THE EFFECT OF CHANGED ECONOMIC CONDITIONS AND STATE INSURANCE ON PRIVATE PENSION FUND BENEFITS, CONTRIBUTIONS AND VALUATIONS

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TWICE in the past forty years war has abruptly changed economic conditions in the country and the new economic conditions have in their turn affected the circumstances of all pension funds. Before the war of 1914–18, the great majority of pension funds provided pensions based on the average salary through the period of service for a low contribution rate. The inflation of salaries and wages between 1914 and 1919 disclosed the weakness of the system since the pensions provided proved to be small in comparison with the new level of remuneration and to be inadequate to support the member during retirement. The experiences of this period led to the adoption of the system of basing the pension on the remuneration of the final year of service or of the average remuneration of the years immediately prior to retirement. The financing of the additional pensions to members for whom pensions on the pre-1914 basis had been provided and the establishment of the new system for members currently contributing was materially assisted by the high yield obtainable on investments. It should be added that for a scheme with funds invested before 1914 the depreciation of assets due to the high interest rates which had been obtaining immediately after the war increased the cost of reorganization of the scheme.

2. During the second world war a more limited measure of inflation of the cost of living and a corresponding increase in salaries and wages occurred. The financing of additional liabilities has, however, been made more costly by the progressive reduction in interest rates. *Per contra*, the depreciation in the values of Stock Exchange investments which had to be faced in 1919 has not been repeated and a general excess of market values over balance-sheet values is recorded. In funds maintained by local authorities where the assets are mainly invested on deposit with the authority no such appreciation appears. They were not generally in existence in 1919 so that no direct comparison is possible.

3. With the initiation of the new State retirement pension under the National Insurance Act, 1946, the character of the State pension has changed. It originally consisted of the sum of 10s. a week from age 65 for persons engaged in manual labour or receiving remuneration of less than £250 a year. Thus it hardly affected the normal pension scheme for staff employees. In 1940 the pension age for women was reduced to 60 and in 1941 the limit of remuneration under which an employee has to contribute was raised to £420. Under the National Insurance Act, 1946, the pension has been raised to 26s. a week and will only be payable on retirement from employment after the attainment of 65 if male or 60 if female. With few exceptions all persons contributing to a pension fund will contribute to the national scheme whatever their remuneration may be. Thus, in so far as existing funds are concerned, an immediate duplication of benefits and of contributions arises and decision

has to be reached on the question of accepting the double benefit at the cost of the double contribution or of obtaining relief from the latter at the cost of a reduction in the total pension to be received from the private and the Government scheme.

4. To summarize the situation at the present date it may be said that the chief changes in economic conditions affecting pension funds in this country are that

(1) the decrease in the value of the currency in terms of goods has produced a rise in the general levels of remuneration;

(2) the progressive reduction of the rate of interest has reduced the capacity of accumulated funds to meet the claims for pensions; and

(3) the intervention of a State pension of substantial amount and universal application, for which a considerable contribution is demanded, may have increased the total pension contribution to a level no longer considered reasonable.

5. As compared with thirty years ago the same feature of a rise in the level of salaries and wages is evident, though not to the same degree, but the problem of depreciation of assets is replaced by that of the reduced earning capacity of assets. At both times the inflation of the currency has had an effect equivalent to a direct capital levy on the funds and has affected adversely those persons who by personal thrift had built up what they considered to be adequate provision for old age. In the past the employer met the cost of restoring the pensions to appropriate levels and it appears likely that he will have to do so again for two reasons: first, because it is normally beyond the capacity of the employee to offer much assistance in that direction and, secondly, because the employer frequently accepts either a moral or an actual liability to see that adequate pensions are paid to employees no longer capable of work.

SALARIES AND WAGES

6. Probably the best known general index of the changed purchasing power of money is the *Cost of Living Index* published monthly in the *Ministry of Labour Gazette* and now in process of being replaced by a new index. This index is compiled on a distribution of purchases of household commodities considered appropriate in 1914. The distribution has not been altered, and the sole change recorded is in the prices of the items entering into the calculation. The index therefore indicates the increase in the cost of living subject to the limitations indicated. A further index is published in the *Oxford Bulletin of Statistics* and furnishes a more modern measure of the increases in the cost of living. In both cases it must be remembered that the Government has controlled the price of food by means of subsidies.

The movement in the two indices is given below:

	1914	1938	1945	Increase 1938–45
M.O.L. Index	100	155	204	32%
Oxford B.O.S. Index	100	155	155	55%

7. In the issue of February 1947, the *Economist* reviewed the movement of wages during the war period and indicated that a considerable difference existed between the increase in wage rates and the increase in earnings. The Ministry of Labour review of wage rates indicated an increase of 38% between October 1938 and January 1945, but the *Economist* estimated an increase in

earnings of 57% or half as much again as the increase in rates. The review of wage rates which is contained in the January 1947 issue of the *Ministry of Labour Gazette* estimates that the average percentage increase in wages in the industries for which the information is available is 65% on the rates obtaining at the beginning of the war and states further that a period of stability which has set in since July 1946 suggests that the series of post-war wage adjustments has been largely completed.

8. It is of course wages which are pensionable, and wages are the product of the number of hours in the normal working week and the wage rate. Pensionable wages therefore are a function of the wage rate and not of earnings. It is not possible to obtain for the same period average salaries and wages derived from the statistics of pension funds, but in the next two paragraphs I give for representative funds some figures showing the average increase for a part of this period.

9. The following changes in the average remuneration of manual workers are taken from the records of certain pension funds.

	Average annual pensionable wages of male manual workers				Increase %
	Year	Amount	Year	Amount	
		£		£	
Fund I	1940	179	1945	239	34
Fund II	1940	176	1945	273	55
Fund III	1940	206	1945	320	55

Fund I is a local authority fund; Fund II is the fund of a statutory public supply authority; and Fund III is a private employer's fund.

10. For the same funds the following changes in the average remuneration of salaried employees have been recorded:

	Average annual pensionable salaries of male salaried employees				Increase %
	Year	Amount	Year	Amount	
		£		£	
Fund I	1940	295	1945	370	25
Fund II	1940	320	1945	378	18
Fund III	1940	319	1945	423	33

For salaried employees the scheme of increases is usually either a fixed sum irrespective of present salary or a percentage of salary with a maximum. Thus the tendency is to restrict the increases for the higher salaried employee. The general effect is to raise the average salary of the lower ranks of employees at all ages to a greater degree than the average salary of the higher ranks. The passage of time, however, almost invariably raises the salary offered to new appointments in the higher ranks and thus tends to restore the balance. The ultimate effect of the increases may be taken as proportionate to salary for all ages and amounts. I do not consider that the allowances should be permitted to affect the salary scale used in a valuation, since the original rates of progression with age may be expected to restore themselves provided that a radical alteration in the constitution of the staff does not occur. Since these

figures were compiled a new 'Charter' for local government employees has substantially increased salaries and a comparison of the 1940 average with 1947 is estimated to show an increase of about 50%.

THE RATE OF INTEREST

11. The yield on investments reached a peak immediately after the war of 1914–18 when Government stocks could be bought to yield well over 5% and local authorities were paying 6% on borrowings. From that point there was a gentle decline until the epoch-making conversion of War Loan in 1932 from a 5% to a 3½% interest-bearing security. This operation, which changed the rate of interest on £2,000 millions of stock at a stroke, radically altered the whole aspect of investment and inaugurated a period of lower interest-bearing issues. Interest rates again declined slowly until the outbreak of the war of 1939–45 when a rigid control of the investment of money was imposed. Since the end of the war, events have accentuated the pressure of money awaiting investment and have thereby depressed the rate of interest on new Government borrowing to 2½%. At the time of writing a reversal of the trend appears to be in progress and Government stocks can be bought to yield nearly 3%.

12. The progressive reduction in the yield which can be obtained on investments has been reflected in the yields on the invested funds of pension schemes, as may be seen from the following figures:

Year	Average yield on the fund, both invested and uninvested items taken at book values		
	Fund A	Fund B	Fund C
	£ s. d.	£ s. d.	£ s. d.
1926	5 7 1	4 19 8	4 13 4
1931	5 6 6	4 16 9	4 14 4
1936	5 0 4	3 12 1	4 11 5
1941	4 11 1	3 12 2	3 9 11
1946	5 0 6	3 10 11	3 3 9

Fund A is a private pension fund in which one of the provisions is that the employer shall make up the average yield in the year to 5%. The yield shown is the real yield before the payment under the guarantee. It reflects the extreme care and vigilance taken over investment, and also the recent increase of dividends on a moderate holding of the highest classes of ordinary stocks.

Fund B is a private pension fund where no guarantee exists.

Fund C is the fund of a local authority. The rates of interest at which a local authority can borrow from its superannuation fund are now limited by the rates at which the authority can borrow from the Public Works Loan Commissioners. These rates vary from 1½% for under 5 years to 2½% for 15 years or more. A further decline in the yield on local authority funds must therefore be expected.

13. This steady fall in interest yield led to corresponding reductions in the valuation rate of interest. At the present time valuations are being made at rates of interest ranging from 3½% to 2¾% according to the estimates of future yield for each individual fund except where a guaranteed rate enables a higher rate of interest to be employed.

14. What yields and valuation rates are to be expected in the future? In framing the answer, the permanency of a pension fund must be considered. A pension fund is not a financial organization interested in day-to-day yields or prices; it is a long-term entity organized in five-yearly periods and should properly be viewed in relation to periods of, say, thirty years. The question is then what average rate of interest can be expected over the next thirty years. What temporary loss or gain is to be anticipated in the immediate future in relation to current yields? Unless control is retained for all time over the means of production it is difficult to see how the low rate of interest can be maintained. On the other hand, the existence, in parallel with our own community, of large and wealthy English-speaking communities across the Atlantic may strengthen the feeling in favour of freer conditions in Great Britain, and with relaxation of control the pressure of investment money may be relieved. Interest rates may then rise and investment values may fall.

If this comes about, some inducement to saving may be required and may be found in an increase in investment yields. The 5% rate has been banished for ever by the technique of money management elaborated during the war, but a yield of $2\frac{1}{2}$% appears uncomfortably low.

In the figures which are used for illustration in the later paragraphs of this paper I have employed a basic rate of interest of 3% per annum and I have considered at various stages the effect of reducing this rate to $2\frac{1}{2}$% per annum.

THE STATE PENSION

15. At 30 September 1946, the pension paid by the State on retirement consisted of 10s. per week to the contributor who had attained the age of 65 together with a further 10s. a week to the contributor's wife if she was over the age of 60. This pension was provided on attainment of age 65 for a male contributor and age 60 for a female contributor by virtue of contributions under the Contributory Pensions Acts. Contributors consisted of persons who earned less than £420 a year or engaged in manual labour. In addition to these contributions of insured persons and their employers the State made direct grants to the scheme of the excess of expenditure over income. For persons not qualified for a contributory pension, an old-age pension of equal amount was payable from age 70 subject to a means test.

16. On and from 1 October 1946, the rate of the contributory pension paid to the contributor and of the old-age pension paid to the single person or the husband in a married couple under the existing Acts has been the same rate of pension as will be payable under the National Insurance Act, 1946, namely 26s. a week. A further 16s. a week is paid in respect of the wife of a pensioner. Three important differences in the conditions under which the pension is granted must now be recorded. The first is that the pension commences to be payable *on retirement* after the pension age and not on attainment of that age; the second is that for new entrants after 1 October 1946 the period for which contributions must be paid to qualify for pension has been raised from 5 to 10 years; and the third is that all employed persons without limit of salary are to contribute and to receive the pension.

