximation to the total cost of benefits for those who first fell sick at age x. The author is indebted to a company which carried out an investigation recently on National Insurance statistics relating to June 1967 (Cmnd 4124, Table 1), suitably augmented by figures supplied by the Government Actuary's Department. The table produced by the company shows the ratio of the number of persons per 1,000 aged $(x+t+1)$ who had been sick for

between $(t+1)$ and $(t+2)$ years to the number of persons per 1,000 aged $(x+t)$ who had been sick between t and $t+1$ years. Let this ratio be $k_{x+t+1:x+t}$. The values found were as follows:

Age	$k_{x+t+1:x+t}$				
$(x+t)$	$t=1$	$t=2$	$t=4$	$t=6$	$t=8$
30	·43	·84	·85	·88	—
40	·53	·84	·87	·90	·95
50	·73	·81	·84	·89	·93
60	·76	·89	·89	·86	·93

Similar attempts to divide the Manchester Unity rates into component years have been made in the past, and have resulted in the assumption that the proportion which 'after t years' sickness bears to 'after two years' sickness is independent of age for $t=8$. This assumption is supported by the above table. The k factors could thus be used to derive a 'single premium' on a select basis which is comparable with that produced by the American approach. The lives in the aggregate population who are passing through the waiting period are, however, allowed for in the friendly society functions.

56. Benefit is sometimes required in a lump sum. That is to say, the contract will be long-term, the premium rate fixed at outset, and on a certain event—loosely, the disablement of the life beyond reasonable expectation of recovery—the full entitlement to benefit is settled in one sum. The precursor of a sickness policy providing this type of benefit is a disability benefit, attached to a life policy, and providing that in the event of the life becoming permanently disabled the sum assured under the life policy will be paid immediately. This is merely a way of adding a further amount to a waiver of premium benefit, at least in form, assuming that waiver of premium relates to disability deemed to be permanent. If a life office has decided that in such circumstances an annual additional premium P^w may be paid in order to commute future premiums (life and additional benefit) of P, then if the sum assured is S and the rate of interest required is i, P^w has to be increased in the ratio $(P+iS)/P$ and this puts the office in a position to pay the sum assured immediately.

57. We have seen however that modern policies providing income are based on the notion that recovery should be provided for in the policy conditions. Disability covers a whole range of conditions, from purely physical and obvious total breakdown to psychosomatic conditions difficult to define for insurance purposes. The approach of insurance underwriters to the problem of defining permanent disablement for the purpose of lump sum policies is that, as usual, there must be a waiting period and six months is the minimum. The disability must be of such a nature that it is impossible for the life to take up any form of gainful employment, and in the opinion of the insurance company it must be considered that the situation will not change. Since the definition is severe, the rate of disability must be lower than the rate of disability allowing for recoveries.

58. It must be presumed also that the rate of permanent total disablement in

the past was much higher than the rate would be today: tables such as that quoted in Hamza's paper, and Hunter's table, no longer provide any guidance. There are no modern statistics relating to 'total and permanent' disability as thought of for insurance purposes. Permanent impairment is no longer necessarily a bar to useful employment; for example, restrictions on mobility which would have been severe years ago are now eased by modern aids and special vehicles. The actuary can only hope to make an arbitrary reduction in modern disability rates to allow for a policy condition restricting claims to 'total and permanent' disability.

59. At this point it is interesting to see evidence of the effect of a 'severe' definition of disability. Appendix 1 shows some unusually low rates of becoming disabled, recently published in respect of a Swiss Pension Fund.[21] It appears that the Fund has a waiting period for disability of one year, but comparison with the American Basic Continuance Table (Appendix 3) shows that the Swiss rates are still very low. The high rate of mortality for disabled lives is another feature indicating a 'severe' definition and maybe the figures give some help to the actuary in search of adjustments to allow for cases presumed to be permanently disabled.

60. The problem confronting the insurer who provides a lump sum benefit is chiefly the moral hazard, which takes a peculiar form. The first aspect, particularly appropriate to consider in modern times, is that the claimant has to know that recovery is deemed to be impossible. This is entirely contrary to the spirit in which the bulk of the business should be run, and may place the medical attendant in an awkward position. The second aspect is that a large lump sum is an especially tempting prize for the malingerer, and though the actuary may consider that the rate of becoming irrecoverably disabled is today low in comparison with his estimate of the ordinary rate of becoming disabled, a considerable loading ought to be made if the sole benefit under the policy is a lump sum.

61. Another type of contract which requires special consideration, particularly as regards the appropriateness of the normal rates, is a 'key man' policy taken out for the benefit of his firm. The business background is not uncommon —because of his special skills, the value of such a man to his business is often several times the income he draws. For the reasons described in the previous paragraph, it is not usually advisable to contemplate paying a large lump sum benefit. It is better to provide instalments of benefit whether recovery is thought to be possible or not. Another point to remember is the object for which insurance should be provided, namely to tide a business over a difficult period, or perhaps to provide reasonable compensation for a misfortune. This leads to the idea of decreasing benefit, fading away to nothing perhaps seven years from the date of the policy, and of an amount largely related, at the outset, to known or readily determined facts. Thus if disability were to occur immediately after effecting the policy, there would be a six months' waiting period, say, after which benefits would be payable by monthly instalments commencing at a level of

say three times (depending on circumstances) the amount the insured was earning just before the disability started. After one year from the outset of the policy, the monthly instalments would decrease, and they would decrease again at annual intervals, ceasing altogether seven years from the date of issue. There are, nevertheless, occasions on which a lump sum benefit seems to be the only reasonable solution to the problem of providing good insurance cover. If the actuary has weighed up the factors, and is not exposing the funds to a disproportionate hazard, it is justifiable in the author's view to put forward terms for a lump sum 'key man' benefit.

62. Partial disability benefits fall into two classes—ex gratia and contractual. The former are considered to be appropriate for controlling some of the claims, and actually saving the insurance company money whilst helping to rehabilitate the insured. Where it is known that ex gratia benefits are favourably regarded by the company, the actuary would note this as one factor in making the final decision on the level of rates. Other factors are equally difficult to quantify—for example the allowance which should be made for a 'strict' definition of disability (that the insured can do no work at all, by reasonable criteria) rather than a 'liberal' definition (that the insured is unfit to follow his own occupation). Contractual benefits for partial disability have been introduced, usually in a somewhat experimental fashion in this country. It is thought that the conditions for benefit should be (i) that the insured has been totally disabled, and drawing full benefit for a period and (ii) that he is earning at a lower rate than before he was disabled, having changed his employment. In such circumstances, the full sickness benefit is adjusted in proportion to the loss of earnings. No investigation of the effect on sickness rates has so far been possible.

63. In some European countries, however, a fully developed scheme of partial disability benefits has been in existence for a number of years. The arbiter responsible for assessing the degree of disability, expressed as a percentage, is a physician. He usually follows criteria established for social insurance purposes; and it should be noted that the actual earnings are not the main consideration. Indeed, 80% disablement may entitle the insured to full benefit and if he can use his residual earning power his total money resources could be higher than before he was disabled. It is likely that this system has a cumulative effect; claims consciousness tends to increase the observed rate of sickness in much the same way as has been described in § 11. There is, however, no detailed statistical basis for analysing partial disability benefits. To quote Dillner: 'cases of sickness with partial compensation were treated [when investigating the experience] as cases with total compensation which by a special analysis has been found to involve a margin of about 10 per cent'. Further speculation on the question of partial disability benefits is profitless in the present state of our knowledge, but it should be remembered that varying practices in different countries considerably affect the comparability of sickness rates.

PART VI—CONCLUSION

64. The state of legislation in most countries of the world where long-term sickness insurance is transacted shows that so far, the special nature of this class of business is not widely recognized. Actuaries have a considerable responsibility to discharge in this direction. With the development of a 'harmonized' approach to the legal and taxation framework which affects many countries today, it behoves us to see that correct principles are now applied, so far as this can be achieved by the profession.

65. The aim of this paper has been to trace various influences which have determined the present state of private insurance in this field. It is hoped that deeper understanding of the background will stimulate the further research which an accumulating supply of data will surely justify.

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APPENDIX 1

The following table shows values of various sickness functions mentioned in the paper. The Manchester Unity investigations related to male lives, and the considerable extra morbidity in the sickness experience rates for women is illustrated by the National Insurance figures. The Swiss Table EVK 1970 is a double decrement table and the rates published were dependent rates. A good idea of how low the rates of becoming disabled are in this experience can be gained by comparing the table in Appendix 3. The rules of the Swiss Pension Fund can be assumed to be at least as severe as imposing one year's waiting period. The rate of mortality of disabled lives is also high (see § 59 of the paper).

	WEEKS OF SICKNESS PER MEMBER PER ANNUM									RATES OF SICKNESS AND MORTALITY		
	Manchester Unity 1893–97 Experience Occupation Groups AHJ		National Insurance Experience 1967–68 (June to May)							Swiss Pension Fund 1961–68 Table EVK 1970		
			Employed Men Excluding Civil Servants		Employed Unmarried Women		Employed Married Women		Self-Employed Men	Active Lives (Male)		Disabled Lives (Male)
Age group	All periods	All periods excl. first 6 months	All periods	All periods excl. first 168 days	All periods	All periods excl. first 168 days	All periods	All periods excl. first 168 days	All periods	Dependent rate of mortality $*q_x^a$	Dependent rate of becoming disabled $*i_x$	Rate of mortality q_x^i
20–24	·814	·088	1·05	·097	1·24	·140	1·49	·095	·42	·00077	·00010	·03214
25–29	·867	·147	1·25	·167	1·59	·331	1·60	·210	·54	·00082	·00010	·03697
30–34	·966	·207	1·54	·246	2·17	·855	2·36	·545	·70	·00090	·00012	·04104
35–39	1·136	·306	1·74	·390	2·89	1·378	3·48	1·284	·81	·00120	·00020	·04437
40–44	1·443	·481	2·13	·620	3·29	1·840	3·97	1·882	·90	·00176	·00051	·04694
45–49	1·804	·699	2·55	·872	4·12	2·241	4·61	2·231	1·21	·00280	·00159	·04877
50–54	2·539	1·190	3·24	1·325	5·55	3·452	5·80	3·126	1·56	·00502	·00464	·04984
55–59	3·759	2·092	4·60	2·254	7·31	5·263	7·94	5·248	2·81	·00826	·01395	·05018
60–64	5·893	3·765	7·89	4·797	—	—	—	—	4·98	·01210	·04580	·05028

APPENDIX 2

Let μ_x^{ad} = the force of mortality for an active life aged x

μ_x^{ai} = the force of falling sick for an active life aged x

$\mu_{[y]+t}^{id}$ = the force of mortality for a sick life who fell sick at the age of y and has been sick for time t

$\mu_{[y]+t}^{ia}$ = the force of recovery for a sick life who fell sick at the age of y and has been sick for time t

δ = force of interest

$l_{[y]+t}^{i}$ = number living from a group of policyholders all of whom fell sick at age y and are still sick after time t

l_x^{aa} = the number of active lives living at exact age x

then

$$l_{[y]+t}^{i} = l_{[y]}^{i} \exp[-\int_0^t (\mu_{[y]+\tau}^{id} + \mu_{[y]+\tau}^{ia}) d\tau]$$

and

$$\bar{a}_{[y]}^{i} = \frac{1}{l_{[y]}^{i}} \int_0^{\omega-y} l_{[y]+t}^{i} \, e^{-t\delta} dt$$

and the continuous analogue of equation (iii) page 11 is

Present value (as before) for a continuous annuity

$$\bar{\bar{a}}_x \text{ say} = \frac{1}{l_x^{aa}} \int_{t=0}^{\omega-x} l_{x+t}^{aa} \, \mu_{x+t}^{ai} \, \bar{a}_{[x+t]}^{i} \, e^{-t\delta} dt \quad . \quad . \quad . \quad \text{(iv)}$$

The important conclusion we can draw from (iv) rather more readily than from earlier work is that if we can determine the forces of mortality, falling sick and recovery required, (iv) is an exact formula; this helps clearly to bring out the central importance of the function l_x^{aa}.