17. The additional contribution payable by the employer may be illustrated by giving the annual contributions in respect of a staff of 1,000 male employees. For this staff the annual contributions for health, pension and unemployment benefits before 1 October 1946 was £4,983 and under the National Insurance

Acts, 1946, rises to £10,833; the increase is 117%. The increase in an employer's aggregate contribution would normally be greater since some of his employees in the higher grades would not contribute for health, pension or unemployment benefits under the original Acts. Contributions under the 1946 Acts for those employees would have no counterpart under the earlier schemes.

18. The adult male contributor paid 1s. 11d. per week before 1 October 1946 and will pay 4s. 11d. per week when the National Insurance Acts, 1946, come into force. The increase here is 157%. His situation may be alleviated by the greater tax reliefs obtainable. Under the earlier Acts the tax allowance was £1 a year but the full contribution under the National Insurance Acts is allowed for relief of income tax. Tax reliefs do not assist persons receiving low salaries and paying little or nothing by way of income tax. They are, however, of material assistance where a substantial tax liability exists and to that extent afford relief to persons receiving the higher salaries.

19. The points of importance in relation to an existing pension fund are that

(1) the pension provided by the fund is augmented by the State retirement pension; and

(2) in addition to contributions to the fund the member will have to make a substantial contribution to the State scheme.

The double contribution may well prove a matter of hardship to the less well paid members and may lead to a demand for relief. The employer may also require some adjustment of the fund pension in order to provide relief of contributions.

Many pension funds possess all the powers necessary to effect any adjustments which may appear desirable when the National Insurance Act, 1946, comes into force. For those funds which require modification and where the constitution makes it impossible or very difficult to make an alteration, section 69 (4) of the National Insurance Act, 1946, affords a means of progress. This section empowers an appropriate Minister of the Crown or Government department or in certain circumstances the Chief Registrar of Friendly Societies to make regulations to give effect to the desired alterations. The Chief Registrar has intimated that he will make these regulations for each fund separately as and when he is requested to do so.

20. Schemes of adjustment of pension funds in order to avoid duplication of contributions and benefits fall under three heads.

(1) The scales of benefits and contributions are reduced so that the pensions provided by the fund and the State reach approximately the same total as before the adjustment.

(2) The salary or wage is modified by the exclusion of a fixed sum for the purpose of calculating contributions and pensions.

(3) The adjustment is made to the pension by deducting the whole or part of the State retirement pension as and when it is received and an equivalent reduction in contributions is made by deducting a fixed sum from the contribution calculated at the normal rates on the full salary or wages.

If the pension fund only provides pensions to the member it is reasonable to bring only the State retirement pension in respect of that member or a part of it into account, but where the fund provides annuities for wives or widows it would be consistent to make allowance as well for the wife's pension of 16s. a week or the widow's allowance of 26s. a week.

21. Modification (1) is simple in operation and easy to explain to members. It also relates contributions and pensions to the same salary and thus avoids complications in the actuarial structure of the scheme. A weakness is that the total of the contributions to the fund and to the State scheme is a higher proportion of total remuneration of the members receiving the lower levels of salaries or wages than is the case where members are paid at higher rates. Furthermore, since a member in receipt of a break-down pension would not necessarily qualify for continuous sickness benefit from the State scheme, the effect of reducing all benefits is to reduce the pension in the case of break-down of health, a benefit which is already small enough. It will be noted that the member receives the State retirement pension in addition and can only qualify for this at age 65. If he retires on pension from the fund at an earlier age, he will still have to contribute to the State scheme up to the age of 65 in order to qualify for the retirement pension.

22. Modification (2) has the merits of simplicity and of affording reasonable relief of the double contribution burden. It is specially suitable for funds where the wages of members remain sensibly constant throughout life, i.e. funds providing pensions for manual workers. It suffers from the defect noted in connexion with modification (1) of reducing break-down pensions by a substantial amount. Its application to salaried staff will be discussed in greater detail later but it will be sufficient to indicate here that it produces actuarial and administrative complications if applied to a fund already in existence. In such a fund its introduction might require service prior to the date of introduction to rank for pension on full salary and later service on the modified salary. The problems of valuation would be complicated by the necessity for employing two salary scales. Unless entry to the fund is restricted to members receiving more than a certain minimum salary the modification may also result in the payment of contributions on microscopic pensionable salaries.

23. Under modification (3), the contribution relief is usually made for administrative convenience a fixed weekly or annual sum irrespective of the age of the member or the method of calculating the original contributions. The equivalent pension adjustment is then derived as an annual sum to be deducted from the fund pension on and after the attainment of the pension age under the Acts. The contribution relief is normally calculated as the equivalent at the earliest entry age of a pension deduction of one-fortieth of 26s. a week for each year of contribution relief. The rate of deduction will be found to vary with age at entry and for late entrants the rate is reduced. The method can be extended to past service pensions paid for by the employer and to service ranking for pension at different rates; it can also be applied as it stands to funds where the normal pension age differs from the retirement age of the State scheme. It may be noted in passing that it is not possible to grant a contribution relief in respect of the whole retirement pension, since at advanced ages the equivalent relief might exceed the original contribution to the fund. The modification permits pensions granted on break-down of health to be paid in full up to the pension age of the Act when the State pension relieves the fund, but correspondingly places on the employer the moral responsibility for maintaining the member in benefit in the State scheme.

Modification (3) is more complicated to explain to members than the two previous modifications but is free from the actuarial complications of modification (2). The reduction in contribution is roughly a quarter of the full

contribution to the State schemes for all the benefits of those schemes and thus the lower-paid members on the staff do not get relief to the extent that may be desirable. The calculation of a member's contribution is made more cumbersome, and especially so if the reduction varies with the age of the member when the modification is introduced. The complications are less if a flat deduction from the normal contribution is adopted, or if the normal contribution is reduced to a lower percentage. In comparing the two adjustments last mentioned it should be noted that while the effects on the finances of the fund hardly differ, the effect on the contributions of individual members do differ substantially. The flat deduction from contributions equivalent to a flat deduction from pension treats all members alike, but the reduction of the normal contribution to a lower percentage affords less relief in the lower salary grades than in the higher. This fact must be recognized and the adoption of a lower percentage contribution can be justified in any given fund only by administrative expediency.

24. While the modifications may normally be introduced so as to affect pensions in respect of future service only, the consolidation of war-time cost-of-living bonuses with salaries which is taking place at the present time alters the position considerably. The employer is able to obtain some relief from his commitments by proposing to consolidate on terms which take into consideration the full State retirement pension by one of the methods outlined above. The modifications in such a case would apply to pensions in respect of both past service and future service, and in that case it would be necessary to make the adjustment of salary under modification (2) equal to or less than the amount of bonus to be consolidated. If this is done it would not then be possible to raise the objection that members are receiving in respect of past service a pension less than they were expecting to enjoy by the original rules of the fund.

RATES OF CONTRIBUTION

25. In the foregoing paragraphs, the main changes in economic conditions affecting pension funds have been recorded and it is now necessary to examine in detail the effects of those changes. No pension fund can survive without special subsidies if the contribution rates are less than the amounts indicated by the experience of the fund. Members can be admitted to a fund at any age providing that the contribution charged is adequate, though there are obvious disadvantages to the member in late entry, particularly where the benefit depends on the number of years of contribution and where a qualifying period has to elapse before a break-down pension can be granted. In calculating the rates of contribution which follow I have used a suitable service table and have taken the pension benefits to be 1/60th of the average salary of the 5 years prior to retirement multiplied by the number of years of contributing service with a maximum pension of 40/60ths. Contributions have to be paid for 10 years before a pension is granted for reasons of ill health before the normal pension age. The member and the employer each pay one-half of the contribution, and members' contributions are returned with compound interest at 3% per annum on death or withdrawal.

The following table indicates the probabilities of death, withdrawal, and early retirement employed for the period of active service. The mortality of pensioners after the normal pension age is that of the $a(m)$ ultimate table and in all cases the value of a pension on retirement due to break-down of health

has been taken as the same number of years' purchase as that of a pension at the normal age of retirement.

Age	Probabilities of exit from active service by		
	Death	Withdrawal	Early retirement
20	·0015	·015	—
30	·0027	·005	·0001
40	·0044	—	·0014
50	·0072	—	·0050
60	·0132	—	·0150

26. The following table gives three salary scales applicable to male members together with the ratio of the final salary to the salary at each entry age (referred to as the increase ratio).

Table 1. Salary scales. Males

Age at entry	Scale A		Scale B		Scale C	
	Scale salary	Increase ratio	Scale salary	Increase ratio	Scale salary	Increase ratio
	£		£		£	
20	159	1·00	159	2·83	159	5·14
25	159	1·00	239	1·88	211	3·87
30	159	1·00	299	1·51	276	2·96
35	159	1·00	344	1·31	364	2·24
40	159	1·00	382	1·18	472	1·73
45	159	1·00	410	1·10	580	1·41
50	159	1·00	429	1·05	679	1·20
55	159	1·00	442	1·02	758	1·08
60	159	1·00	448	1·00	805	1·01
65	159	—	450	—	817	—

For convenience of examination, scales B and C have been brought on to the same origin at age 20 as scale A. Scale B is a medium scale giving an increase ratio of 2·83 at age 20. Scale C is a high salary scale with an increase ratio at 20 of 5·14. The increase ratio of scale C is at each age substantially greater than the corresponding increase ratio of scale B.

27. The rates of contribution derived from these scales using 3% interest are shown in Table 2.

28. The first and most important aspect of Table 2 to which attention must be drawn is that the introduction of a salary scale increases substantially the contribution rate at the younger ages while affecting the rates at the higher ages to only a small degree. The reason is not far to seek. A member whose salary follows the scale makes contributions in the early years on salaries which are small in comparison with the average salary at retirement on which he is qualifying for a pension. On the flat scale his contribution is proportionately greater. Hence the rates on the flat salary have to be increased at the younger ages if the salary rises according to scale; at the older ages the rise in the salary becomes less significant and the contribution rates are nearly the same. Furthermore, the steeper the rise in salary, the flatter the contribution scale

Table 2. Rates of contribution per £100 of salary. Males: 3%

Age at entry	Scale A		Scale B		Scale C	
	Pension age		Pension age		Pension age	
	60	65	60	65	60	65
	£	£	£	£	£	£
20	10·1	7·2	13·7	9·6	20·2	14·2
25	11·2	8·8	14·0	10·8	19·7	15·1
30	12·4	9·7	14·3	11·1	18·7	14·4
35	13·6	10·7	14·9	11·6	18·4	14·0
40	14·8	11·7	15·7	12·2	18·5	14·0
45	16·1	12·7	16·6·	13·0	18·5	14·2
50	17·7	13·9	18·0	14·2	18·9	14·9
55	19·3	15·2	19·3	15·2	19·8	15·3

becomes. In point of fact, the contributions on scale C salaries are almost the same at all ages. It may be noted that the restriction of pension to a maximum of 40/60ths interrupts the trend of the contribution rates at age 20 for pension at age 65.

29. The second point is that on all three scales of salary the increase in contribution consequent upon the earlier pension age is about 30%. One exception occurs at age 20 where the contribution rate at age 65 is affected by the restriction of benefit noted above.

30. Let us now examine the contribution rates required if the modifications of paragraph 20 are introduced. In neither the first nor the third modification do the rates of contribution have to be altered but in the second the exclusion of the first £x radically steepens the salary scale and so changes the contribution rate. The following tables show the effect on salary scales and contribution rates of excluding for both the pension and contribution the first £100 of salary. This is the salary of which the State pension of 26s. a week or £67. 12s. a year is approximately 40/60ths.