Because (iv) is exact, it values correctly 'current attack' annuities $\bar{a}_{x+t}^{i}$ and 'future attack' annuities. Further development helps to clarify the situation. It is clear that, if we start with a population of l_x^{aa} at exact age x, the survivors at age z will be:

l_z^{aa} active lives (including some who have suffered one or more spells of disability)

and say

l_z^{ii} disabled lives who became disabled at some age between x and z.

The reserve we must theoretically hold for their benefits will be as follows:

$l_z^{aa} \bar{\bar{a}}_z$ is held for future attacks among present active lives . . . (v)

For the *current* spell of disability of the l_z^{ii} lives who are disabled, the reserve for those aged exactly $x+\theta$ when they became disabled will be

$$a_{[x+\theta]+z-x-\theta}^{i}$$

But the number of lives who became disabled in a short interval of time $d\theta$ when their age was $[x+\theta]$ was

$$l^{aa}_{x+\theta}\,\mu^{ai}_{x+\theta}\,d\theta$$

and survivors to age z number

$$l^{aa}_{x+\theta}\,\mu^{ai}_{x+\theta}\,.\frac{l^{i}_{[x+\theta]+z-x-\theta}}{l^{i}_{[x+\theta]}}\,d\theta = l^{ii}_{(z,\theta)}\,d\theta \text{ say}$$

and so the required reserve

$$=\int_{\theta=0}^{z-x} l^{ii}_{(z,\theta)}\,a^{i}_{[x+\theta]+z-x-\theta}\,d\theta \quad . \quad . \quad . \quad \text{(vi)}$$

For future attacks, after recovery from the present spell, of the $l^{ii}_{(z,\theta)}\,d\theta$ lives the number who recover in an interval of time du at age $u \geqslant z$ is

$$l^{ii}_{(z,\theta)}\,d\theta\,.\frac{l^{i}_{[x+\theta]+u-x-\theta}}{l^{i}_{[x+\theta]+z-x-\theta}}\,\mu^{ia}_{u}\,du$$

and the corresponding reserve will be

$$l^{ii}_{(z,\theta)}\,d\theta\,.\frac{l^{i}_{[x+\theta]+u-x-\theta}}{l^{i}_{[x+\theta]+z-x-\theta}}\,\mu^{ia}_{u}\,e^{-(u-z)\delta}\,\bar{\bar{a}}_{u}\,du$$

The total future attack reserves for disabled lives is thus

$$\int_{\theta=0}^{z-x}\int_{u=z}^{\omega} l^{ii}_{(z,\theta)}\,\frac{l^{i}_{[x+\theta]+u-x-\theta}}{l^{i}_{[x+\theta]+z-x-\theta}}\,\mu^{ia}_{u}\,e^{-(u-z)\delta}\,\bar{\bar{a}}_{u}\,du\,d\theta \qquad \text{(vii)}$$

APPENDIX 3

Basic continuance table: lives disabled from date of disablement, by duration per 100,000 active lives exposed at each age
(Reproduced from Minor's paper—reference 14)

Duration			Age at beginning of policy year in which disablement occurs									
Yr.	Mo.	Day	22	27	32	37	42	47	52	57	62	67
	0	8	10807	10679	11604	12621	13721	14957	16384	18115	20162	22704
	1		3923	3877	4372	5029	5895	6918	8158	9816	11737	14206
	2		1412	1396	1618	1961	2417	3048	3820	4931	6462	8550
	3		664	657	778	981	1257	1676	2239	3110	4427	6324
	4		367	363	432	547	730	1020	1447	2158	3317	5182
	5		231	229	273	347	476	692	1029	1630	2656	4472
	6		162	161	192	245	343	515	793	1327	2264	4022
	7		125	124	149	190	270	417	659	1145	2017	3706
	8		105	104	126	161	231	365	587	1039	1850	3488
	9		93	92	112	144	208	334	537	970	1729	3309
	10		85	84	103	133	191	310	505	919	1633	3148
	11		79	78	96	125	180	295	481	877	1558	2999
1			75	74	91	119	172	283	463	842	1491	2865
	1		72	71	87	115	166	274	451	825	1467	2822
	2		69	68	84	111	161	267	440	811	1445	2783
	3		66	66	81	107	156	260	431	797	1425	2746
	4		64	64	79	104	152	254	422	785	1406	2711
	5		62	62	77	101	148	248	415	773	1389	2679
	6		60	60	74	99	145	243	407	763	1372	2648
	7		58	58	73	96	142	238	401	752	1356	2620
	8		56	57	71	94	139	234	394	743	1341	2593
	9		55	55	69	92	136	230	389	734	1327	2567
	10		53	54	68	90	134	226	383	725	1312	2542
	11		52	53	66	89	131	223	378	716	1299	2519
2			51	52	65	87	129	219	372	707	1286	2497
3			39	40	51	70	107	185	319	617	1131	2203
4			32	33	44	61	93	163	285	552	1010	1961
5			27	29	39	55	85	149	260	501	910	1756
6			24	26	35	50	78	138	240	459	825	1578
7			21	24	32	47	73	128	222	422	750	1415
8			19	22	30	44	68	120	206	388	681	1265
9			18	20	28	41	64	112	191	357	618	1125
10			16	19	26	38	60	105	178	328	558	995
11			15	18	25	36	57	98	166	302	504	874
12			14	16	23	34	54	93	155	278	455	762
13			13	15	22	32	51	87	144	255	409	658
14			12	14	21	30	48	82	134	234	366	563
15			12	14	19	29	46	77	125	215	326	475

ABSTRACT OF THE DISCUSSION

The author, in presenting his paper, said that the stimulus for it had been the realization that life offices in the United Kingdom were on the point of supporting a new morbidity investigation on the lines of the Continuous Mortality Investigation. Soon after he had written the paper, the Institute and Faculty had sent details of the proposed investigation to all offices contributing to the Continuous Mortality Investigation, so § 37 in which he referred to the proposals might well have been § 1 had the paper been delayed until after the offices had reacted favourably. Faced with any investigation, actuaries instinctively asked what the object of the investigation was to be. It would be presumptuous of him to describe to members of the Institute the object of Watson's Manchester Unity investigation, but he drew attention to the fact that one of the main objects of the American investigation was to create a standard for the statutory control of reserves. The current stage in Britain was challenging because neither of those two precedents exactly fitted the present situation.

In fairness to overseas colleagues he felt that he should mention that a paper had been published by the South African Society and a paper marked October 1971 had been submitted by P. A. Burns to the Institute of Actuaries of Australia and New Zealand. He hoped his own paper would stimulate actuarial interest over a considerable area of the globe in view of the interest already shown in other countries, and he profoundly hoped that there would be contributions to research in the near future.

Mr D. J. Bond, in opening the discussion, said that long-term sickness insurance had rarely been the subject of a full-length paper to the Institute. Sickness had been mentioned from time to time, and as examples he quoted Dr Benjamin's paper on *The Measurement of Morbidity* (*J.I.A.* 1957, **83**, 225), and Daw's *A Comparison of Mortality and Sickness in relation to Geographical and Socio-Economic factors* (*J.I.A.* 1971, **97**, 17), and the discussion a month before on the Government's White Paper on Pensions. In addition, there had been a few papers presented to the Students' Society. The paper gave an astronaut's view of the world's methods of translating sickness statistics into premium and valuation reserves. As the systems employed in other countries became increasingly understood, comparisons could more easily be made with our own system leading to a more scientific method of presenting the statistics. The friendly society system used by a fair number of offices in the United Kingdom had hardly been mentioned in the paper and he thought that was a great pity because many actuaries did not completely understand the merits and demerits of the friendly society system and a fuller discussion would not have been out of place.

He had little to disagree with until § 5, where the statement that underwriters knew what to look for was more a pious hope than a statement of fact, and he felt sickness-insurance underwriters should also have a hand in looking after sickness claims. Daw had written: 'The point in the gradual deterioration of health at which death takes place is unmistakable but the point at which sickness begins is hazy and ill-defined, as is also the point at which recovery takes place when health is improving.' Underwriters were used to dealing with degrees or grades of 'health' and their skills could here be of value.

The paper dealt with the problem of rising claims during an economic recession but he thought the falling value of assets was more important particularly if a high proportion of the funds was invested in equities. Accordingly, equities were less appropriate as investments in a purely sickness fund than in a life or a pension fund.

The case for linking the maximum amount of insurance offered to the earnings level just prior to disability was put in § 7. If an insured's income were gradually falling due to deteriorating health, the speaker asked whether that benefit should be reduced merely because the insured kept on working for as long as possible. He asked if the office should effectively cancel the cover if the insured retired early because his health was failing. For those reasons many policies were written with the maximum amount of benefit limited to a proportion of the man's earned income at the date of taking out the policy, not the date of the claim.

§ 10 dealt with the responsibility of the actuary in the preparation of the statutory returns to the Department of Trade and Industry and reference was made specifically to 'the extent to which account has been taken of the nature and term of the assets available to meet the liabilities valued'. They were not told how that should be done. Part of the trouble was that one ordinary long-term insurance business fund frequently covered both life and sickness contracts. The nature and term of the life assurance assets might not be right for sickness. As he had already suggested, the proportion of equities should be smaller in a purely sickness fund.

He did not understand why, later in that paragraph, there should be 'precise adaptations' of the statutory returns, particularly bearing in mind that not all the offices in the United Kingdom valued on the friendly society basis. He preferred the Department of Trade and Industry to specify their requirements and leave the actuary to present the returns in the most informative way within the broad framework of the regulations. A number of offices had submitted returns incorporating information on long-term sickness insurance business and those that he had seen gave the authorities sufficient information to enable them to check the valuation liability and also to calculate with reasonable accuracy the overall expected claims which they might compare with the overall claims paid. That gave as much information as could be obtained from the statutory life returns. Whether it was enough was an open question.

The table in § 11 painted a gloomy picture of increasing sickness. Fortunately his own office's experience in that period had shown no significant trend. Figures for 1962 to 1969 were: $+7, +3, -4, -4, +7, -4, +4, -7$, overall $+2$. He thought offices with no experience of their own would have difficulty in calculating premiums.

To counter inflation several offices had offered policies where the rate of benefit could increase, sometimes while a claim was being paid, sometimes at stated time intervals, such increases being granted without the production of further medical evidence. It was suggested that the continuous morbidity investigation of the Institute should measure the rate of claim under increasing benefit policies separately, and it would be very interesting to see whether there would be any significant difference in the long term.

He thought § 12 overstated the case of the cost of claims administration. His office had paid claims amounting to over £330,000 in a year recently with a claims department of four people. He assumed that the insured paid for the standard medical certificates required to administer a claim. The cost would be considerably higher if that were not so.

The double decrement technique described in § 24 produced an over-valuation in that disabled lives were valued twice, as active lives and also as disabled lives. That had the somewhat curious effect that the same life might be valued in respect of one insurance on two different mortality tables, raising some interesting analysis of surplus problems.

It was important that the distinction between medical selection at outset and reverse selection on claim as described in § 31 was fully understood. For example, the selection in § 25 was reverse selection. The Manchester Unity experience had a kind of reverse selection of two years in that only after two years' continuous incapacity did a claim enter the ultimate 'over two years' period. The basic continuance table produced in Appendix 3 had a reverse selection of fifteen years. He suspected fifteen years was chosen to ensure that the ultimate table was effectively a single decrement table relating to mortality only—in other words, if a person had been ill for fifteen years it was very unlikely he would recover. There were very few statistics relating to initial medical selection. He was not so concerned with selection according to the length of waiting period, since that phenomenon was not borne out in practice in his office's investigations. Also it had not been taken into account either in the Manchester Unity table or, he assumed, in the published basic continuance table.

In his office, women's sickness experience was overall about $1\frac{1}{4}$ times the men's experience, while the 'after two years' experience was almost double. National Insurance statistics also showed that women claimed far more sickness than men. He was, therefore, surprised by § 40, and could not believe that the sickness rates of men and women were sufficiently close to justifying using the 1964 Commissioners Table for both men and women.

If he understood § 45 correctly, then Ove Lundberg's investigation led to the conclusion that

the frequency of claims in any future period could always be estimated and, as an increasing pool of past experience was built up, confidence in the results would be increased. In Britain, long-term sickness insurance by individual policies was normally subject to premiums fixed at the outset, and that was perhaps why Lundberg's work was not so well known as it should be.

The speaker found §§ 48 to 51 too brief to allow full understanding without reference to the papers mentioned. He suspected the high values of coefficient of variation in Table 3 would rapidly diminish if claim rates were assessed under policies with a waiting period of more than three months. An expected value of sickness annuity of ·710 for a life aged 22 should be the result of a very heavy weighting of shorter periods of incapacity. The longer the period before which a claim would be paid the less the effect of a very large number of quick recoveries. Nevertheless he doubted whether the coefficient of variation could be reduced to a figure where statistical techniques could be employed to value a sickness insurance fund.

In group single premium business (§ 53), it was important that the premiums paid for any one year's cover were sufficient to cover the cost of expected sickness claims commencing in that year because the employer had the option to discontinue the insurance at any time, leaving the insurance office with the claimants only. As one of the methods of calculating that reserve, the 'after two years' friendly society function was analysed (§ 55) to enable an estimate of the ill-health annuity value to be made. In theory, the use of the friendly society factors to calculate an ill-health annuity value could not produce the true annuity value since the exposed to risk used in calculating the 'after t years' expected number of weeks of sickness for lives now aged $x+t$, included those entering after age x and excluded those withdrawing after age x. However, the Manchester Unity rates were so out of date that such refinements probably could be ignored.

With policies securing a lump sum benefit the definition of incapacity had to be extremely tightly drawn, so that a claim for an income benefit policy, for example, could be met, while the claim for a lump sum benefit policy might be deferred.

Under 'key man' policies, considered in § 61, the person entitled to benefit was not the insured life. Benefit was paid to the company to compensate for the key man's absence and the key man himself might receive no specific benefit. He thought there were several really difficult problems which were not mentioned in the paper. The insurance company, and not the policyholder, had to assess whether the key man was incapacitated or not. If a key man failed to live up to expectations, his employer could benefit doubly by having the man declared incapacitated. He got rid of the inefficient key man and he received a lump sum as well. Another difficulty arose in obtaining the co-operation of the key man on a claim. How would the office insist on medical evidence if the insured life had no personal incentive to co-operate with the insurer? 'Key man' insurance should be offered only where the key man himself would receive some sickness benefit. Obviously the key man should also have proven ability and the employer ought to be financially sound.

Offices relied very heavily on the medical profession in long-term sickness insurance business, particularly when deciding whether or not to admit a claim. The United Kingdom was, therefore, fortunate to have general practitioners of high quality. That was also relevant to §§ 62 and 63 which dealt with partial benefits. Where offices introduced such benefits, they would have to be defined very carefully for the benefit of the insured and of the medical attendant completing the claim form. On the continent, he believed that benefit was offered only in those countries where the national insurance scheme also paid partial incapacity benefits, so that the doctors there were used to classifying degrees of incapacity. British doctors were in general not required to specify degrees of incapacity and they would have an exceedingly difficult task in certifying claim forms relating to partial disability. Indeed, P. Stocks in 1949 had said that 'only a physician is competent to decide what a patient is suffering from; but the patient often has to decide whether or not he is ill at all'. So it was a very difficult question for the doctor to say whether or not the insured was partially ill. He thought that benefits for partial incapacity would not gain acceptance in Britain—particularly while the State scheme had almost the most stringent definition of incapacity that could be devised.

The paper had again led him to realize the imprecisions of the methods of translating sickness statistics into forms actuaries could use. Perhaps that was not so surprising since sickness itself was so imprecise, subject to so many variations such as age, sex, occupation, environment and the state of the economy. The cause of sickness had also changed. Ulcers now rarely caused long claims as they did even a few years previously, while coronaries and anxiety states increased day by day. Perhaps the best that could be done was to keep as up to date as possible with a system which was flexible and easily revised, and that might be why the old 'friendly society' basis still managed to hold its own despite its obvious inadequacies. Of one thing, however, he was certain. Because of the lack of precision in existing methods, it was doubly important that long-term sickness insurance funds were closely watched over by actuaries.

Mr A. E. M. Fine felt that, although the Manchester Unity approach to the derivation of premiums could be inflexible, it could be used to determine premium rates for disability contracts where the end of the benefit-paying period coincided with the end of the coverage period and where the term of the policy was not short enough to be affected by initial selection. That situation was common among the majority of plans currently issued in the United Kingdom—for example, a standard disability income policy providing benefits and coverage to age 60 or 65. However, there was an increasing number of plans coming on to the market which did not fit into that category. Firstly, there were plans where the benefit-paying period could be longer than the coverage period—those included Group Disablement policies as a special case. Premium rate calculations would be relatively simple if rates of incidence of sickness dependent on age were available as well as sickness termination rates dependent on duration since commencement of sickness and age at commencement of sickness. Secondly, there were the short-term plans. Use of Manchester Unity functions for those types of plan could seriously overstate the cost of benefits, since the effect of initial selection excluded from cover those persons who were disabled at the inception of the policy. Use of Manchester Unity functions without adjustment did not enable a distinction to be drawn between those disabled at inception and those not disabled but an approximate adjustment could be made to the premiums so determined to allow for that selection. The method made use of Cd. 6907 where rates of sickness were split up by period. That again illustrated the need for rates of incidence and termination of disability.

The problems of determining premium rates also arose when considering bases for reserves under those policies. Where the Manchester Unity approach could be justifiably used in determining premiums, the need was felt to distinguish between reserves in respect of active lives ('future-attack' reserves) and reserves in respect of disabled lives (split into 'current-attack' reserves and 'future-attack' reserves in respect of those currently disabled). With only Manchester Unity functions available, it was not possible to distinguish between those currently disabled and those not currently disabled.

He noted the reference in § 40 to the 1964 Commissioners Table as being unsuitable for determining office premiums. Inasmuch as that was a reserving table with heavy margins and for the additional reasons given in § 40, that might be true; but that did not stop offices in the United States using the table for both participating and non-participating disability income policies. Under the participating version, the office premium, he understood, was related generally to the net premium determined under the 1964 Commissioners Table and the revenue surplus arising under those policies was distributed normally by means of annual cash dividends. In the case of the non-participating version, the office premium was normally related for convenience to the net premium determined from the 1964 Commissioners Table by loadings which were tested at certain ages by an 'asset share' study equating premiums to benefits and bringing in the offices' own experience rates of incidence of disability, termination of disability, mortality, and so on.

He had calculated certain premiums to compare Manchester Unity with the 1964 Commissioners Table. He had considered two types of standard disability income policies, with benefits and cover ceasing at age 60 and 65 respectively. He had looked at quinquennial ages at entry from age 20 to five years before termination age, investigating separately elimination

periods of one month and three months. By elimination period he meant the period of continuous disablement which had existed before benefits could be paid; the author in the paper referred to it as the waiting period. In his calculations he had used a mortality basis of A 1949–52 Ultimate rated down 2 years, 5% interest and nil expenses. For disability he used alternately 80% of Manchester Unity AHJ and the 1964 Commissioners Table. For the latter he used Table B1 of Volume III of the Commissioners Table, the Basic Continuance Table, part of which was reproduced in Appendix 3 of the paper. The major difference between the Table in Appendix 3 and the original version was that the latter allowed for days up to 3 months' disablement and months thereafter. The Continuance Table went up to 15 years' duration, and he had arbitrarily made certain assumptions as to disability after fifteen years. The calculations showed that the premiums determined on the two different bases were virtually the same at the younger ages at entry. With increasing age at entry, the premium determined on the 80% of Manchester Unity basis exceeded that determined on the 1964 Commissioners Table basis by an ever-increasing amount. The ratio between the two premiums was about two to one at age of entry five years before expiry of the policy. Although the latter effect might in part be explained by the fact that the Manchester Unity approach overstated the true position at the shorter terms, it was also due to differences in the nature of the underlying disability incidences and termination rates under the two disability bases.