Table 3. Salary scales. Males

Age at entry	Effect of excluding the first £100 of salary					
	Scale D (derived from Scale A)		Scale E (derived from Scale B)		Scale F (derived from Scale C)	
	Scale salary	Increase ratio	Scale salary	Increase ratio	Scale salary	Increase ratio
	£		£		£	
20	159	1·00	159	5·93	159	12·2
25	159	1·00	375	2·51	299	6·46
30	159	1·00	536	1·76	474	4·08
35	159	1·00	658	1·43	711	2·72
40	159	1·00	760	1·24	1,003	1·93
45	159	1·00	835	1·13	1,294	1·49
50	159	1·00	887	1·06	1,560	1·24
55	159	1·00	922	1·02	1,773	1·09
60	159	1·00	938	1·01	1,900	1·02
65	159	—	943	—	1,932	—

The scales are obtained from the original scale by deducting 100 and multiplying the result by 159/59.

31. The general effect of the adjustment is to increase materially the steepness of the scale and the natural result is an increase in the contribution rates particularly at the younger ages. Except for age 20, scale E, derived from the medium scale B, is seen to be about half-way between scale B and the high scale C and the scale F becomes astronomical.

32. The contribution rates on the new salary scales are given in Table 4.

Table 4. Rates of contribution per £100 of salary. Males: 3%

Age at entry	Scale D		Scale E		Scale F	
	Pension age		Pension age		Pension age	
	60	65	60	65	60	65
	£	£	£	£	£	£
20	10·1	7·2	15·3	10·7	23·7	16·4
25	11·2	8·8	15·6	11·6	22·1	16·7
30	12·4	9·7	15·1	11·7	21·5	15·6
35	13·6	10·7	15·4	12·0	19·4	14·7
40	14·8	11·7	16·0	12·5	19·1	14·5
45	16·1	12·7	16·9	13·3	18·9	14·5
50	17·7	13·9	18·2	14·3	19·2	15·0
55	19·3	15·2	19·3	15·3	19·8	15·5

It is of interest to note that under scale F the contribution rates for future service benefits show a material decline with advancing age up to age 45. As a practical measure a contribution rate uniform for all ages at entry would be justified.

33. I now collect together for examination the increase ratios and the contribution rates, and in order to reduce the size of the table I have done so for every tenth age only.

Table 5. Comparison of increase ratios and contribution rates. Males: 3%

Salary scale	Increase ratio	Contribution rate for pension age		Increase ratio	Contribution rate for pension age	
		60	65		60	65
	Age at entry 20			Age at entry 30		
		£	£		£	£
AD	1·00	10·1	7·2	1·00	12·4	9·7
B	2·83	13·7	9·6	1·51	14·3	11·1
C	5·14	20·2	14·2	2·96	18·7	14·4
E	5·93	15·3	10·7	1·76	15·1	11·7
F	12·2	23·7	16·4	4·08	21·5	15·6
	Age at entry 40			Age at entry 50		
AD	1·00	14·8	11·7	1·00	17·7	13·9
B	1·18	15·7	12·2	1·05	18·0	14·2
C	1·73	18·5	14·0	1·20	18·9	14·9
E	1·24	16·0	12·5	1·06	18·2	14·3
F	1·93	19·1	14·5	1·24	19·2	15·0

From this table it appears that the rates of contribution run in sympathy with the increase ratios, and, bearing in mind that a rate of contribution quoted to the nearest one-half of 1% is sufficiently accurate, it is possible to make a sufficient estimate of the rate of contribution on any other increase ratio likely to be met in a given case. The table also shows (scales E and F) the substantial increases in the contribution rate required from new members at the earliest ages if modification (2) is adopted. It would be quite possible for two members entering within a few days of each other, one just before and one just after the alteration, to contribute in respect of future service at rates differing by 3% or 4% of salary for apparently similar benefits. Modification (2) is therefore open to administrative objections if applied to an existing fund in respect of service after an appointed day.

34. It now remains to complete the discussion of contribution rates by examining the contributions required on the basis of a lower interest rate.

The effect of reducing the rate of interest in the calculation of contribution rates for a pension fund may be estimated in two parts: (1) in respect of the period of active service, and (2) in respect of the period during the receipt of pension. For the latter period the increase is determined by the ratio of the annuity-values at the pension age adjusted for return of contributions on death: for any pension age this ratio is approximately constant for all ages at entry. The first part may be examined from the point of view of the salary scale. The effect is obtained by forming a new salary scale from the product of the old scale salary and the factor $(1+i)^x$, where i is the reduction in the rate of interest.

In Table 6 are shown the new salary scales derived by this method from scales A and B and the increase ratios.

Table 6. Effect on salary scales of reducing the rate of interest by $\frac{1}{2}$% : Males

Age at entry	Scale G (derived from scale A)		Scale H (derived from scale B)	
	Scale salary	Increase ratio	Scale salary	Increase ratio
	£		£	
20	159	1·25	159	3·53
25	163	1·22	245	2·29
30	167	1·19	313	1·80
35	171	1·16	370	1·52
40	176	1·13	421	1·33
45	180	1·10	463	1·21
50	185	1·08	498	1·13
55	189	1·05	526	1·07
60	194	1·03	546	1·03
65	199	—	562	—

The increase ratios for scale G are the values of $(1\cdot005)^{65-x}$.

35. With these increase ratios in mind and with the aid of Table 5, it is possible to make an estimate of the contribution rates required on a $2\frac{1}{2}$% interest basis. I have, however, calculated the contribution rates *ab initio* and record them in Table 7.

As has been seen in the earlier tables of contribution rates, the differences between the rates calculated on the rising scales and those on the flat scale are at their greatest at the early ages at entry.

Table 7. Rates of contribution per £100 of salary. Males: $2\frac{1}{2}\%$

Age at entry	Pension age 60			Pension age 65		
	Scale A	Scale B	Scale E	Scale A	Scale B	Scale E
	£	£	£	£	£	£
20	12·1	16·4	18·2	8·6	11·4	12·7
30	14·3	16·4	17·0	11·1	12·7	13·2
40	16·7	17·6	17·8	12·9	13·5	13·7
50	19·2	19·6	19·7	14·9	15·1	15·2

36. It is now appropriate to consider the effect on the contribution rates of the change in the rate of interest. The comparison is set out below for scales A, B and E.

Table 8. Comparison of contribution rates per £100 of salary at 3% and $2\frac{1}{2}\%$ interest

Age at entry	Pension age 60			Pension age 65		
	3%	$2\frac{1}{2}\%$	Ratio (3)÷(2)	3%	$2\frac{1}{2}\%$	Ratio (6)÷(5)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Salary scales A and D					
	£	£		£	£	
20	10·1	12·1	1·20	7·2	8·6	1·19
30	12·4	14·3	1·15	9·7	11·1	1·14
40	14·8	16·7	1·13	11·7	12·9	1·10
50	17·7	19·2	1·08	13·9	14·9	1·07
	Salary scale B					
20	13·7	16·4	1·20	9·6	11·4	1·19
30	14·3	16·4	1·15	11·1	12·7	1·14
40	15·7	17·6	1·12	12·2	13·5	1·11
50	18·0	19·6	1·09	14·2	15·1	1·06
	Salary scale E (derived from scale B by the exclusion of £100)					
20	15·3	18·2	1·19	10·7	12·7	1·19
30	15·1	17·0	1·13	11·7	13·2	1·13
40	16·0	17·8	1·11	12·5	13·7	1·10
50	18·2	19·7	1·08	14·3	15·2	1·06

The ratios of the $2\frac{1}{2}\%$ contribution rates to the 3% rates run in the same remarkably regular manner on all the salary scales.

37. Having discussed contribution rates at two rates of interest and on certain salary scales, I pass to the third method mentioned in paragraph 20 for modifying benefits and contributions to allow for the new State retirement pension. Briefly it was suggested that the pension from the fund should be reduced by 1/40th of 26s. a week for each year of contribution to the State scheme and to the fund and that the contributions should be reduced by an equivalent level weekly sum. The amounts of these reductions on a 3% and a $2\frac{1}{2}\%$ interest basis are given in Table 9.

It is suggested that members should pay the ordinary rate of contribution on salary less one-half of these weekly sums while they contribute to the fund. On retirement before 65 a member will have to continue contributing to the

Table 9. Weekly level contribution equivalent to $n/40$ths of 26s. a week
payable from age 65, where n is the number of years of contribution to
the fund and to the State scheme (with a maximum value of 40)

Age at entry	Fund pension age 60		Fund pension age 65	
	3 %	2½ %	3 %	2½ %
	s. d.	*s. d.*	*s. d.*	*s. d.*
20	2 3	2 8	2 2	2 7
30	2 9	3 3	3 0	3 6
40	3 5	3 10	3 9	4 2
50	4 3	4 7	4 9	5 1

State scheme in order to remain eligible for his pension from age 65 and to
receive his other benefits from the scheme. He will receive from the fund the
full pension up to age 65, and from 65 his pension will be reduced by 1/40th
of 26s. a week multiplied by the number of years for which he has contributed
under the National Insurance Act, 1946 (and earlier Acts), and to the fund
after the modified scheme came into force.

38. Thus the calculation of the contribution to be paid into the fund will
be made in two parts:

(1) the sum obtained by applying to his salary the rate of contribution
applicable to his age at entry to the fund, and
(2) the reduction of (1) taken from the scale according to his age at the
date of entry into the State scheme.

In dealing with a large staff the determination of the contribution becomes
considerably more complex on the adoption of such a scheme. It would be
possible to facilitate the calculation by computing tables of contribution
amounts. If the normal contribution varies with age at entry to the fund such
a table would be required for each rate of contribution.

39. It appears from Table 9 that over a certain age the relief of contribution
may exceed the payment to the State scheme, and this suggests that, as the
latter is calculated as being the contribution required on entry at age 18, the
relief should be similarly taken. If the relief is thus taken as a constant sum not
varying with age, the calculation of the members' contributions to the fund is
reduced to a more manageable operation. The effect on the fund is to reduce
the liability by a sum larger than the value of relief of contribution, thus
affording a small reduction in the net liabilities of the fund.

In view of the substantial liabilities thrown on the fund by the increases in
the level of salaries and wages and by the reduction of the rate of interest, any
measure likely to grant an easement of the burden, however slight, is of great
importance. The ordinary member cannot claim that the proposal treats him
unfairly since he is granted a relief of contribution calculated in the same
manner as the State scheme contribution imposed upon him, and he will not
receive from all sources less in pension than before the adoption of the modi-
fication. In fact all members over 25 and under 55 on the adoption of the
modified scheme or on entering this scheme will receive pensions from the
fund and the State greater in total than would have been received from the
fund alone before the State scheme came into operation. Members under

25 on entry or adoption of the modified scheme will receive the same total pension as they would have received had the fund not been modified. The modification cannot be applied to all members over 55 on 5 July 1948 as these members may not qualify for the State retirement pension.

40. The alternative is to fix the contribution relief at the weekly sum recorded against, say, age 20 in Table 9 and to compute for late entrants the equivalent annual rate of deduction from pension in respect of each year of contribution relief. Table 10 shows the results of this computation.

Table 10.   Annual deduction from pension commencing at age 65 for each completed year of contribution relief

Age at commencement of contribution relief	Fund pension age 60		Fund pension age 65	
	3 %	2½ %	3 %	2½ %
	Weekly contribution relief			
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
All ages	2 3	2 8	2 2	2 7
	Annual pension deduction			
20	1 14 0	1 14 0	1 14 0	1 14 0
30	1 7 0	1 8 0	1 4 0	1 5 0
40	1 2 0	1 3 0	19 0	1 1 0
50	17 0	19 0	15 0	17 0

A scheme for modification on these lines has been adopted for local government superannuation funds (see S.R. and O. No. 1245 of 1947).

VALUATION

41. In order to exhibit within reasonable compass the effects on estimates of the net liability for benefits of the changes in economic conditions and of the modifications of benefit discussed earlier I have made the following assumptions.

(1) The existing members of the fund number 3,143 aged between 20 and 60 and distributed according to the column of l_x^s in the service table.

(2) The salaries receivable by these members agree in total age by age with the result of applying the scale salaries to the number of members at each age.

(3) Pensionable service commences at age 20 and ranks in full from that age.

(4) The normal contribution rate for the rising salary scales is 12% of salary and for the flat salary scales is 10% of salary. Members pay half this rate and the employer the other half.

42. The salary scale employed for rising salaries is scale B with the derived modifications. On these bases the total salaries are:

Full salaries   £1,084,000
Full salaries less £100 per member   £769,700

The modifications for which figures are supplied are discussed in paragraph 20. For convenience I summarize them briefly here:

Modification (2) excludes the first £100 of salary from the calculation of contribution and benefits.

Modification (3) deducts 1/40th of £67. 12s. a year, multiplied by the number of years of contribution relief (maximum 40), from the fund pension on attainment of age 65. A relief of contributions is allowed of 2s. 2d. per week at 3% interest and 2s. 6d.* per week at 2½% interest.

In setting out the figures I have given liabilities in respect of past and future service separately. Under the heading of past service is included returns of past contributions. The figure under the heading of future service is obtained by deducting the value of future contributions from the total of the values of pension in respect of future service and of returns of future contribution and adjusting the result to secure that no member is at any stage treated as an asset in the valuation. Modification (3) has been applied to members under the age of 55 only.

43. I now give the net liabilities, past and future service benefits separately, for rising salaries.

Rising salaries (1)	Valuation rate of interest (2)	Past service benefits (3)	Future service benefits (4)	Total liability (5)	Column (5) expressed as ratios	
					(6)	(7)
Pension age 60:		£,000	£,000	£,000		
(i) Full salary and benefits	3%	3,645	502	4,147	1·00	—
(ii) Modification (2) (full salary less £100)	3%	2,993	455	3,448	0·83	—
(iii) Modification (3) (normal contribution less 2s. 2d. a week)	3%	3,294	405	3,699	0·89	—
(iv) Full salary and benefits	2½%	4,068	836	4,904	1·18	—
(v) Modification (2)	2½%	3,340	716	4,056	0·98	—
(vi) Modification (3) (normal contribution less 2s. 6d. a week)	2½%	3,678	726	4,404	1·06	—
Pension age 65:						
(vii) Full salary and benefits	3%	2,772	123	2,895	0·70	1·00
(viii) Modification (2)	3%	2,297	110	2,407	0·58	0·83
(ix) Modification (3) (contributions as (iii))	3%	2,422	50	2,472	0·60	0·85
(x) Full salary and benefits	2½%	3,061	277	3,338	0·80	1·15
(xi) Modification (2)	2½%	2,529	274	2,803	0·68	0·97
(xii) Modification (3) (contributions as (vi))	2½%	2,657	129	2,786	0·67	0·96

44. From the figures given in paragraph 43 some deductions may be drawn. The reduction of the valuation rate of interest from 3% to 2½% increases the total net liability by approximately 18% if the pension age is 60 and 15% if the pension age is 65. The liability for pensions at 60 is broadly 45% greater than for pensions at 65.

45. The introduction of modification (2) in respect of future service benefits affords only a slight relief of liability notwithstanding that the rate of contri-

* The even figure is taken to facilitate equal division between employer and member.

bution, maintained at the old existing rate, is inadequate. The relief varies from nothing to $2\frac{1}{2}\%$ of the total liability for full benefits and so will be quite insufficient to meet the cost either of an increase in the level of salaries and wages or of a reduction in the valuation rate of interest. If introduced for pensions in respect of all service, the relief is of the order of 17% and would compensate for a 17% rise in the level of salaries or for the reduction of the rate of interest by one-half of 1%.

46. Modification (3) if introduced for pensions in respect of future service does effect relief of liability of between 2% and 5% of the total liability. If the full State pension is deducted the relief is increased to between 11% and 18% of the total liability and would thus compensate for a rise of rather less in the level of salaries or of a reduction of about one-quarter of 1% in the valuation rate of interest at pension age 60 and one-half of 1% at pension age 65.

47. Since, as a result of the war, the level of salaries appears likely to rise by at least 30% and the earned rate of interest to drop by $\frac{1}{2}\%$ or more, it follows that the total increase in liability is likely to be upwards of 45%. Short of providing substantial additional funds (and thereby accentuating the reduction in the rate of interest earned) the only adjustment capable of even partially meeting the situation is postponement of the normal retirement age by 5 years. Even with this, modification (3) may be required to meet the full additional liability. If additional funds are forthcoming it may be better at the present time to provide them by means of additional annual payments over a period of years, since this procedure would avoid the immediate drop in the earned rate of interest which would be the result of a lump sum payment into the fund.

48. The net liabilities for a flat salary of £200 a year per member are now given.

Flat salary (1)	Valuation rate of interest (2)	Past service benefits (3)	Future service benefits (4)	Total liability (5)	Column (5) expressed as ratios (6)	(7)
		£,000	£,000	£,000		
Pension age 60:						
(i) Full salary and benefits	3%	1,673	279	1,952	1·00	—
(ii) Modification (2) (full salary less £100)	3%	837	139	976	0·50	—
(iii) Modification (3) (normal contributions less 2s. 2d. a week)	3%	1,168	178	1,346	0·69	—
(iv) Full salary and benefits	$2\frac{1}{2}\%$	1,857	437	2,294	1·18	—
(v) Modification (2)	$2\frac{1}{2}\%$	928	219	1,147	0·59	—
(vi) Modification (3) (normal contributions less 2s. 6d. per week)	$2\frac{1}{2}\%$	1,304	257	1,561	0·80	—
Pension age 65:						
(vii) Full salary and benefits	3%	1,282	127	1,409	0·72	1·00
(viii) Modification (2)	3%	641	63	704	0·36	0·50
(ix) Modification (3) (contribution as in (iii))	3%	779	13	792	0·41	0·56
(x) Full salary and benefits	$2\frac{1}{2}\%$	1,417	211	1,628	0·83	1·16
(xi) Modification (2)	$2\frac{1}{2}\%$	708	106	814	0·42	0·58
(xii) Modification (3) (contribution as (vi))	$2\frac{1}{2}\%$	844	46	890	0·46	0·63

49. The salary assumed to be received by each member is £200 a year for the whole of his service with the employer. The total salaries amount to:

<div style="text-align:center">

Full salaries of £200 a year   £628,600

Full salaries less £100 a year   £314,300

</div>

The ratios in columns (6) and (7) of the table in paragraph 48 depend upon the assumed flat rate of salary, and for items (ii) and (iii), (v) and (vi), (viii) and (ix), (xi) and (xii) will be varied by any change in the basic flat salary.

50. The increase in liabilities consequent upon a reduction of one-half of 1% in the valuation rate of interest is the same as for rising salaries at both pension ages. The liabilities for pensions on full salary at pension age 60 are approximately 40% greater than at pension age 65.

51. Since the flat salary assumed is £200, the introduction of modification (2) reduces the liabilities for both past and future service to one-half of the full liability. If the modification is introduced for future service benefits only, the relief amounts to between 7% and 10% for pension age 60 and 4% and 6% for pension age 65. If introduced for all service it would be compensation for 50% rise in the salary level or 25% rise in salary level coupled with a reduction of one-half of 1% in the valuation rate of interest.

52. Modification (3) affords relief of future service liability amounting to about 6% of the total liabilities. At pension age 60 if applied to all service the relief compensates a reduction of one-half of 1% in the valuation rate of interest and for a rise of 15% in the level of salaries. At pension age 65 it is a reduction of one-half of 1% in the rate of interest and a rise of 30% in the salary level.

53. The post-war wages are likely to be stabilized at a level substantially higher than the pre-war wages for the same job, and coupled with the reduction in interest earnings this higher level of wages gives rise to problems of great importance in the future conduct of a pension fund. It is possible from the foregoing figures to obtain an advance assessment of the effect of alternative lines of action.

54. In examining the figures in paragraphs 43 and 48 two aspects should be borne in mind. In the first place, all service since age 20 ranks for pension at the full rate of 1/60th of salary. This does not represent the position in the majority of funds, where back service may not all rank for pension or, if it does, may rank in part at a lower rate than 1/60th. The effect on the present calculations is to advance the mean weighted age in respect of back service and to introduce a factor tending in the estimates to lessen the increases due to the reduction in the valuation rate of interest. The reduction in the rate of pension in respect of back service will reduce the liabilities but not to the full extent indicated by the ratio of the average pension rates. Secondly, the assumption that the numbers in the service table represent the spread of current members with regard to age unduly weights the older age groups. I know of one or two funds only where the service table distribution is a fair approximation to the actual distribution with regard to age. In most funds the number of members at the older ages is much less than the numbers which have been used to produce the valuation liabilities for this paper. Again, the effect of the assumption as to age distribution is to reduce the proportionate cost of a change in the rate of interest and to magnify unduly the cost of back service pensions.

CONCLUSION

55. It has been possible during the course of this paper only to review briefly the problems confronting the management of a pension fund as a result of post-war economic conditions. The necessity for a substantial rise in the contributions required to provide given benefits has been demonstrated equally with the necessity for the provision of additional capital for existing funds if the current rates of contribution and benefits are to be retained. For a fund about to be established the position is clear; higher rates of contribution are required than have hitherto been deemed necessary. How should an established fund proceed? The first action is to achieve a state of solvency, either by provision of new capital or by reduction or modification of benefits. On the new level of benefits appropriate contribution rates for new entrants should be adopted and the fund can continue. Unless special circumstances make it essential I do not consider that the old fund should be closed and a new fund opened for new members.

56. One further aspect not strictly economic requires mention here. Medical science has progressed in marked degree during the war and the medical discoveries of the past seven years have been described to me as being of greater importance than those of the previous forty years. In particular, owing to the new drugs capable of mastering, in most cases, the infection of pneumonia, there is a prospect of a substantial prolongation of life of persons over 65, i.e. the pensioner class. This prolongation will only gradually become apparent but its prospect cannot be ignored and it would be prudent to make some allowance for it in any scheme of reconstruction of a pension fund.

57. It may appear that an established fund is more hardly hit by the new economic conditions and certainly the members of such a fund may feel that this is so. But is this really the case? In the first place their past contributions have accumulated at higher rates of interest than appear likely to be earned in the future, and secondly by reason of their contributions they have acquired a title in equity to a higher rate of pension than if they were just starting to contribute. From the employer's point of view the social conscience of the present time compels him to pay pensions on some scale, and his past contributions, however inadequate they may now appear, have put him in a better position than if he were about to fund his obligations. From all points of view any fund at the present day is better than no fund at all.

58. Finally, I must acknowledge gratefully the helpful criticisms of Mr Duncan C. Fraser, M.A., F.I.A., and the labours of Mr G. Heywood, F.I.A., F.F.A., who undertook the necessary calculations, the greater part of which are not visible in this paper.

ABSTRACT OF THE DISCUSSION

Mr W. F. Marples, in introducing the paper, said that the subject with which it dealt was an important one, because there had been a marked increase in the number of pension schemes in the last twenty years. The social conscience of the time urged an employer to provide for the old age or incapacity of his employees, and unless the scheme adopted performed its function to the satisfaction of both sides discredit would undoubtedly fall upon the professional adviser. It was well, therefore, that the employer be left under no misapprehension as to the functions of the adviser. Subject to what might be said in the discussion on the point, he himself felt that the contribution was the keystone of the edifice. A pension fund was a store of value from which, in given contingencies, an annual income would ultimately be disbursed and the store would never be adequate for its purpose if the contribution rates had not been properly assessed. Periodic valuations were in the nature of reviews of the progress of the fund in the light of the records of members, and, while providing valuable data on the situation of the fund, should never be concluded without an examination of the contribution rates. That was his apology for producing so much arithmetic on that point. He would emphasize that the calculations were made on his service table and his salary scale, and the relative values rather than the absolute values were therefore of most interest to members.