New plans recently introduced from America into Britain included hospitalization policies providing income benefits during hospitalization resulting from either a particular specified disease or from a whole range of diseases. Under the classification of the Department of Trade and Industry, such policies presumably constituted 'ordinary long-term business' if they were expressed to be in effect for five years or more. In that case, the actuary would be concerned to obtain satisfactory data to determine premium rates and reserves. More often than not he would be forced to use data not wholly satisfactory for his purpose, such as that published by the Registrar General based on hospital in-patient inquiries. Those inquiries naturally concerned themselves with registrations rather than lives and therefore had to be treated with great care. In determining reserves under such policies the actuary would surely wish to see that an appreciable loading for contingencies was included.

Mr G. W. Pingstone thought that the cost of claims might not be as important as had been suggested unless there was an inflationary era when claims tended to arise in the long-term rather than the short-term. § 12 of the paper also referred to new business and the effects of putting it on the books. He thought one advantage was that claims tended to be small in the early years thus providing a margin to finance development.

Referring to § 18, it was important when looking at premium rates to realize how little variation there was between the 'after six months' sickness' of the Manchester Unity and National Insurance Experience, even allowing for all the medical changes over the last seventy years.

In § 36 the author had made the encouraging observation that there were better techniques which only awaited a suitable volume of business to enable practical research to be applied. He thought the basic position was promising. It seemed to have taken a long time and much effort to persuade people that once they had covered their house mortgage, the next thing they ought to cover was their income.

Reference was made to the investigation of experience by current actuarial techniques, the object being in the first instance to relate offices' experience of sickness rates to a common standard. He felt that there was a danger arising from competition in that offices would improve upon benefit conditions so leading to an unsatisfactory experience without necessarily actually altering their premium rates. It was difficult to know what experience was in fact being gathered if there were ever-changing benefit conditions and he made a plea for stability in benefit conditions until there was some real knowledge of the experience.

He was astounded by the statement in § 39 that 'many American policies are sold on the basis of cover for two years' disability. The argument is that it is not worth paying for a benefit

which would last to normal retirement age.' It did not seem to the speaker they had really got into the business if that was the view, and he disagreed with it completely.

In § 53 there was a reference to the discontinuance position in group business. The question was whether a reserve should be made for claims in course of payment, but there was no reference whatsoever in the paper to group business as such. Under group contracts some offices at least allowed an option to the individual member on leaving service to effect an individual policy which in effect provided him with continuation cover.

On the question of paying benefits by lump sum, he wholly agreed with the author's observations that it was better to provide for payment by instalments whether recovery was felt to be possible or not. He had had some considerable experience in connexion with group contacts over the years and, while it was probably fair to say that the definition of permanent disablement under such policies was a 'living death', nevertheless people did recover. He was particularly concerned about the references to 'key man' benefit. In that context he thought the problem of ever-increasing stress at ever-younger ages was very important and he wondered whether the underwriter could really assess that factor.

Turning to partial benefits, he thought many offices in the United Kingdom were offering such benefits on the basis of loss of earning power following a period of complete disability. He would certainly not want to tie himself to some State official or some State standard of assessment of the degree of disability because control of one's schemes or claims would be lost.

He gave two examples of the effects of State legislation referred to at the end of the paper. The Finance Act, 1971, had caused problems in the form of permanent disablement benefit associated with group life assurance and some sort of waiver had been extracted from the Inland Revenue in relation to benefits already in force. Secondly, there was a very unsatisfactory position in Australia until comparatively recently where the interpretation of legislation by the Commonwealth Insurance Commissioner was such that it was impossible to set up proper reserves for permanent disability insurance business.

Mr F. E. Guaschi thought that most offices had waiting periods coincident with the Manchester Unity tables. He considered that the tables showing the expected number of weeks' sickness in each period of sickness were affected by the reduction in benefit as the claimant entered each period. Also most, if not all, offices limited the amount of benefit to a proportion, commonly three-quarters, of the insured's salary at the date of becoming disabled, and that was undoubtedly a valuable inducement to return to work. It was not unusual for companies to exercise a degree of initial selection by requiring a proposer to accept a longer waiting period than originally proposed. There must be some self-selection by the insured.

Mr F. E. Whitehead (a visitor) referred to § 11 where the author mentioned that the actuary had to allow for trends in long-term sickness and quoted some figures from the Government Actuary's report. The increase in certificated sickness absence under the National Insurance Acts was comprehensively described in *Trends in Certificated Sickness Absence* (Social Trends, No. 2, 1971, published by the Central Statistical Office), though for the purposes of that particular paper long-term sickness was defined as incapacity which had lasted for more than a year. Nevertheless some statistics were given for incapacity which had lasted more than six months; the point was made that there had been a striking increase since the early 1960s in the National Insurance experience of incapacity lasting more than six months. The trends in, and extent of, the long-term sickness rate were puzzling. It was defined as the days of incapacity excluding the first year per insured person, and the following trends could be noticed in the figures. First, the rates for men under 40 had all declined. That had been associated with the improvements in prevention and cure of tuberculosis. The rates for men aged 40 to 60 had been fairly steady but had increased very rapidly since 1966. Finally, for men aged 60 to 64 there had been a steady increase since the early 1950s. He asked the meeting to remember he was talking about incapacity lasting more than a year. The latest rate was 24 days per man in 1968–69

compared with less than 18 in 1954–55. It was particularly difficult to find a satisfactory explanation of the increase in incapacity but clearly higher unemployment rates, redundancy and trends towards earlier retirement were all associated with it.

He was fascinated at the discovery that the Manchester Unity experience in 1893–97 which he had never seen before was in many ways similar to the experience in the National Insurance statistics. He had compared the rates for 1893–97 with the long-term sick cases from National Insurance, and the biggest increases occurred neither at the oldest nor the youngest ages but in the middle age groups. That had also been found when investigating the increases in National Insurance claims for the period since the 1948 Act and in comparing the National Insurance rates in Appendix 1 with the Manchester Unity experience. Another implication of that comparison was that a good deal of the increase since about 1900 in incapacity rates had taken place since 1948.

He thought that one danger of reducing sickness benefit as the length of a spell of incapacity increased was that it might drive sick people back to work.

He was interested to see in § 45 the extent to which bad risks could be identified from previous experience. Statistics had just begun to be produced from the National Insurance records which classified the experience of men in one year by their experience in the previous year. That was being done because many commentators on absenteeism from work had used the techniques to which the author had drawn attention as a means of identifying potential short-term absentees from industry.

In § 55 the author indicated that when $t = 8$ the ratio seemed independent of age, but the speaker thought the ratio seemed constant for lower values of t and he suspected that sampling error would account for much of the differences between the results for $t = 2$, $t = 4$, and $t = 8$. Further, the calculation did not have to be done in that way if it was based on National Insurance statistics because the same people could be followed through successive years of experience and the ratios could be calculated exactly for individual years of age.

Mr R. J. Myers F.S.A. commented on the rôle of the public and private sectors of long-term sickness benefits in the United States. He believed very strongly that governmental measures, i.e. social insurance, should provide a reasonable form of protection on which the private sector could build either through group or individual efforts so that people might have a reasonably good measure of economic security against the various social risks involved in their human lives. However, if the private sector was not doing an adequate job then it was a certainty—and even a necessity—that the government should step in and solve that particular economic security problem. Furthermore, such governmental action would almost inevitably prove to be irreversible.

There had been considerable activity in the private sector during the 1920s. Many individual life insurance policies were sold to which were added disability income riders, frequently for fairly long-term periods. A number of individual personal accident and health policies which were sold for only a short benefit period such as two or five years did not solve the social problems in view. In group insurance, relatively little disability income protection was sold. There were some policies which began as group life insurance whereby the base amount matured at disability and would either be paid in a lump sum or by instalments. Those did not solve the real social problem involved because at the end of the benefit period the individual might still have quite a long lifetime ahead of him.

When the Depression came in the early 1930s, most of the insurance companies had a disastrous financial experience. A few had underwritten policies very carefully but most of them had been 'over-sold' by their agents who had enthusiastically sold policies with cover far too high relative to the income of the individual and the possible loss of that income in the event of economic depression. To the best of his knowledge only one insurance company actually had such severe financial difficulties from its disability experience that it had to go through bankruptcy proceedings, but many other insurance companies were very hard hit and had to make up their disability losses from the life side of their business. The company that did

have financial problems was reorganized and in essence devalued its disability income policies to the extent of a 90% reduction in benefits for the same premium.

Another problem the insurance companies had in the 1930s with the economic depression was that there were many rather unusual court decisions that seemed to pay no attention to the language in the policy despite the very strict definitions contained therein. Perhaps that was due to the belief that insurance companies had huge sums of money so why should the court prevent the poor policy-holder from drawing from that huge surplus?

With that bad experience, most companies ceased writing disability income policies. That, in part, was the reason why disability benefits were written into the American social security system. Although originally started with old age benefits and followed quickly with survivor and dependant benefits, the planners of the social security system kept pressing for disability benefits to complete the picture. There was the pressure that many foreign systems contained those benefits and it was an economic risk not being covered by the private sector. The insurance companies opposed that but were in rather a weak position because they would not sell the particular benefit themselves, and yet they said the government should not do it either. In any event, the disability benefits were included in the social security programme in 1956 despite the dire predictions of the insurance companies.

The social security disability provisions contained a very strict definition of disability. There was about a seven-and-a-half month waiting period (or elimination period as sometimes described in the United States) before benefits were first payable. The definition was very strict and involved inability to engage in any gainful employment. That definition had been tightly administered and in fact many people in the general public felt they could not get disability benefits until they were practically dead. It was not so strict, however, because the social security system was paying more than one-and-a-half million persons disability pensions.

The actual disability experience was somewhat higher than the initial government estimates although it was well below the predictions of some of the insurance companies. In the initial period the disability experience was relatively low. In the next four or five years it rose rather significantly but in the following eight or ten years the disability incidence and termination rates had apparently levelled off. Whether that was true for the most recent year or two, when business conditions had not been too good, would be known only when the experience was analysed.

It was surprising that, unlike many other disability experiences, the disability incidence rates for females were lower than for males by some 25%, whereas it had been thought, from other experience, that the female rates might be as much as 50% higher. There was no good explanation but it had prevailed almost consistently since the beginning.

In recent years the insurance companies had returned to the field of monthly disability income benefits involving periodic payments usually up to age 65. That had been done more particularly in group policies where employers bought policies for their entire staffs rather than for their top executives.