The calculations at $2\frac{1}{2}\%$ interest might now be only of academic interest. When the paper was written $2\frac{1}{2}\%$ was reasonable; rates had now, fortunately for them, somewhat increased; but he would not expect to find much difference between the ratios of values at 3% and $3\frac{1}{2}\%$ and the ratios of values of the same items at $2\frac{1}{2}\%$ and 3%.

In par. 20 reference was made to methods of adjusting schemes for the State pension. In actual practice he found that modification (1) was usually adopted for new schemes because the employer new to pension schemes required simplicity in treatment. The fund pension was regarded as being increased by the State pension to provide the over-all level of benefit desired. Modification (2) was a little less popular, and modification (3) hardly entered into the field. For existing funds all three schemes of modification had been adopted. Personally he preferred modification (3), but it was the most complicated in operation, and that, he often found, was the decisive factor.

It should be pointed out that modification (2) had to be carefully handled in relation to an existing fund. If applied to all members for pensions and contributions on future service the over-all result was some relief to the fund, but it must be recognized that for young members the rate of contribution on the pensionable salary should, in theory, be increased. If the modification was presented in a form which allowed an option to modify or not, the decision to modify by a block of young members might throw some strain on the fund. There was also a danger in the alternative method, mentioned in par. 23, of a flat adjustment of pension in return for a reduced percentage of salary contribution. If the salary was doubled, for instance, the contribution relief became twice as great, while the deduction from pension remained the same.

He would like to make an acknowledgement to Sir George Epps, who had stated (*J.I.A.* Vol. LII) that the results of a change in the salary scale could be obtained by combining commutation functions on a flat salary basis and on a rising scale. Where Sir George Epps had added to obtain his effects he himself had substracted, but the technique was that which Sir George described. He had found it convenient to make those alterations on the actual pension factors; to apply it to the full valuations introduced complications at various stages.

Mr R. C. B. Lane, in opening the discussion, thanked the author for the way in which he had brought together facts and figures relating to various salary scales, etc., on a comparable basis. That in itself, quite apart from anything else, was worth a good deal, because it was not often possible to get, quickly and easily, comparable figures on different bases; and, even if the figures were not strictly applicable to any particular circumstances, they provided a very valuable guide.

He commented on the salary-scale technique, and particularly on the technique when the salaries were adjusted to allow for the national pension. The author had used three salary scales, A, B and C; A was a flat scale, B was a slightly increasing scale, and C was a moderately steep one. The author then deducted £100 a year and said that contributions and pensions might, thereafter, as one of the alternative methods of adjustment to allow for the national pension, be calculated on the reduced salary. That was the method that he, the speaker, favoured. He found that it was convenient and simple, but he thought that the application to it of the salary-scale technique might hide a fallacy.

From his scales A and C the author derived two other scales, D and F, by taking off the £100. That revealed, as was to be expected, that the salary scale C was made very considerably steeper. Scale A, which was flat, remained flat but at a lower level than before. The author pointed out that the steeper scale had to be allowed for. That was true, but care must be taken to see that fallacies were not introduced in doing so. When regard was had to the fundamental theory underlying the salary-scale technique, it would be found to be based on the essential assumption that, if a man at the age of 20 or 30 was earning more than the average, he was likely to go on doing so, and on the whole was likely to earn the same percentage above the average at 50 that he was at 20. There might be exceptions, but that was the underlying principle. In short, the rate of increase would be the same, but it would be proportional to the salary which that particular man was earning, and a high-salary man would all the time run 20%, 50% or 100% above the average-salary man.

Now, if the deduction of £100 or any other fixed sum was made, it would be a much more important adjustment to a low-salaried man than it was to a high-salaried man. The salary scale was steepened, it was true, but it was steepened a great deal more for those earning a low salary than for those earning a high one; and fallacies might be introduced if that adjusted salary scale was brought into the valuation or calculation of contributions and applied to the adjusted salary. The same result would not be obtained by applying the salary scale directly to the salary, making the adjustment vary afterwards for the flat amount to be deducted.

Which was correct? It was suggested that the application of the salary scale to the unadjusted salary was correct, if the salary-scale technique was ever correct. That suggestion was made because it was based on the assumption that increases were proportional to salaries; and if that had any foundation—and it was likely to have a foundation and seemed reasonable—then it was certainly more likely to be true than the assumption that increases would be proportional to the amount of the salary over and above some fixed and arbitrary amount determined by the allowance for the national pension.

The author was right, therefore, in pointing out that the second method of adjustment was dangerous and might be fraught with difficulties in particular circumstances. It would appear, however, that some of the difficulties were inherent in the direct application of salary-scale methods, and that some of those difficulties could be eliminated by going back to first principles and applying the salary scales to the salaries themselves, and not to the adjusted salaries. In that connexion, it might also be worth noting in passing that there were other ways of applying a salary-scale technique. It was not necessary to apply it in the traditional way as a ratio applied to existing salaries. As an alternative, it might be assumed that every person's salary would remain exactly as it was at the time of valuation with the addition of increments which were fixed for each person and not proportional to the salary. There might be occasions when that would be a better approximation than the traditional method, and certainly a better approximation than the application of a salary-scale method to an adjusted pensionable salary. He advocated the making of the adjustment at the end of the valuation.

Whether that sort of factor was important depended largely on the type of staff which was being dealt with, and particularly on whether it was a homogeneous staff. Where the membership was homogeneous and could be expected to have the same sort of salary progression, much of what he had said about the precise method of tackling the arithmetic did not matter very much.

At the other extreme, the flat salary scale presented a difficulty which was inherent in

the salary-scale technique. The salary-scale technique assumed that each individual salary varied with age, and that age was the only variable; but the experience of the previous 20 to 30 years showed that salaries were affected by other factors, for example, inflation due to war or other causes. In valuing a pension fund, therefore, it was necessary not only to examine how the salaries progressed with age but to consider what would be the effect on a valuation of a two to one inflation, for example, which was roughly what had taken place in the previous 7 to 10 years.

In a fund which had been valued with a fairly steep salary scale, some allowance would have been made for increases. Whether those increases arose because members became 10 years older or simply because the country passed through 10 years of inflation was perhaps by the way; what mattered was whether enough had been allowed in total. But with a flat salary scale, even if the membership was made up entirely of operatives earning £4 a week, who had earned £2. 10s. or £3 before the war, the fact that the scale had changed from one flat level to another would have a very big effect on the fund. It might even have made it insolvent.

That underlined the fact that salaries were not a function of age only, but of age and of other things. Was it possible to allow for that? It was certainly dangerous to use a flat salary scale in the calculation of contributions; it was necessary to allow something for the fact that in certain events—certain changed events—more money would be required. The experience of the whole of this century indicated that there was a much greater tendency for inflationary effects to predominate and for salaries to go up, costs to go up, and the value of money to go down; and it would be reasonable, in setting up a fund of a certain type, to allow something for the probability that that would happen again.

That led more or less naturally to another important point. Funds of the traditional type, in which the pension was calculated by reference to fractions of the salary of the individual employee, were operated in various ways; sometimes the pensions were calculated in terms of the final salary and sometimes in terms of the average salary. Both those methods had their advantages. The author was right in pointing out that a pension geared to the final salary had a certain appeal both to an employee and to an employer, because they both knew that the employee was going to retire with a certain pension related to his final status. The author was right in pointing out that what happened at the end of the first World War, when certain average salary scales were found to be unsatisfactory, was what might always happen in such circumstances: because the pension was based on average salary, it was not large enough in relation to the inflated final salary. Was it right, however, to go from the one extreme to the other in order to solve the problem? The great difficulty of basing pensions on final salary was that if inflationary effects were experienced—as they had been experienced, and as he believed that they would continue to be, to a greater or less extent—then funds of that type were going to be strained very seriously. Whether they were strained or whether they were made insolvent would depend on whether the contributions paid in were enough on balance for the pensions to be paid out. That in turn might mean whether the salary scale on which the contributions had been calculated was steep enough. If it was made steep enough and allowed something for the secular trend of salaries, the position might be satisfactory; but it was true to say that a pension fund built up in that way was very sensitive indeed to secular fluctuations in the value of money and salary levels.

Was it true to say that a pension based upon the average salary was necessarily too small? The problem had been confused in the past by comparing two pension schemes, one based on eighteiths of average salary and one based on eightieths of final salary. Obviously the average salary basis, when it was eightieths in both cases, was going to be much smaller, but equally the contributions to that fund would be much smaller. Was it right and proper to compare those two? Should not the comparison be between a fund where the pensions were related to the final salaries and one where the pensions were related to average salaries but so adjusted that the proper contribution on a reasonable salary scale was the same for both? In short, funds should be compared in which the pension was based on, say, eightieths of final salary and sixtieths of average salary.

If that were done it would often be found that the 'cake' was about the same size in each case, that the amount of money which had gone in was about the same, and that the division was not very different. If it was found that the division was very different with a 'cake' of the same size, it would probably be because there was heterogeneity present, a mixture of two kinds of staff so utterly different that they should be separated for all purposes.

The main disadvantage of the final salary method was that it was sensitive to salary fluctuations although it might be the best method to adopt. Where the average basis was used, it was possible to get much the same results, provided the contribution was made high enough and the staff and circumstances were reasonably homogeneous. The results should not then be very different, and, if they were, the reasons might be deeper than that simple rule. Moreover, where the average salary basis was used, fluctuations would not be so likely to render the fund insolvent. With a three to one inflation the pensions might be inadequate, and it might be necessary to pay in more money, but that would be a voluntary option to the employer, not a payment for the discharge of a liability which he had assumed and for which, on the facts, he had not contributed enough.

With regard to the adjustment to be made for national pensions, simplicity was the first rule, and method (2) was simple and should be used wherever possible. Beyond that, the important point was to secure reasonable equity between one employee and another, and in particular between one group of employees and another. Just how important that was depended on whether the fund was contributory, and how much of it represented the employer's contribution and how much that of the employees. The employer should not have the option to use his money just as he liked, but there should be greater flexibility in the use of the employer's money than in the use of the employee's. The employee's money must be employed for his own benefit.

Finally, it was very important indeed that any method of adjustment should be such that it could be easily modified because he was sure that the same level of pensions would not last for all time. It had been necessary to adjust pension funds twice for variations in national pensions, and it was reasonable to suppose that it would have to be done again. Method (2) for making the adjustment, the deduction of £100 from the salary, with pensions based on average salary and a sufficient contribution to provide an adequate pension, lent itself admirably to ease and simplicity all round.

The salary-scale technique and the valuation technique, and indeed the whole of the paper, were directed primarily to the privately administered fund; but in these days, when so many funds were insured under group life and pension schemes and with an assurance company, some attention should be paid to that type. It was worth emphasizing that the same sort of influences affected those funds. In short, if one set up an insured scheme and salaries went up, one of two things would happen: either the pensions would be inadequate, or the cost would be tremendously increased. Which happened depended on which end was fixed. If such a fund were set up on a 10% contribution, and salaries went up, the first effect would be inadequate pensions. If, on the other hand, the pensions to be provided under the insured scheme were related directly to the final salary by one rule or another, there would be a steep rise in the benefits to be provided, and the contribution which the employer, or the employer and employees together, had to find would go up correspondingly. In short, the same effects emerged, but in the form of an inadequate pension or an increased cost and not in the form of a somewhat surprisingly large valuation deficiency. It might be an advantage that the increase in cost happened automatically, but the money had to be found. That was something that was often overlooked.

The great advantage of running a fund under the traditional internal arrangement was that there was a means available in the salary-scale technique of putting away a reserve for such contingencies, which was in effect an equalization reserve, because it was not related directly to and deliberately pigeon-holed for individual employees.

The author mentioned mortality at the end of the paper, but the speaker thought that it was worthy of a separate section. Mortality had improved steadily for a generation at least, and there was every indication that it would go on improving. Each advance in medical science led to annuities costing more, and that had to be borne in mind.

He did not want to say much about interest, but it was perhaps the most important factor in the operation of pension funds, and it was always necessary to face the possibility of changes in that respect. Interest rates went up and interest rates went down, and with them the value of the invested funds. What was to be done about that, and how was the valuation to be adjusted to that? It was very important. The result depended on how the fund was invested. For example, it might be found that, if credit was taken for capital appreciation, the valuation had been weakened. The treatment of the assets was therefore very important, but the main point was that the high probability of changing circumstances must be faced, and it was very important, when making a valuation, to look critically at the circumstances as they existed and to take into account what would happen if the circumstances changed.

It should not be a source of surprise to find that circumstances had changed and that a weakness had revealed itself. If on the valuation basis adopted the fund could be seriously prejudiced by any changes that were probable, or even reasonably possible, then that valuation must be considered to be one which might prove to be too weak. Valuation should be made in the face of changing circumstances, and not on assumptions which were considered implicitly to be unchangeable

Mr P. W. Glassborow said that he would deal mainly with the implications arising from the first part of the paper. An actuary should give advice to the managers of pension funds to a much greater extent than was implied in the mere writing of a valuation report. The actuary had, or should have, a wide knowledge of pension funds before he came to give advice on the subject, and should therefore be prepared, and to some extent eager, to give advice on the records which the fund should maintain and on the investment policy which should be adopted; and in the latter connexion he should certainly advise a large pension fund to go outside the trustee securities. The actuary should also give advice on the general scheme to be adopted in setting up a new fund, i.e. whether in the circumstances a final salary, an average salary or a money purchase scheme was suitable. That advice should aim at two things above all others, apart, of course, from financial stability. Those two things were simplicity in the scheme and equity between the various employees who were to become members of the scheme. He disagreed with the apparent acceptance of the position as outlined by the author in regard to the investment of local authority funds, referred to in paragraph 2 of the paper. The local authority pension funds with which he himself had come in contact had not in fact been deposited with the local authorities concerned, and there should not be left on record anything that might imply that the profession approved of such deposits. Such a practice imposed on the pension fund a cost which should rightly be borne by other accounts of the local authority, because in the majority of cases the pension fund could easily invest its money to obtain a higher rate of interest, with greater security by reason of the spreading of the risk, than by deposit with the authority itself.

In par. 10 of the paper it was suggested that after a period of marked inflation the tendency was for the lower salaries to be raised first and for the higher ones to come into line later. He thought that that was true, but, judging by the experience of the last period of inflation (after the 1914–18 war), the time taken might be twenty to twenty-five years.

Mr J. M. Moore said that the economic changes referred to by the author indicated the difficulties involved when an actuary made a valuation, or assessed contribution rates, for a pension fund where the pension depended on earnings. The calculations would frequently be based on a set of variables of which at least one, the future earnings, could not be estimated with confidence. Actuarial methods could deal with this variable under stable conditions, but, having regard to the experience during recent years, it was doubtful whether stable conditions could reasonably be assumed for the future and whether a reasonable estimate of the future course of earnings could be made. That was, of course, not a new type of problem in actuarial work which frequently involved the difficulty of deciding how to give useful advice without the use of actuarial technique where that technique was unjustifiable, e.g. where a reasonable estimate of the probable

course of the variable could not be made. Thus, in the valuation of a pension fund where the pension depended on earnings, the actuary needed to state in his report that provision had not been made in the valuation for a general and substantial increase in the level of earnings. Such a statement would be a safeguard for the actuary and a fair warning to the trustees of the fund.

In deciding upon salary ratios for purposes of valuation or of calculation of contribution, some provision might be made for a moderate increase in the level of earnings but that would necessarily be arbitrary and should not be an unreasonable burden upon the fund or the contributors.

The author referred to the moral obligation which employers frequently accepted to finance any deficiency that might arise from an increase in the level of earnings. It usually resulted in pensions being increased for members in service but not for those who had retired. Such a differentiation between members appeared to be unreasonable.

The author gave tables of contribution rates and valuation results on the basis of certain assumptions which included the assumption that a single scale of decrements and of salary-increase ratios, according to attained age, would be appropriate for all ages at entry. That was a convenient assumption frequently made for valuation purposes, when it represented the mixed position for all members at the valuation date. Such an assumption was, however, much more difficult when members were considered according to the age at entry for the purpose of calculating contribution rates. It was certain that, at least in some respects, the position would be different for different ages at entry. Thus the probabilities of withdrawal and early retirement shown in par. 25 could not be regarded as being appropriate for all ages at entry; for example, an entrant at age 40 was assumed to be subject to no probability of withdrawal and to have an immediate probability of early retirement, despite early retirement not being allowed until after 10 years of membership. Further, the salary ratios might vary according to age at entry and, if members were allowed to retire at their option over a range of ages prior to age 65, the age at entry might also influence the age at retirement. It would therefore seem that any tentative comparisons between the contribution rates for different ages at entry as shown in the author's tables should be viewed with caution.

With regard to the schemes of adjustment referred to in par. 20, modification (2) appeared to have the important advantage of simplicity whereas each of the other two modifications produced the result that the benefits and contributions under a pension scheme would always be subject to a scale of adjustments. Modification (2) would, however, usually require a small increase in the contribution rates and that would lead to obvious anomalies amongst existing members if the increases in the contribution rates were calculated on the basis of average earnings. A few simple examples showed that existing members whose earnings were below the average at any age would be treated relatively favourably. Thus modification (2) was probably unsuitable for existing members. If modification (2) were used for new members, the pension payable to any member who retired before the national insurance retirement age would not be augmented by the national pension until the member reached that age. If that were regarded as being an objection to modification (2) there would be no difficulty in making an appropriate increase in the pension payable during the period between the date of retirement and the attainment of the national insurance retirement age subject to the contribution rates being correspondingly adjusted. It did not seem that the two difficulties mentioned by the author with regard to modification (2) were particularly important, or that members with earnings of not much more than £100 would be very common or present much difficulty. Thus modification (2) appeared to be preferable for new members and one of the other two modifications for existing members.

Probably only a small and special group of the existing members would choose to have any of these modifications applied if the reduction of contribution had to be shared with the employer. Such a group might not represent an average sample of the existing members, and adjustments based on averages for all members might not be appropriate.

Mr A. C. Robb said that hitherto the subject under discussion had been considered largely and naturally from a theoretical aspect. Speaking as one of the few actuaries

who were concerned with the day-to-day administration of a pension fund, he would like to introduce a practical consideration. The author referred in par. 40 to S.R. and O. No. 1245 in modification of local government schemes. Briefly, that S.R. and O. followed modification (3) with regard to the State insurance. There was a standard reduction of the contributions. For new entrants that entailed a standard reduction of the superannuation benefit, and for existing members there was an option to take that reduced contribution, and, in consequence, a reduced benefit. For the new entrant the reduced superannuation figure was, in most cases, £1. 14s. per year of service, corresponding to an entrant at age 20; for existing members the reduction was graduated according to the age at option. There could be no question but that the reduction was necessary for new entrants; the Government had stated that it desired to avoid any duplication of benefit from public moneys. The reason for the option was given in par. 19 of the paper; the double contribution might well prove a matter of hardship to the less well-paid members, and might lead to a demand for relief.

The reduction might lead to inequitable results as between individuals. Under the Local Government Superannuation Act of 1937, contributions ranged from 2½% of remuneration, in the case of certain surviving ex-Poor Law officers, to 6% for new entrants. A level reduction of 1s. 2d. a week in contributions should not lead to a level surrender of benefit.

It might be of interest to refer to the response to the option which had so far been experienced. The results did not seem to justify the labour involved. The Government Actuary, when he worked out the figures in S.R. and O. No. 1245, prepared no fewer than five tables for the calculation of the reduction of benefits. Those tables were not necessarily mutually exclusive throughout a member's service; even in the short time since the scheme had been in operation he had come across a case which switched from one category to another. Moreover, there was a paragraph in the Order which stated that a person who had completed the necessary number of years—usually forty—to qualify for full pension did not suffer any further reduction of benefit. Some members, therefore, could pay 1s. 2d. less a week for the rest of their service and suffer no reduced benefit in consequence. The point had to be borne in mind in interpreting the results.

Once an option had been made, there arose the question of transfers between authorities, so that in addition to the five tables for the calculation of the reduced benefit it was necessary to apply, in such cases, one of three further tables to modify the transfer value. The option had entailed sending out to every contributor an option form, receiving back those forms, keeping the records, and also calculating the modified contribution, which, as had been pointed out, was very complex. To date, in the London County Council, approximately 31,000 forms had been sent out for contributors under the 1937 Act, and of those about ·5% opted into the modified scheme, including those who had taken the reduced contribution without incurring any reduction of benefit. For those who came under the Asylums Officers Superannuation Act, 5000 forms were sent out and ·25% opted. It might well be asked whether it was worth while.

There were several explanations of which the first was, he thought, the inherent laziness of human nature. It was necessary to opt into the modified scheme; it was much easier to do nothing and to stay out. Secondly, most of the members concerned were in excepted insurance; in other words, the effect of the increased national insurance contribution would not be felt until 5 July 1948. Thirdly, the amount of the reduction in contribution, namely 1s. 2d. a week, was negligible. It must be remembered that most of the local authority funds had been approved for income tax purposes, and therefore the average saving to the individual would be reduced to, say, 10d.

He suggested that the option might very well be omitted from later arrangements. It was being written into the firemen's pension scheme, and presumably into police pensions, but from the point of view of the local authority—and he thought that the experience of the L.C.C. was typical of others—the option was a nice actuarial plaything, but an administrative nightmare. He was envious of Titania's scheme in the *Midsummer Night's Dream*, of which her attendant said 'The cowslips tall her pensioners be'.

With regard to valuations, he thought it was essential that for new entrants account

should be taken of the reduced contribution and the reduced benefits, since the latter were appropriate to entrants at age 20; but the almost non-existent optants, with their graduated reductions in benefit, might very well be ignored completely.

Mr R. W. A. Fowler referred to the statement in par. 10 of the paper in which the author said 'I do not consider that the allowances should be permitted to affect the salary scale used in a valuation, since the original rates of progression with age may be expected to restore themselves'. He assumed that the normal rise experienced by manual workers had been 50 %, and that the salaried workers had had a rise of about 30 % only on the average. That meant that a middle-aged salaried worker would have a salary 30 % more than by the 1940 scale. If the 1940 salary scale was applied to the increased salary, the salary was, in effect, assumed to remain 30 % above what it would have been had the 1940 basis continued all the way through. Suppose the opinion was held that the balance between salaries and wages was going to be corrected, and that salaries would eventually be 50 % above 1940 levels; the 1940 salary scale applied to the 1945 salary did not make an appropriate allowance. As the valuation liability consisted of the product of the existing salary and a function based on the salary scale, it was necessary to postulate, before discussing the method, when a reversion to the old rate of progression was to be expected to take place. If the change was expected within a few years, then obviously it was necessary to increase the 1945 salaries to the expected level after the elapse of two or three years, and the 1940 salary scale should be applied to the salaries as so adjusted. The use of the 1945 salaries with the 1940 salary scale was insufficient where a reversion to the normal rate of progression from age to age was expected. The author's views on that point would be very much appreciated.