One of the prime features of that type of protection was that the definition of disability was often the same as the social security definition, which although quite a strict definition, was quite satisfactory. In some instances employers wanted a somewhat more liberal definition in order to weed out some of their staff who they felt were not really competent, and in that case the insurance companies would agree, hopefully charging adequate rates for it. The disability benefits under private group policies were coordinated with social security and 70% of salary for total disability benefits (including social security benefits) might be paid. That caused difficulties for actuaries, since they had to estimate the effect of offsetting social security benefits against the total benefits payable and quite frequently social security benefits changed in magnitude.

In the group disability policies currently being issued there was great emphasis on paying the benefits up to age 65 rather than for a limited period of time. He thought it was very desirable that it should be done, and it was very important that the role of the private sector should be developed and not leave a vacuum for further expansion of the social security system. Although

that was good for the insurance business, it was good for the nation that there should be a balance between the public and private sector in the provision of economic security.

Mr G. J. Knapman said that in § 13 of the paper reference was made to a statement from a Students' Society paper by Mr Bond to the effect that the same basis could be used for sickness and mortality for both premium calculation and valuation. The author had very rightly pointed out that it was essential to check the actual experience before using such a basis for valuation. He would also agree that if a significant difference was found the premium basis would need to be reconsidered. Since there were few long-term claims it was necessary to look at them carefully. It was possible to obtain a reasonable agreement on the overall experience and still have a significant variation in long-term claims. If there was an excess of long-term claims he thought that should be taken into account in following the 'friendly society' method commonly in use in the United Kingdom. His own office had been writing that class of business for nearly ninety years and had one of the largest sickness and accident funds, but it was paying benefit to only 170 people for more than twenty-six weeks which was obviously subject to considerable statistical variation.

§ 14 referred to the American actuary approaching the problems in the light of tables designed for valuation. It was said the British actuary was constrained to follow 'friendly society' methods but the speaker thought they had been evolved for friendly societies giving benefits very similar to those they were currently valuing.

Referring to partial disability benefits, he distinguished between the benefit which might be paid when the insured was partially incapacitated from following his own occupation and that payable when the insured was totally unable to follow his own occupation and took up some other occupation. In some circumstances a number of offices, including his own, had proportionate benefit, the proportion being that which the actual loss of earnings bore to the insured's income prior to the onset of incapacity. That benefit was paid as of right, and it could have a favourable effect on the sickness experience. He emphasized that a certificate from the medical attendant giving the degree of incapacity was not received. The doctor's certificate merely said the insured could not follow his own occupation. There was, therefore, no need to seek difficult subjective assessments on the degree of incapacity which the medical attendant might be reluctant or unable to supply.

He thought that the taxation of benefits under sickness and accident insurance was unfair. It was the only example where tax was payable on an insured benefit but no tax relief was given on premiums and he suggested an arrangement similar to that for self-employed pensions business, with full tax on the benefits and tax relief on the payments. Ideally there should be tax relief on the interest on the fund. That would enable offices to offer very necessary protection to self-employed persons who at present could obtain that benefit only out of net income.

Dr O. Lundberg (a visitor) said that, although there were very similar conditions, legal regulations and problems in Sweden, actuarial models were different. The author had given a review of the British models, the continental model with a double decrement table and the American model built up from disability insurance connected with life insurance. Swedish long-term sickness insurance since the beginning of the century was based on the probability of falling sick and a 'survival' function defining the probability of remaining disabled. Swedish actuaries had not been interested in calculating the number of active lives in individual insurance or collective disability insurance. Approximating the number of active lives by the number living would mean an error of at most 5% on the safe side if the probabilities had been estimated from statistical samples of active lives. It was very difficult to define the active proportion, and short-term sickness should be excluded.

He agreed with the author that multiple decrement techniques were unlikely to point the way forward in modern sickness insurance. The approximation was made in Sweden that the 'survival' function was assumed to be independent of age. A sickness annuity independent of age could be put outside the integral valuation in the single premium formulae. The author had

referred to Dillner and to the 'survival' function in § 47. After about ten years its termination rate was constant, corresponding to a mortality rate for the disabled population of about 5%. The Commissioners Table in the United States did not seem to be too high according to Swedish experience.

In § 31 the author dealt with medical selection, selection according to length of waiting period and reverse selection for the disabled due to decreasing termination rates. A deeper study of the mortality for different durations of disability might throw light upon the inter-relation between mortality and morbidity. Selection resulting from the choice of waiting period was apparent in Sweden and arose from self-selection. Those more exposed to falling sick seemed to prefer a shorter waiting period than other people.

Originally there were different opinions in Sweden about methods of valuation. One company used Manchester Unity tables with the British method while others calculated for all policies the premium reserve of future attacks and a claim reserve for all those entitled to draw benefit at the valuation date. The latter reserve had to be increased with regard to the calculated number of claims incurred but not reported.

The speaker said that the last sentence of § 45 of the paper was incorrect if the author was referring to long-term sickness insurance, but was correct if he meant motor insurance.

He thought it was wonderful that although there had been two world wars, other world crises and inflation, long-term sickness insurance was still based in Great Britain on Watson's tables from Manchester Unity 1893–97.

In Sweden a new situation had arisen since a permanent disability pension granted according to the Swedish National Insurance Act would as a rule qualify the insured as permanently disabled for private insurance. Where the national pension was only granted for one or two years, that greatly affected private insurance. Some Swedes thought that the premium for long-term sickness insurance ought not to be automatically renewable and some offices wrote individual and group insurance on a single-premium basis.

Mr C. S. S. Lyon referred to Daw's paper (*J.I.A.* 1971, **97**, 17) on regional variations in mortality and sickness. Daw had available to him at that time only general statistics relating to sickness insurance as a whole produced, he thought, by the Department of Health and Social Security. Earlier in 1971 the Government had published two very long volumes resulting from the Social Survey into the condition of handicapped and impaired people in Great Britain living at home, and the second of those volumes dealt with work and housing. He was concerned with work.

The volumes showed that the population of working age that was impaired—excluding housewives—was divided into three parts: firstly those who were working; secondly those who were off sick temporarily or unemployed; thirdly, there were those who regarded themselves as permanently disabled and unable to work again, and it was that last group that was particularly interesting. The survey was based on a one-quarter per cent. sample of the whole population, interviewing in depth people who responded to it. It had been carried out initially by postal questionnaire. The percentage of economically active population who were impaired in some way had been found to be nearly constant across the whole working community. 'Impaired' meant either a permanent handicap or a physical condition which affected the ability to do certain things. That figure was pretty constant between 2% and 2½%, with little regional variation. It broke down into a slightly higher figure for men, 2·6%, and a lower figure for women, 1·6%, which suggested that women tended to give up being in the labour force and stayed at home.

There were some startling variations among those who said they were permanently disabled and unable to work again. In the Northern regions and Wales it emerged that the economically active population was diminished by 1·6% because of people who regarded themselves as permanently disabled; in the West Midlands, the South West and Scotland the figure was 1·2%; and in South-East England, including London and East Anglia, the proportion was 0·8%. The pattern was very similar in the case of people who were temporarily sick or unemployed where

there were about half as many as the number who regarded themselves as permanently disabled for the purpose of the discussion.

Why had these variations occurred? They did not seem to be explained by different distributions of manual and non-manual workers in different regions, though that was no doubt a factor. For non-manual occupations the proportion permanently disabled in the country as a whole was 0·7% but for manual workers it was twice as high at 1·4%; for people in personal service it was higher still. No doubt there were errors of over-statement because to some extent those were people's own opinion of themselves. There were also errors of under-statement because people in hospitals and institutions were not included. Other sources of under-statement must exist because the sample had detected only half the people who received industrial injury disablement pensions.

When the regional variations were compared the results were found to be similar to those Daw had produced for sickness caused by arthritis and rheumatism and also by heart disease, no doubt because they were usually long-lasting conditions. That suggested that there was a much more pronounced regional variation in long-term disability than in mortality as Daw had shown there was for sickness as a whole, and that should be considered with care when underwriting long-term sickness insurance.

Mr L. J. Martin said that the Manchester Unity experience of 1893–97 had been used for so many years by actuaries dealing with friendly societies and sickness insurance in general that he felt he should comment, almost perhaps for historical reasons, upon the relatively recent trends within the Manchester Unity itself. For many decades the sickness liabilities of all the lodges within the Unity had been valued using the rates exhibited by the occupational groups AHJ, with loadings where the experience of the lodge had exceeded 100% of the normal expectation on that basis.

The trend of actual to expected claims for the whole Society for all periods of sickness, calculated by reference to the unadjusted AHJ rates, had over the last three decades been as follows:

Valuation	Final year of valuation period	Ratio of actual to expected sickness (%)
Fifteenth	1943	96
Sixteenth	1948	85
Seventeenth	1953	83
Eighteenth	1958	81
Nineteenth	1963	78
Twentieth	1968	77

Thus, over the last twenty-five years, the overall claims rate had diminished only very slowly and very steadily from 85% to 77% of the expectation. In each of those quinquennia the ratio of actual to expected cost of full pay had been a little higher than that for reduced long-term claims, but the differences had also been remarkably constant.

Mortality experience had also remained fairly constant having varied between 93% and 100% on a mixture of ECRD and CCRD over the same period. For the twenty-first valuation of the Manchester Unity which was about to be made the basis used for so long was being changed. A new series of sickness and mortality rates had been constructed, reflecting new trends revealed within the experience of the Manchester Unity. The new rates would, he hoped, be published and might be of interest to other actuaries. The all-periods sickness rates in that table differed slightly from the AHJ rates: the short-term sickness rates had been increased and long-term rates decreased, reflecting recent experience.

When dealing with sickness experience it was the rate of claim for sickness benefit which was being examined and not the rates of actual sickness. Rates of claim were subjective. In friendly societies there was marked correlation between the amount of sickness benefit insured and the

rate of claim. As the author had indicated in his paper, the levels of claim and the extent of the company's liability was also affected by the wording of the contract, by underwriting practice and by the extent to which effective supervision of claims was maintained. If superimposed upon those subjective matters were those which were known to affect the actual rates of sickness, i.e. age, sex, marital status, geographical location and occupation, it became apparent that standard tables should be used with great care. The rates of claim of one organization might be quite inappropriate for another. It was possible to use any recently published table applicable to an appropriate class of lives to produce tables of life assurance premiums which would give reasonable results. The same was not necessarily possible for sickness insurance and standard sickness tables. It seemed to him there was little point in going into the theoretical niceties of actuarial techniques and formulae if the basic rates to be used did not represent the likely future claims experience of the organization. In practice this was particularly so when dealing with very short periods of sickness benefit where the rates of claim seemed invariably to turn out much higher than any table seemed to indicate. There were also similar dangers when assessing premium rates and valuation bases for sickness benefits which commenced after a period of sickness of three or six months. In the latter instance, premiums were likely to be very expensive. The use of an inappropriate table could produce some embarrassing results. Luckily, however, the general margins and loadings for expenses were probably sufficient to act as a buffer against any marginally adverse experience. He found himself always anxiously awaiting the claims experience on a new sickness table or fund, whereas mortality seemed so much more straightforward.