Whilst on the subject of salary scales, there was another point, raised by Mr Lane, on which he would like to comment. Mr Lane stated that the traditional use of salary scales was satisfactory provided that the salary of each employee, whether above or below the average, could be assumed to progress proportionately according to the scale. It was well known that the variation about the average of salaries earned by people aged, say, 18–20 was very small, and that the variation about the average of salaries earned by people aged 60 was very large. Obviously, each individual's salary did not go up according to the salary scale. Normally, it was only necessary to assume that, in total, the salaries of each age-group would increase in the ratio of the salary scale. It was necessary to consider what kind of variation was hidden in the average salary of each group only when there were limits to be brought into account. That was the point that Mr Lane was making when he said that care was necessary with modification (2) to make sure that there were no fallacies in the method; when any kind of limit was imposed, such as the omission of the first £100, it was necessary to consider the variation of the salaries about the average.

In par. 12 the author gave the average yield on various funds taken at book values. After the previous meeting of the Institute, when the importance of the connexion between the yield on a fund and the method by which the fund was valued was stressed, it was a little surprising that no mention had been made in the paper of the method of calculating the book values on which those yields were based.

Mr H. P. Clay thought that in a pension fund there was a pooling of resources, what the layman called 'using the law of averages'. Should not that be translated into the duty of the actuary to explain the limits within which he felt that his technique enabled him to suggest an answer?

The author, in par. 55, talked of the problems confronting the management of a pension fund as a result of post-war economic conditions. Personally, he agreed; the management of a pension fund had very much greater difficulties than the actuary. Actuaries might ask themselves who were the people who constituted that management and what they could do to help them. He agreed with an earlier speaker that the actuary was perhaps doing less than his duty if he merely answered the questions put to him, and that he should go further and endeavour to see that the right answers were given to the right people.

Personally, he had a rule that he would not value a fund at one rate of interest only; he valued at two rates of interest, because that showed the layman how much difference there could be in an interest assumption of, say, not $2\frac{1}{2}\%$ and 3%, which the author had used, but perhaps a difference of $\cdot 25\%$, so as to be able to go on to say 'My limits as regards mortality suggest so much'. On the question of salary scales, he tried to divide the problem into two parts, and on that subject he was happy to be on the same ground as Mr Lane. Where the actuary had to deal with a final salary pension, he should say something in his report to indicate that allowance for 'salary increase excluding inflation' produced one answer, and 'including inflation' produced another, an unknown which he, personally, could not and would not estimate. Others might have that pre-vision which had been talked about in other places, but he was in favour not of pre-vision but of provision.

His experience with regard to national insurance adjustments of pension schemes was that there were three classes of people concerned: the first class consisted of the older existing members, who did not want to change, and who did not want their contributions and benefits reduced in any circumstances; the second and third classes were the younger existing members, and the new members who had just joined the service, and both of these classes wanted to pay lower contributions. What the position would be after 5 July 1948 depended, he thought, on the Budget; it might be that members would begin to appreciate that pension funds had to be paid for, and should be paid for. He felt that reductions in contributions would lead some months (or years) later to a demand for the increase once again of contributions and pensions.

Method (2) seemed to be the method which the Government felt should be followed, unless he had misunderstood the remarks made in the House of Commons to the effect that the Government pension was intended to provide a subsistence pension adequate for the lowest paid unskilled workers and for them alone. From that point of view, to leave out the amount of salary corresponding to that of the unskilled worker seemed to be the right thing to do.

Mr G. Heywood referred to the use of the term 'increase ratio' in the paper, and said that the author compared the increase ratios based on certain salary scales with the rates of contribution based on the same salary scales and found that there was a very close correspondence between those two functions. In fact, when it was remembered that in practice rates of contribution were usually required only to the nearest whole number per cent, it was possible, given the rates of contribution on one salary scale, to estimate with sufficient accuracy rates of contribution on a new scale solely by comparison of increase ratios; but he thought that in doing this a note of warning should be sounded, in that a rate of contribution depended on the salary scale figure at every age between age at entry and normal pension age, but the increase ratio depended solely on the salary scale figure at age at entry and pension age; if those two figures were the same in the salary scale the same increase ratios were produced, irrespective of what happened at intermediate ages.

There was, however, another method which could be used for the rapid calculation of contribution rates, or in fact any pension fund factors, on different salary scales, and that method had the advantage over the one which he had just mentioned of being not an approximation but exact. The author had already referred to a method introduced originally by Sir George Epps, by a development of which it was possible to derive a complete family of salary scales from a standard scale. Suppose the standard scale were to be denoted by S; then by excluding or adding at each age £20, £40, £60, and so on, it would be possible to arrive at salary scales which might be denoted by S−20, S+20, S−40, S+40 and so on. The greater the deduction at each age the steeper was the salary scale so formed, so that, for example, the scale S−100 would be steeper than the scale S−60. Similarly, the greater the addition to the salary scale at each age the flatter was the resultant scale, so that the scale S+100 would be flatter than the scale S+80. As he had been connected with much of the detailed work in the paper he could say that, since the paper was written, experiments had been carried out on those lines, and a complete family of salary scales from S−140 increasing by twenties to S+100 had

been constructed. Having constructed the scales, all the valuation factors could be rapidly produced on any of those scales provided that the two basic sets of factors were available, one on the standard rising scale and one on the flat scale.

The method, which was the same in principle for all factors, could be demonstrated by considering the simple case of the value of future contributions.

If
$$D_x = v^x l_x : {}^sD_x = v^x s_x l_x,$$

and if
$$\bar{N}_x = \sum_x^{\omega-1} D_{x+\frac{1}{2}} : {}^s\bar{N}_x = \sum_x^{\omega-1} s_x \, D_{x+\frac{1}{2}},$$

then the factor on scale S for the present value of future contributions per unit salary would be

$${}^s\bar{N}_x / {}^sD_x = F_1 \text{ (say)}.$$

The factor on a flat salary scale for the present value of future contributions per unit salary would be
$$\bar{N}_x / D_x = F_2 \text{ (say)}.$$

The value of future contributions on scale $(S - k)$ became

$$\frac{\sum\limits_x^{\omega-1} (s_x - k) \, v^{x+\frac{1}{2}} l_{x+\frac{1}{2}}}{(s_x - k) \, v^x l_x}$$

$$= \frac{{}^s\bar{N}_x - k\bar{N}_x}{(s_x - k) D_x}$$

$$= \frac{s_x}{s_x - k} \frac{{}^s\bar{N}_x}{{}^sD_x} - \frac{k}{s_x - k} \frac{\bar{N}_x}{D_x}$$

$$= \frac{s_x \cdot F_1 - k \cdot F_2}{s_x - k},$$

which was easily found when the two basic sets of factors F_1 and F_2 had been calculated.

Complete families of factors could be calculated in that way very easily and rapidly, so providing an extensive range of factors. In fact, it seemed that it might well be possible, by having only three or four standard scales, to produce from each a complete family of factors, and so to have sufficient factors calculated in advance to meet the needs of any pension fund which might come along.

Having obtained such a complete range of factors, the next development which suggested itself was that instead of using the normal method of employing one salary scale throughout all age-groups in a valuation, it might be possible to use different scales for different age-groups in the same valuation. The standard scales selected would probably be used for the majority of ages, but for any specific age-group, where it appeared from an examination of increase ratios that a steeper or a flatter scale would be appropriate it was a simple matter by the method just outlined to derive the necessary factors. Without going into any further detail, it could be said that the procedure went some way towards the theoretical ideal of using a select salary scale.

Again, the method might be used in dealing with the problem of high-salaried officers and the making of promotion reserves. The usual method, he thought, was to exclude high-salaried officers and to value them separately, but that did not fully answer the problem, because a special reserve had to be included at the end for the replacement of present high-salaried officers by younger members. If a family of salary scales and a family of factors such as he had mentioned were available, it was quite easy to give special treatment to the age-group containing high-salaried officials, or, on the other hand, to value them separately. Similarly, the age-group which contained the members who were likely to be promoted when the present high-salaried officers retired might also be given special treatment by being valued, for example, on factors based on a scale showing a similar increase ratio, so that the appropriate promotion reserve was automatically included in the valuation.

He ventured to suggest, therefore, that in skilful hands the use of a complete family

of factors based on a complete family of salary scales could be very powerful, and could give rise to great flexibility in pension-fund valuations.

Mr R. I. MacIntosh said that there was one aspect of the possible modification of a pension fund which he thought had not received the attention which it might well have had. It was well known that, as a result of falling interest rates and increasing salary scales, pension funds had been hardly hit financially, and it would be admitted that the National Insurance Act offered an opportunity to make some improvement in their position. It was desirable, however, first of all, to examine the suggested modification to see whether it was justifiable.

Looked at from the point of view of the employees—and it was quite possible that the actuary might be approached by the employees' section of the committee of management—it might be said 'we are being asked to pay 3s. extra, the difference between 1s. 11d. and 4s. 11d., and we consider that there should be some re-arrangement by which our contributions to the fund are reduced by that amount'. He thought that the actuary should point out that the extra contribution for national insurance was not, in effect, 3s. at all. On the 1s. 11d. scale the contribution was roughly £5 a year, on which the employee was entitled to claim tax relief on £1; it would now be going up to about £12. 10s., but the employee would have tax relief on the whole amount. Admittedly, the effective net increase in the employee's contribution depended on the rate of tax which he paid. If the employee paid only 3s. in the £, this 3s. increase would be reduced to about 2s. 4d. On the other hand, if he paid at 9s. in the £, and allowance was made for earned income relief, the 3s. was reduced to 1s. 4d.

That was looking at the matter in its most unfavourable aspect and assuming that that 3s. increase had been produced by the increased cost of pensions only; but on reference to tables in which the national health contribution was broken up, it would be seen that, whereas with the 1s. 11d. contribution 6½d. was the retirement pension payment, under the new scheme it was 1s. 7d., so that even on a gross basis the employee was being asked to pay only an extra 1s. He did not think that on those grounds the actuary would be well advised in telling the employees to proceed with their claim for a reduction of payments at the expense of a reduction in pension.

Again, it seemed to be assumed in the paper that the existing payment of 10s. had already been taken into account. He was afraid that he did not know in how many existing pension schemes that 10s. did play a part. He thought it would do so in a minority only of funds. The employee, therefore, was concerned with the increase in pension from 10s. to 26s., and it was only a 16s. increase that he should be considering. If the employee was asked to give up the whole of the 26s. in return for a reduction of contribution, he would appear to be 10s. worse off.

From the point of view of the employer, it was true that the increased payments had to be met, but he did not feel that the employer should necessarily meet the cost by a reduction in his pension fund contributions. The employer was being asked for a subsidy which he had not had to make previously, and it was not quite fair for the entire cost of the subsidy to be saved by an adjustment of pension-fund contributions.

There were many pension funds where there was a limit of salary, sometimes quite a low limit; for example, it might be as low as £300 or £400. The limit was probably introduced in the first place because it seemed then to be reasonable with few people earning more than that figure, and because it was desired to reduce the initial cost. Though the time might be awkward, he thought it was necessary to consider whether some of those limits were not out of date, and whether they should not be raised if the pension funds were to fulfil their original purpose.

Mr D. A. Porteous expressed special interest in the three methods put forward in the paper for modifying schemes to avoid duplication with the national insurance retirement pension. There had been a good deal of discussion of them that evening, and there seemed to be general agreement that scheme (2) was to be preferred, but he did not want it to be assumed that that was the unanimous conclusion of the meeting. Reference was made in the paper to some of the unsatisfactory features of that scheme,

and the actuarial difficulties could be illustrated by some of the figures which were given. If, for example, a scheme had been established on the basis of salary scale B, it would be seen from Table 2 that the contribution needed for the full benefit on retirement at age 60 would be 13·7 % of salary for an entrant at age 20. On the flat salary scale A, however, on the same table the contribution would be 10·1 % of salary. If, therefore, in a fund based on salary scale B the first £100 of salary were left out of account, the contribution ought to be reduced by a fixed £10·1 a year, or actually a little less, because the £10·1 included some provision for the return of contributions on death or withdrawal; but, arising from the way in which the modification was expressed, the contribution would actually be reduced by £13·7 a year, which, of course, was far too much for the young new entrant. That was the reason why the contribution shown in Table 4 for salary scale E was increased from 13·7 % to 15·3 % of salary. In past modification schemes, when the modification was applied to manual workers only on flat salary scales, the difference was not very marked, but he suggested that it would become of considerable importance.