Until quite recently few offices wrote permanent long-term sickness and disability insurance. Such business was primarily the concern of friendly societies and a small number of actuaries. Currently the business was growing steadily in popularity and as a result more offices were writing such business and more actuaries were becoming interested in that side of their work and the statistics and techniques relating to it.

Mr S. Benjamin, in closing the discussion, thought that the history of sickness insurance in the United Kingdom fell into three periods: firstly, before 1903 and the publication of the Manchester Unity investigation; secondly, the period up to 1932 when papers to the Institute and Faculty reported the traumatic experience of the American offices; and the subsequent period in which many offices which had formerly ignored the business entered the sickness market. A fourth period was starting with the entry of the C.M.I. into the field.

The first period was recorded in an interesting paper by Francis Neison at the Third International Congress in 1900 and he reported nine previous investigations starting from 1751. He was concerned with the heavy cost of protracted illness and it was interesting to hear the same discussion going on currently. He had suggested sickness benefits should finish at age 65 and be replaced by annuities payable whether people were ill or well and that it was necessary to limit costs by reducing payments for a protracted illness. Alfred Watson had commented and confirmed the effectiveness of that thirty years later using Manchester Unity data. Neison in 1900 had said that sickness insurance was not a practicable business and that there was a fortune for anyone who could run it on lines similar to industrial branch assurance which had covered benefits on death so successfully.

The start of the second historical period was described in § 5 of the paper where the author had said that the disastrous history of the business in the United States was a factor of fundamental importance. In 1932 two papers were presented to the Institute on the subject and another to the Faculty. One of the two papers presented to the Institute was submitted by an American, Rhodes, and presented in his absence. At the same time H. P. Clay presented a paper on business in the United Kingdom. Its opening paragraph stated that during the five years 1926 to 1930 inclusive the life insurance companies transacting business in the State of New York reported an aggregate net loss of surplus in connexion with disability insurance as follows: 1926 $18 million, 1927 $21 million, 1928 $20 million, 1929 $22 million and 1930 $48 million. Translated into modern terms he thought that could read as follows: the United Kingdom companies,

speaking at that point i time, in 1966 to 1970 lost £36 million, £42 million, £40 million, £44 million, £96 million—that was the situation they were in. He had just multiplied by ten for inflation through the 40-year period and divided by five to convert dollars to pounds. It was a traumatic experience. Rhodes had said there had been an orgy of competition and in administering claims companies had been too concerned about the effect of rejecting a claim on their new life business in the locality. He had said his own company had not made losses; that had caused a stir and he had said he thought that was due to the special policy which framed the contract as a contract of indemnity and limited benefit to a fixed proportion of the insured's income prior to disability.

The speaker referred to Mr Bond's suggestion that underwriters should get some experience of the business and said there had been an interesting paper *Continuous Disability Insurance* (*T.F.A.* 1934, **14**, 21) given by W. A. Robertson in 1932. It had illustrated practically every point of underwriting, claims, policy wording and so on, with specific case histories.

In 1952 Mr Knut Medin described United Kingdom sickness methods as non-probabilistic because only expected values were being used. He distinguished between the straight method where the expressions used the probability that an active life might fall sick, and the sickness annuity method where the expression was the probability of falling sick based on all lives, active and sick. There were some figures given by an American, E. H. Minor, to the Eighteenth International Congress in 1968 of continuance tables by age of persons remaining sick, which in parts were similar.

He had compared Medin's Swedish table with the American table at ages 35 to 45 starting with a thousand people who had been sick for one month. Looking at the continuance after six months, and after twenty-four months, there were sixty and twenty-three respectively left (± 1 in both cases). Medin also gave a table which could be compared with the American table of new cases of sickness and again the figures were fairly close. Medin gave a rate of falling sick of 0·11 at 25 rising to 0·14 at age 55. Minor gave 0·11 rising to 0·17. Also Minor gave the average length of claim as about four weeks for those in their 20s and eight weeks at age 50. In one case, calculations for short-term benefits for American policies using 80% Manchester Unity showed heavier premiums which were closer to American premium rates at longer terms with longer waiting periods. The calculation of premium rates was probably the easiest way to compare the two totally different approaches of the sickness method and the invalidity method.

Minor's paper to the 1968 Congress gave spectacular-looking graphs of the growth of the business but on closer inspection showed that growth in loss of income benefits had been only about $6\frac{1}{2}\%$ per annum. The hospital and medical benefits had been growing at the fantastic rate of 16% per annum. He described the current American situation of aggressive competition and very high lapse rates and referred to the widespread use of guaranteed renewability where the premiums could be increased for a whole class but not for an individual. Most American policyholders were unaware of the difference between cancellable and non-cancellable policies.

In a recent paper, Dillner explained a method using the probabilities of becoming sick, based on a denominator including both active and disabled lives, which made the method theoretically sensitive to the needs of the population to which it was being applied. He defended the method as being flexible and simple. The tradition in the United Kingdom of friendly societies and Manchester Unity seemed simple and flexible, but if the benefit continued beyond the term of the policy there would be considerable difficulties in using that method.

Mr Benjamin thought the fourth historical period was about to start in the United Kingdom with the C.M.I. investigation. It was interesting that the investigation would start off by looking at the experience on Manchester Unity methods but would also move to other methods, looking at the rates of starting claim at age x and then, later, at the amount of the claim.

Referring to reinsurance, the speaker thought the obvious method was by original terms but he wondered about reinsuring of claims beyond two years in order to limit the cost.

The President (Mr R. S. Skerman) said that Mr Hamilton-Jones's theme was very timely and he was happy to propose a vote of thanks to him for presenting it. He believed there was a need for

protection against loss of earnings due to disability over and above that provided by the State and that need was one which he believed private insurance should meet. The paper was timely because insurers in the United Kingdom had in recent years become increasingly aware of their responsibility to meet that need and the volume of business had expanded considerably.

The assessment of proper premium rates and valuation reserves was not an easy actuarial problem. It was first necessary to have available reliable statistics of past experience, and the extension of the functions of the mortality investigation to the collection of experience from insurers of morbidity statistics was therefore much to be welcomed. It was also necessary to use those statistics to make estimates of future experience and difficult questions of judgment arose because of the many factors which entered into such estimates. As examples, the President gave future economic conditions and a level of disability which in the future would be regarded as qualifying under the definition of disability in the policy. Suitable actuarial techniques had to be applied to the estimates of future experience in order to determine premiums and reserves. The author had provided a survey of all those actuarial problems, and his paper was a valuable addition to actuarial literature.

The author, in reply, referred to some of the criticisms of his paper. He fully agreed with Mr Bond in his remarks about the long-term investment of sickness funds. He thought the proportion of equities should be carefully watched and he thought that the Department of Trade and Industry would have problems because there was no obligation on offices to separate the assets by class of their long-term business.

He thought that in § 10 he perhaps had been guilty of too much precision in using the word 'precise'. There were a number of areas in connexion with returns to the Department of Trade and Industry which were extremely vague. Perhaps he should have said 'more precise'.

Some of the points in the discussion had cancelled each other out. The opener was worried about female lives, but Mr Myers had explained that human behaviour was beyond rational analysis. The author said that the American tables included a small proportion of female lives; it was not thought worthwhile making a distinction because the American statistics were built up from benefits attached to life policies in the early days. Most of the American statistics relating to longer-term sickness were a carry-over from the earlier investigation. The Americans produced those tables by modifying in the light of experience the earlier periods of claim but keeping the older figures for the later period. That was remarkably similar to the approach to the Manchester Unity. Mr Fine had compared the Manchester Unity and Commissioners tables. The position was being watched closely in South Africa, Australia and Britain.

Hospitalization benefits had been mentioned several times during the evening—British actuaries were trying to convince their Continental friends that the class of business discussed that evening was separate from hospitalization business and that, for example, a group which has been set up to discuss problems of sickness business in Europe should look at the two as separate problems. Unfortunately that proposition was accepted in the wrong way, i.e. that if there were two separate problems, one was for the life actuaries and the other was for those who provided only hospitalization benefits.

Mr Pingstone had warned about the long period effect of claims costs and the author agreed that his warnings should be taken seriously. That business required a considerable amount of self-control as well as actuarial control.

Mr Guaschi remarked on the effect on recovery of a reduction in benefit but the author agreed with Mr Whitehead's remark that it was wrong to force a sick man back on his feet. If he was sick and was being compelled by sheer economic necessity and pressure to return to work, that was not the object of the exercise. Dealing with human behaviour was what made the whole subject so very difficult and it was fascinating to see what was demanded of them and the degree to which those demands could be met without jeopardizing economic stability.

The distinction in the paper between accident and sickness business—or between the claims due to accident and due to sickness which would be found in American literature—was deliberate. He thought there was a very large area not covered by the paper in which friends in

the accident insurance world were experts and which actuaries would find quite different and fascinating.

He was most grateful personally to Mr Whitehead for the comments he had made, particularly on the trends of the experience.

In the United States, a problem which he hoped would not arise in the United Kingdom was the unusual court decisions. The public wanted two things, a benefit when ill and a solvency guarantee, and the price the public were prepared to pay was governed to some extent by competition. The guarantee was governed by a deliberate control of the conditions under which benefit was paid; the actuary's job was to balance everything out and traditionally he leaned over in favour of a firm financial basis for the business. That meant that strong controls were used as a secret weapon. That had been the traditional development of the business and the secret weapon was only produced when the insured himself was being unreasonable, maybe submitting a large and rather dubious claim on a longer-term basis than it appeared to warrant. Offices were normally much more lenient than a reading of their conditions would seem to imply.

Mr Knapman has referred to the need for checking the actual experience for the valuation basis as mentioned in § 13 of the paper. The author said he was quoting Mr D. J. Bond's remarks in that paragraph.

The speaker sympathized very much with Mr Knapman's plea for a Manchester Unity type of investigation in the United Kingdom. It had done well in the past and there was a detailed professional examination on the subject. He was also glad that Mr Martin had spoken on behalf of the friendly societies even though they were perhaps of slightly diminishing interest on account of overall trends over which he thought there was very little control. A very great debt was owed to the friendly societies and the new tables and the new rates to which Mr Martin referred ought to be welcomed.

The reference to the fantastic growth of hospital benefits in Minor's paper was interesting. The speaker stressed the great importance of public understanding of the difference between long-term and short-term contracts. He thought in the United Kingdom the public were properly aware of the difference, whereas in the United States there was a little more room for misunderstanding.