So far as the effect on pensions was concerned, methods (2) and (3) could be made to produce the same result, i.e., so far as modifying the pensions was concerned. If the pension fraction was 1/60, by leaving £100 of salary out of account the pension was reduced by £1. 13s. 4d. for each year of service. This compared with £1. 14s. for new entrants in Table 10. The modification might equally well be expressed in that way, and it made it much easier in terms to include the provision that the reduction in pension should not come into operation until the national insurance retirement age was reached. He thought that that would be more important in future, as all the amounts involved would be very much larger than they were before. Under the old modification scheme reductions in pension were small, and the contributions which a retired employee had to pay as a voluntary contributor under the State scheme to keep alive his pension rights were also quite small; moreover, he was not compelled to continue as a voluntary contributor if he did not wish to do so.

Under the new scheme, not only would the reductions in pensions be much larger than before, but the retired employee would have to continue the payment of substantial contributions under the National Insurance Act; there would be no option. The pensions were quite small in many cases, even without any reduction, and the national insurance contribution might be a very heavy burden on them. In that respect, scheme (3) was an improvement, and it had the further advantage that the reduction in contributions could easily be calculated as the proper equivalent of the reduction in pension. Scheme (2) was perhaps the only practicable one in pension schemes arranged by means of insurance company contracts, and he believed that it was possible there for pensions to be adjusted at retirement so that the pensioner could get a larger amount until he reached the age of 65 and a correspondingly reduced amount afterwards; but for the ordinary superannuation fund he thought that scheme (3) was much to be preferred.

He demurred, however, to the author's suggestion in par. 39 that existing members would not be unfairly treated if the value of the reduction in pension was greater than the value of the reduction in contribution. That position might be faced if the finances of the fund were in a serious position and something drastic had to be done about it, apart altogether from modifications rendered necessary by the National Insurance Act; but otherwise he thought that an existing employee was entitled to expect that the value of the reduction in his pension should not be greater than the value of the saving in the contributions which he would pay jointly with his employer. That was the basis of the scheme outlined in Table 10 of the paper, and from his concluding remarks in par. 57 the author appeared to share his opinion on that point.

Mr W. H. Clough, in closing the discussion, said that having lived for the greater part of his professional career in the relative calm of life assurance, he found himself in his declining years open to all the blasts that came the way of the actuary who handled pension funds. Those blasts had been well illustrated in the discussion that evening. It was not difficult to see how much easier was the lot of the life-assurance actuary, in that

life assurance companies had never taken on themselves the risk of inflation, though he could remember that, in Central Europe, after the first World War, attempts were made by some companies to provide adequate life assurance facilities in that respect. In the same way, the medical profession happened to be on the side of the life-assurance companies for the bulk of their contracts, and it was interesting to note that annuity business only became popular with offices since they had commenced to handle pension funds.

On the other hand, it was true to say that when dealing with pension funds the factors involved were likely to operate adversely. In the long run money was bound to lose its value in a world which was visited from time to time by war; and, while it was all very well for Mr Clay to say that he was not prepared to take any pre-vision with regard to the course of such inflation, the fact remained that if the criterion of a pension fund was the adequacy of the pension which it provided for the retiring member, by basing pensions on the final salary, the risk of that inflation was definitely included and its effect had to be considered at the five-yearly intervals of valuation.

He was inclined to feel that nearly all the safety valves which had formerly been available were ceasing to protect pension funds. Even the rate of withdrawal of female members was no longer so effective now that the Government advocated that women should remain in employment after marriage. Further, the management of currency meant that the rate of interest was not likely to rise as it had in the past when the inflation became acute, and it was obvious from the size of the national debt that no Government could afford to allow interest rates to rise to any large extent.

He was not in agreement with Mr Lane's suggestion that if the benefits were greater proportionately there was an equal value in pensions based on average salaries compared with those based on final salaries. There was no doubt that the member regarded his pension as most nearly adequate when it bore a relation to the salary which he was receiving just prior to his retirement.

As the author had said in presenting the paper, the keystone of any pension fund was the contribution, not only in the sense that it must be one which could be afforded by both sides, but in the sense that the most satisfactory pension fund was one in which in assessing the rate of contribution the actuary had taken into account all the elements referred to, including even that of inflation, if he felt that that was necessary. The actuary who looked after pension funds had moved away from the considerations which applied in life assurance work, where there was a contract on a money purchase basis and no currency risk was involved, and had gone into the arena in which, when calculating the contribution, it was necessary to take into account all those other elements, including a hypothetical salary scale, and to try to make the contribution as level as possible in relation to salary throughout a man's career. Every five years, of course, there came a time when adjustments could be made, but the actuary of the pension fund would surely be judged by the way in which he was able to smooth the course of the fund from valuation to valuation.

Apart from the other values of the paper, it gave a clear indication how, in changing economic circumstances and in changing Government attitudes, it was possible to find the best technique for marrying pension funds to national insurance schemes as they came along, linking the pension age with that of entry into national pension, and adjusting the pension, whatever form of modification was adopted, in accordance with the national insurance scheme. He agreed with other speakers in that in his experience there had so far been very little inclination on the part of local government employees or members of other pension funds to take advantage of any reduction in contribution which involved a reduction in benefit.

He agreed with Mr Lane that, when the marriage of the old and a new fund had to be considered, as great a flexibility as possible should be allowed in deciding the best method of utilizing the employer's past contributions. It was not practicable to give effect to theoretical considerations of equity, so long as every employee received back at least the equivalent of as much, with interest, as he had placed in the fund.

He would add to the plea made by other speakers that it was desirable that the actuary should keep in touch with the management of the funds and also with the members in

order to give real advice. At the inauguration of the fund the actuary should make certain that, as with life offices, greater flexibility of investment was given to the fund than many of them had had in the past. He should provide an opportunity for the members and for the management to appreciate all the considerations which came into play. It should be quite clear that the actuary served a useful purpose not only in valuation but in all the other advice that he could give to a pension fund from time to time.

He would like to conclude by paying a tribute to the author for a very interesting paper. He hoped that in the hands of secretaries of funds it would not become a sort of handbook which would enable them to say 'We thought it was going to cost only so much; we are sorry that your calculations are not in line'. In the hands of actuaries it would be most useful; it was a paper which would serve the function of a 'model fund' giving ideas of cost on different bases both to students and to those who were engaged in practice on such problems.

The President (Mr A. H. Rowell), in proposing a vote of thanks to the author, congratulated him upon his ability to produce so large an audience on such an unpleasant evening. He also congratulated the audience on the excellence of the debate.

He had only one suggestion to make. He felt that it might be unfortunate if the form of the paper (especially if it were put to the use that Mr Clough had envisaged) could be interpreted as implying that the introduction of the increased State pension represented an unquestionable reason for modifying existing schemes. There might, he imagined, be cases where the advice given on the question of marrying pension funds might not inappropriately follow precisely the lines of Mr Punch's famous advice to people contemplating matrimony.

Mr W. F. Marples, in reply, expressed his appreciation of the reception which had been given to what he described as 'a large amount of hard work done by other people'. On his way to the meeting he visited the Secretary of a fund to discuss methods of marrying that scheme to the State scheme. The discussion ranged over most of the points raised that evening, and then the Secretary had said 'Nobody has raised the matter yet, so why should we?' and he had replied 'Agreed'. Nine times out of ten that was the advice to give. The actuary could point out to his clients that the State pension added a bit extra to the pension from the fund, and that that bit extra was desirable in the new conditions. That advice would avoid all the complications set out in the paper.

He thought that Mr Lane's interpretation of the salary-scale technique fell a little short of its actual power. The fundamental assumption was that the volume of salaries increased between certain ages. It did not matter to the actuary whether one man had £100 more than his proportionate share of the increase, provided that the total increase for all did not exceed the gross increment according to the salary scale.

The following communication has been received.

Mr K. J. Burton and Mr F. J. C. Honey. Mr Marples begins his paper by referring to certain general economic considerations affecting the finance of pensions funds, but it appears to us that he does not sufficiently stress the instability of the present position.

It will be remembered that after the 1914–18 war there was a period of violent inflation lasting for some two years followed by a very rapid deflation over the next two years. We have experienced a considerable degree of inflation during the last two years and there are signs that it may now be coming to a halt; whether there will now be a period of deflation, or whether there will be further inflation, it is impossible to say. It is true that public opinion is far more strongly opposed to deflation now than it was in 1921 and there are, of course, other differences in our economic position at the present time as compared with our position after the 1914–18 war. For instance, in 1920 we had a very large credit balance on our overseas trading account, while in 1947 we had

the largest debit balance on our overseas trading account that we have ever experienced. Our economic position is, therefore, far more critical and the outcome appears unpredictable.

In these circumstances, it appears to us that it is very unlikely that any alteration in pension funds made at the present time can have any permanence, and that, if it is essential that some alteration should be made now, regard should be had to the likelihood of further change in choosing the basis for the present alteration. In particular, we feel that there are strong objections to adjusting pension schemes on the lines of method (2) set out in Mr Marples's paper.

The exclusion from the salary of the individual employee of a fixed sum for the purpose of calculating contributions and pensions would have the result of magnifying the proportional effect on the finances of the fund of any future general salary-scale changes.

Thus, take as a simple concrete example Scale A of the paper. An increase of 25 % in salaries would raise the salaries at all ages from £159 to £199. If £100 of salary is excluded for the purposes of calculating contributions and pensions, the effective salary on which these are calculated would increase from £59 to £99, or by 68 %, as against the increase in the actual salaries of only 25 %.

It is clear, therefore, that this method of adjustment would introduce an element of considerable instability into the fund, and would greatly increase the risk of its becoming insolvent.

We should also like to comment briefly on the references in par. 6 of the paper to the increase in the cost of living between 1938 and 1945. It is worth recalling that the old Ministry of Labour cost of living index was designed to show the average percentage increase in the cost of maintaining unchanged the standard of living prevailing in working-class families prior to August 1914, and it was always of doubtful validity as a measure of changes in the cost of living according to the conventional standards of other sections of the community. At the time of its supersession last year by the new interim index of retail prices, the former index had ceased to be satisfactory even so far as working-class expenditure was concerned, largely owing to the heavy weight assigned to food, and the fact that Government subsidies have been mainly concentrated on food.

Without entering into the general question of what a cost of living index should measure, we feel that regard should be had also to the limitations of the index published in the *Oxford Bulletin of Statistics.* That index is based on the price changes derived from figures given in the various White Papers on the national income (the latest being Cmd. 7099) for broad categories of consumer goods and services over the whole range of expenditure on these goods and services of the entire community. These price changes, expressed as percentages, are then weighted in accordance with the pattern of pre-war working-class expenditure as disclosed by the 1937–38 inquiry of the Ministry of Labour—a pattern which, as a consequence of rationing and increasing shortages, has in recent years become progressively more remote from reality—the only modification in the weights so disclosed being in relation to beer and tobacco which have been accorded an increased importance.

This index, in common with both the old and the new Ministry of Labour indices, disregards changes in direct taxation, but takes into account price changes due to indirect taxation. It is doubtful, however, whether the weighting is satisfactory in this respect, and it is indeed far from clear what the index really measures.

In view of the fact that both direct and indirect taxation involve a charge on gross income, it seems to be worth considering whether, in framing such indices, direct and indirect taxation should either be both eliminated or both taken into account, and the particular purposes for which the index is to be used obviously have an important bearing on this question. However that may be, it appears to us that there is no published index which would be really suitable for the purpose Mr Marples has in mind in his paper.