The following written contributions were submitted:

Mr K. J. Clark, F.S.A.: The author refers to a paper by E. H. Minor for a description of current actuarial methodology for individual policies written in America. One of the points made by Minor and restated by the author is the inappropriateness of the 1964 Commissioners Disability Table and other published experience data for calculating premiums for an individual company.

A number of recent developments in the American product have made the problem of choosing an appropriate morbidity basis for long-term disability insurance more acute:

Liberalized definition of total disability. Some companies insure 'own occupation' to age 65. What proportion of claims previously terminated at the end of the shorter 'own occupation' period will continue as claims? What will be the effect on recovery rates during early claim durations? This development is viewed with great alarm by many actuaries.

High amounts of issue. Many companies write $2,500 of monthly benefits, all tax free, and a few write as much as $4,000 per month. How much additional margin, if any, is needed on large policies? Although previous studies have shown very little variation in experience by amount, large amount business in such studies would today be classified as average size issues.

Cash values or return of premium benefit. These benefits provide for return of a percentage of premiums less claims paid, perhaps 100%, either at age 65 or after 10 years; sometimes with cash values at intervening durations. These benefits will have a marked effect on rates of persistency and the quality of the persisting business. Unexpectedly high persistency by the claim-free policyholders along with relatively few but large claims can produce losses under both the

long-term disability insurance benefit and the return of premium benefit. These benefits also present unique valuation problems which require use of computers. It will be another five years before the first return of premium benefit is paid under long-term disability insurance in America and, meanwhile, in calculating premiums, actuaries must use assumptions based on little data.

Rapid increase in social security benefits. Already many insured people would receive a higher after-tax income disabled than working, and future increases in social security benefits will add to this population of over-insured policyholders. Presently, companies cannot protect themselves through policy provisions. The actuary must either ignore or estimate the effect over-insurance will have on long-term recovery rates.

Liberal guaranteed insurability provisions. Such provisions may be renewable to age 50 or even later, and may allow the insured to double his cover subject only to proof of financial insurability. We know very little about the relationship between select and ultimate morbidity under short-term disability insurance and virtually nothing under long-term disability insurance. The wide variation in premium rates for this benefit suggests somewhat less than uniform agreement on this question.

Index-linked or automatically escalating benefits. Benefit payments may be linked to a price index or the policy may provide for an automatic annual percentage increase in the benefit payment while disabled. To calculate premiums for the index-linked benefits, one must either use very conservative assumptions or pray for good fortune. The automatically escalating benefits are not as troublesome but one must still consider what effect such benefits will have on recovery rates.

Minimal or no dividends projected. Participating premiums for policies written today provide little or no margin for anticipated dividends. The market place has forced par companies to compete with nonpar companies on the basis of 'initial cost' instead of net payments or net cost. Thus, actuaries for par companies as well as nonpar companies must identify realistic assumptions and reasonable margins if they are to develop competitive premium rates.

Keen price competition. The losses experienced in America under medical expense insurance and the desire of companies to seek a larger share of the disability insurance market to replace their medical expense insurance market (which may be nationalized) has stimulated price competition as well as product competition. The above liberalizations in product have been accompanied by reductions in premium rates by as much as 20%.

Mr E. H. Minor, F.S.A.: I shall confine my comments to the references to practices of American actuaries and to the implications regarding the insurance cover chosen by American applicants. Whatever disagreements I may have with the author are with respect to the latter.

Since the paper has been prepared almost entirely from the viewpoint of the actuary, the problems of the sales force, claim adjusters and persistency of policyholders have been given rather scant attention as compared with the intricacies of the actuarial techniques involved. Yet, if I recall correctly, it was Sir Alfred Watson who stated that sickness insurance was 'more of a managerial than an actuarial problem'. We should not forget that benefits which appear to be ideal to the actuary may have little appeal to the prospective policyholder and that merely moderate satisfaction with the cover is insufficient to prevent lapse by the healthy life on the renewal date.

It is the design of the policy that determines the ultimate experience, and anti-selection is the privilege of each renewing policyholder. The longer the waiting-period, the less chance there is for the policyholder to become familiar with the insurer's definition of disability and the efficiency of the claim department. The actuary's ratio of actual to expected is therefore more likely to work out favourably with a six-month waiting period than with one or two weeks or thirty days. From his point of view, it becomes a 'better' benefit—but the American public prefers a shorter wait. This puts a heavy burden on the underwriter and the claim manager who may suffer from the actuary's miscalculations—rather than the contrary that all too often

prevails. As long as American policyholders prefer a 30-day waiting period to 6 months and can therefore afford only a two or five-year benefit, the actuarial problems involved in providing benefits to age 65 become of much less significance than they may be for the British actuary. The author covers this situation in § 39 but his observation that the argument is that 'it is not worth paying for a benefit . . .' is not a phrase we would understand—I think he means that Americans feel the benefit 'costs too much'. The substantial benefits provided by the Government for those with young families tends to encourage that attitude.

There may be some misunderstanding of the extent of conservation included in the American Basic Continuance Table. It should be emphasized that the use of the American table for valuation purposes does not imply that any American company would expect, after reasonably good underwriting, not to have a substantial margin—barring a severe economic slump. Actual results should be well below 90% and the comparison made with Swiss experience (see § 59) is not surprising.

The comments of § 42 as to the apparent lack of age variation in the values of $p_y^{\frac{1}{2}}$ may be well taken. However, a re-examination of the basic termination rates during the first fifteen years of disability incline me to believe that we cannot dismiss this actual experience until there is clearer proof based on credible modern experience. The doubts that have been expressed by British actuaries may have been influenced by the computational labour required for so long a select period. Whether it is nobler for the actuary to set aside the age variation and escape the cumbersome calculations, or stay with the basic data letting the electronic computer provide the multitude of tabular values required, is the real question today. American actuaries decided to turn this problem over to a central bureau which published a volume of select disabled life annuities offered to all companies at very low cost. Not only did the computer do all the work but the actual print-out was reproduced directly by the printer. One of the many tables shows that the quinquennial age variations in these annuities, even after ten years of disability, are of some significance (see page 63).

I agree fully with the author's contentions in §§ 61–63. The matter of additional allowance for permanent partial disability benefits is of considerable importance in connexion with Workmen's Compensation cover for accidental injuries, but partial benefits unduly complicate the actuary's problem in insuring long-term sickness disability. During economic prosperity a sizeable partial benefit loses its attractiveness through inflation but could be a source of serious financial loss during a slump.

The tributes paid to Watson's Manchester Unity Experience are well deserved and many American actuaries share this view. However, the suggestion that 'pension fund' notation became a more modern and desirable form than Hamza method functions as developed by American actuaries cannot be subscribed to. We still think highly of Hamza methods and have endorsed them in our current models of premium calculation in the latest edition of our textbook *Health Insurance Provided Through Individual Policies* (Society of Actuaries, 1968). With the use of modern electronic data processing equipment, the problems of long-term continuance table functions become less cumbersome and the 'pension fund' method preferred by Hunter and Phillips is no longer popular.

Mr H. F. Rood, F.S.A.: § 2: The fact that disability payments are no longer made after retirement is important and was one of the lessons learned during the Depression, when disability benefits in effect became retirement benefits for some who wanted to take advantage of the companies. Secondly, most life insurance companies issue guaranteed renewable contracts today, rather than cancellable policies. In fact, the latter are not permitted in many States, although companies still do have the right to refuse to renew on a premium-paying date. This has changed the underwriting practices considerably.

§ 3: The competitive situation has been largely responsible for the definitions of disability used. After the Depression, companies were very tough but over the last few years with a booming economy many companies have relaxed the definitions.

Disabled Life Mean Reserves—Section III—$100 Monthly Indemnity
1964 Commissioners Disability Table @ 3% Interest

Benefits expire within T years of valuation date	Duration from date of disablement to date of valuation more than 10 years but less than 11 years										
	Age at disablement										
T	22	27	32	37	42	47	52	57	62	67	72
1	584	585	586	586	587	586	585	583	580	576	568
2	1666	1673	1680	1683	1686	1680	1671	1654	1631	1596	1531
3	2644	2662	2678	2686	2695	2679	2653	2610	2551	2456	2293
4	3532	3563	3591	3607	3623	3592	3542	3463	3352	3174	2885
5	4339	4384	4427	4451	4475	4425	4346	4224	4047	3766	3338
To age 50	10074	8677	6226								
To age 55	11097	10331	8857	6278							
To age 60	11771	11420	10589	8964	6317						
To age 65	12206	12123	11707	10698	8972	6197					
Lifetime	12758	13015	13125	12897	12341	11277	10099	8751	7270	5815	4463

§ 5: Disability experience began to worsen in the 1920s, several years before the Depression. I believe this was largely due to the fact that companies were extremely competitive in their benefits, some even providing increasing benefits for long duration disabilities. Court decisions made it necessary to recognize total and permanent disability after a reasonably short period of time and when a person was prevented from following his own occupation. Consequently, most of the companies were issuing policies with a 90-day waiting period but were making payments retroactive to the date of disability. In 1930 the majority of companies changed to a 4-months period and about 1933 nearly all of them ceased issuing income disability, although a few continued with a $5 a month benefit. They issued comparatively few policies because the underwriting was so severe that most agents would not apply for disability and thus risk a declination of the benefit with the possible loss of the life insurance sale. It was not until about 1948 that companies generally began to issue $10 a month income disability again with life insurance, although a few offices successfully issued non-cancellable disability benefits throughout this period.

§ 39: I believe that short-term disability coverage has been offered largely because the companies feared a repetition of the bad experience of the 1930s and were particularly concerned with situations such as a mental breakdown where it was difficult to disprove the disability. I believe companies are now more willing to issue benefits payable to age 65, for example. I emphatically agree with the words shown in italics. Companies decide on their policies with respect to underwriting and claims practice and set their premiums accordingly. This is probably more true with respect to disability insurance issued without life insurance, but it is a factor in trying to obtain a homogeneous experience for an inter-company study.

§ 56: Before income disability became popular in the 1920s an instalment benefit was issued, this providing for the payment of a face amount in 10 annual instalments. This was treated as a pre-payment of the face amount, since it was expected that the insured was totally disabled and that the mortality rate would probably be rather high, with most dying within the 10-year period.

§ 57: I believe some of the companies have avoided the problem of psychosomatic breakdown by restricting payments to a relatively short period for such cases, although providing longer benefits for other forms of disability.

§ 60: Lump sum settlements are particularly useful in settling claims of persons who are found to be malingerers. They are then able to effect miraculous recoveries rather than having continually to feign illness. This sometimes raises a moral question as to whether it is appropriate to offer lump sum settlements which may be accepted by persons who are truly disabled but who may be induced to accept what appears to be a large sum of money.

§ 63: The U.S. military services retire men on a percentage disability basis. These men then collect benefits for life, even though they are able to pursue full time occupations. I do not know of this being done in civilian life in the U.S.

§ 64: Legislation and the tax situation are both extremely important in determining the benefits to be paid in various countries. For example, in the U.S. our courts have many rulings involving the definition of total and permanent disability with the result that the policies recognize disability after a specified time, such as six months, and carefully define whether or not the person must be disabled so that he is not able to pursue his own occupation or any occupation. In the United States, the first $400 per month of disability benefits is tax free, whereas benefits in excess of this amount are considered taxable income. In some situations an employee could be better off disabled because of the tax advantage on the first $400 of income than he was as an active employee.

Mr G. B. Trotta, F.S.A.: There has been an explosive expansion of long-term disability (LTD) insurance in the American insurance market and this expansion has had its most dynamic thrust within the group line of operation. Some of its more common features are:

(1) LTD is written on a one-year renewable basis, with premiums payable monthly. Rates are now subject to revision annually, although it was common over the last five years to have issued coverage with a two- or three-year initial rate guarantee.

(2) For the larger cases (say, 500 or more covered lives) benefits are often tailored to dovetail with existing employer arrangements for providing short and long-term disability benefits *via* other existing vehicles. The design of the specific plan is a matter for negotiation between the policyholder, his consultant, and the insurance company. Because of the keen competitive atmosphere which characterizes group sales, LTD has sometimes been underwritten with greater deference to sales acquisition rather than sound underwriting.
(3) Benefits are expressed as some percentage of gross pay (usually 50% to 60%) reduced by other disability payments made by the Social Security systems, disability benefits from the pension plan and from group life insurance disability provision. Benefits are payable after the expiration of the waiting period (generally six months) until the employee recovers, dies, or reaches age 65 (the normal retirement age).
(4) There is often a more liberal definition of disability for the initial two years of disability and a more restrictive definition applying thereafter.
(5) There is normally no submission of medical evidence on individual lives, nor, in fact, is there any significant individual life underwriting at all.
(6) In case of cancellation of the LTD coverage, payments on existing open claims are the responsibility of the carrier, thus necessitating adequate open claim reserves.

§ 5 of the paper is particularly relevant. Group actuaries, prompted by the phenomenon of heavy financial losses in several instances, are stepping back and taking a hard second look at the factors which influence the actuarial calculations underlying LTD. As yet, there is no wholesale withdrawal from the field on the part of the commercial carriers but there is a good deal of rethinking in the direction of more stringent underwriting safeguards and less liberal benefits. It might be of interest to outline, in a somewhat loose 'stream of conscience' manner, the rethinking process which many group actuaries are currently undergoing in the United States:

Why has LTD, apart from the other cover marketed within the group operations, been so difficult to handle? Until the recent appearance of LTD, policyholders and brokers have become accustomed to discussing the need for rate increases against the background of incurred loss ratios largely composed of a high 'paid' component. Thus, if the Medical Care coverage had an incurred loss ratio of 102%, this figure might be composed of paid claims in the neighbourhood of 90%. There was very little room to argue concerning the additional 12% made of various type reserves. However, in LTD it is not unusual for the actuary to come up with an incurred loss ratio of 300% and yet have a paid ratio of less than 50%. Under these conditions, he must then convince others as to the validity of the long-range disabled life reserves which he has established. The initial reaction to his established reserves, borne sometimes out of simple shock when apprised that the rates must be increased 200 or 300%, is likely to be '. . . something must be wrong with those reserves; you simply couldn't need funds of those dimensions to liquidate your outstanding liability . . .' Unfortunately, many actuaries are beginning to have doubts in the opposite direction, i.e. the so-called 'redundant reserves' are beginning to show signs of actually being inadequate. As we see more and more instances of expected terminations proving to be over optimistic, many actuaries are beginning to re-examine their reserve basis with an eye towards strengthening.

Why are LTD premiums susceptible to such excessive increases? As with any underwriting risk which has a low frequency of occurrence, the unexpected addition of only a small number of claims can have a traumatic effect on the ultimate financial experience of the risk. Obviously, this is the case for LTD, where less than three claims per thousand is generally expected in the course of a financial year (this expectation is predicated on disabilities lasting at least six months for a preferred occupational class with a normal distribution by age). It becomes apparent that six additional claims could well triple the expected frequency, whereas the like number of additional claims for, say, basic hospital insurance might only exceed expectations by 5%.

Is LTD an insurable risk, in the conventional sense of the word? Many actuaries are beginning

to pose this question to themselves and to one another because of the unusual number of parameters which ultimately affect the morbidity experience under LTD. The actuary must:

weigh the flux in the over-all economy;
analyse the relative strength of the general industry within which a particular policyholder operates;
assess the possibility of a policyholder's work force unexpectedly contracting as a result of the factors just mentioned;
estimate the effect which an LTD programme will have on triggering those marginal disability claims which might be described as 'within the control of the insured';
determine the degree to which an LTD programme would precipitate early retirements; and
estimate the effect which LTD benefits will have on many outstanding claimants as to whether they make an effort to overcome their state of disability and return to work as opposed to adopting a permanent disability psychology and remaining out of active employment until the normal termination of benefits.

Specifically, what have been the items which have caused actuaries some concern?

(1) Occupational Classes.

(2) Source of LTD Funds. Unlike many other welfare benefits offered within the traditional spectrum of the group operation, LTD is often funded by 100% employee contributions. Thus, the force of anti-selection is brought into play. Since the employee is enrolled on a 'you pay for it all', basis, he is more apt to consider his possibility of receiving benefits in return for his premium contributions than would be the case where he is responsible for only a small portion of the total premium cost.

(3) Benefit Formulae. LTD benefit formulae often reflect the historical pattern established by short-term disability programmes which were prevalent prior to the 1960s, i.e. benefits which provided from 50%–65% of gross income payable for the first 13, 26, or 52 weeks of disability after a short elimination period of, say, seven days. However, with the increasing significance of the various Governmental Income Taxes (Federal, State, and other local) benefits which are modestly described as 50%–70% of gross pay often turn out to be 'overly rich 80%–90% of take-home-pay' as one ascends the gross income ladder. In such cases, the claimant ceases to be financially penalized as a result of his disability and any financial incentive he may otherwise have had to rehabilitate himself and return to active employment has dissipated.

(4) Carve-outs. This term refers to those credits which are given by the actuary in his calculation as he estimates the liability upon which to make his ultimate premium calculation.

(5) Pension Supplement. This benefit within the LTD programme provides for a substantial replacement of the pension benefit which otherwise would have accrued in the absence of the qualifying disability under the LTD programme. It has been found that, where an insured in the penumbra of his retirement (say, at ages 55 and above) determines that he will suffer only an inconsequential loss under his pension programme as a result of going on LTD, he will be more prone to trigger a marginal disability than will a counterpart who anticipates an irrevocable diminution in his pension benefits if he drops out of the active employee in force eight or nine years prior to his normal retirement age.

Mr G. W. Pingstone: As the 'recovery rates' and views with regard to the rate of permanent total disablement in §§ 55 and 58 of the paper are unsupported by any actual experience results, it appears of interest to put forward the results of small investigations in both areas carried out on the data of one large company as a result of the paper.

Recovery rates. Treating death in the same way as in the paper and using the notation of § 55, the experience of very sick lives over the years 1962–70 inclusive for all ages shows $k_{x+t+1:x+t}$ to have a value of about 0·86 for values of t from 0 to 3 inclusive. Unfortunately sub-division of the data by age was impracticable but the close correspondence of the overall result with the figures in § 55 seems of considerable interest.

Rates of permanent total disablement. A comparison for the years 1967–70 inclusive of premiums

and claims for total and permanent disablement benefits provided under group life assurance schemes (instalments over a period of 40 or 60 months in lieu of the capital sum death benefit) showed a steeply rising trend, reaching 50%, over the three years 1967–69, with a reversion to an intermediate level in 1970 if the results for one particularly large scheme were excluded. The results under this large scheme were quite different in that the level of claims in 1967 was double that for the remainder of the business, the claims in 1968 and 1969 somewhat below the level of the remainder, but the claims in 1970 were both double those in 1967 and double those of the remainder of the business in 1970. It is therefore fairly clear that claims for instalment benefits based on permanent total disablement are subject to wide fluctuations and that recent experience by this large company does not support a reducing level in rates of claim, as suggested at the beginning of § 58. The extremely heavy claims in 1970 under the particularly large scheme also seem to suggest reflection of prevailing economic conditions as a contributory factor which must not be overlooked even in the area of 'total permanent disablement'.

Mr G. F. Stout: In § 5, the author discusses the effect of a slump. In the United Kingdom at the moment, there is high and rising unemployment but apart from that the economic outlook is quite bright and interest rates are falling. However, whether unemployment is caused by a slump or by a beneficial slimming down of manpower it is bad for long-term disability business and I agree that the fund should be invested so as to be fairly immune against a recession. That cuts out property and equities. Investments should also be fairly marketable which cuts out mortgages. I would therefore favour sound fixed interest securities, with up to, say, ten years to run for a mature fund.

In §§ 5 and 9, reference is made to the discontinuance of a single premium scheme. The benefit is normally a deferred one and I think it is usual on discontinuance to accept claims where disability has commenced even though benefit is not yet payable.

The use in § 7 of the expression 'waiting period' to refer to a deferred benefit policy is new to me and it seems a pity to risk confusion. Bond uses 'deferred benefit' and I think 'deferment period' is quite clear. If there is no deferment period we have an 'immediate benefit' policy. In the U.S.A. if disability does not last until the end of the deferment period the claim is said to be 'eliminated' giving rise to 'elimination period' but I do not think that that expression is used in the U.K.

Some insurers will have nothing to do with contracts which benefit a third party. I have no doubt that 'key man' contracts as described in §§ 9 and 61 involve a high risk of conflict of opinion in the event of a claim.

To avoid being misled as in § 12 the actuary should make some attempt to allocate the actual expenses to (a) putting new business on the books, (b) servicing existing business other than handling claims, and (c) handling claims. While (b) may be regarded as a function of the number of policies in force I think that (c) can be quite realistically considered as a function of the number of weeks' disablement handled. Both the amount of weekly benefit on each life and the deferment period vary widely in a portfolio so that it would not be satisfactory to relate claims handling cost to either the amount of benefit paid or the number of policies in force. If the claims handling cost expected works out at £c per week of benefit handled, whatever the length of the claim and whatever the deferment period, it is simple to provide for this in both premium and valuation; a sum insured of £x per week becomes £$(x+c)$ per week.