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THE ORIGIN OF IMMUNISATION

by Frank M. Redington, F.I.A.

Ed. Note: The author is one of only eight winners of the Institute of Actuaries' Gold Medal for actuarial work of pre-eminent importance. In that 1968 award, the paper described here was cited as having "opened up an epoch in which new and more realistic principles were to be applied to the financial planning of insurance institutions." Mr. Redington was the Institute's President, 1958-60.

I have many pleasant memories of meetings with actuarial colleagues from North America. Unfortunately these contacts have become all too infrequent since my retirement in 1968. It was therefore a great surprise to learn that the idea of immunisation is flourishing in North America. From the little I have read of your proceedings I think that some reminiscenses of the origin of immunisation may interest readers of *The Actuary*.

In 1951 the sessional meetings committee of the Institute of Actuaries asked me to write the paper on life office valuations for delivery in Spring 1952 that now appears in *J.I.A.* 78 (1952), p. 286. Although the paper was, in this sense, commandeered it was a task which I undertook with enthusiasm because valuation was both my job and my hobby. Although I am an inveterate re-polisher the task was completed to my satisfaction some fortnight before the date for delivery to the scrutineers. At that stage the paper was in its final form except that instead of the passages on immunisation in the earlier part of the paper, there was a conventional passage on the necessity of matching assets with liabilities on such matters as currency, degree of risk and spread over time. I have no doubt that this passage was as plaus-

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ALFRED BAKER: PIONEER IN TEACHING ACTUARIAL SCIENCE

by Peter L. J. Ryall

In the spring of 1885, actuarial concepts and symbolism made their appearance in three of nine questions in an examination paper on Theory of Probability at the University of Toronto. Credit for what may well have been the first actuarial instruction at a university goes to Alfred Baker (1848-1942). Possessor of a keen and diverse interest in education, his accomplishments included reorganizing Canadian teaching of geometry and introducing Spanish into high schools. His talents were recognized both within and beyond the University; he became Dean of the Faculty of Arts (1912-19) and President of the Royal Society of Canada (1915-16).

Professor Baker never forgot or regretted his attachment to actuarial education. On his retirement in 1919, he nicely balanced the utilitarian with the cerebral appeal:

> "I have in my 33 years as Professor of Mathematics tried to feature the practical value of mathematical training as applied to actuarial, engineering, chemistry and the like work, but the singular intellectual beauty of an absorbing mathematical problem has, like art, but aesthetic value for its vindication."

After Professor Baker's death at age 94, his biographer, Professor S. Beatty, left us many happy sidelights on him and his interests, such as:

> "In his own study and in his lectures, he made full use of intuition, and it was always easy to follow the natural course of his exposition . . . He was a lover of nature and a student of history and the classics . . . In mathematics, his main interest was geometry, . . . and he was

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THE E. & E. CORNER

We want more of your queries. Please send them to James J. Murphy at his Yearbook address.

Ques.: *What is the scoring method on essay examinations?*

Ans.: Each examination committee has a grading process to fit its own needs. Most are structured along the following general lines:

The essay answers go directly to a committee officer where they are sorted by question number and mailed to committee members, each of them assigned to a single question.

Each grader starts with a grading outline which lists possible points and sub-points, their numerical values set according to each item's importance. The grader may give additional credit in recognition of a candidate's demonstrated overall grasp and understanding of the subject.

In grading the first few papers, frequently the grader will see that the outline doesn't contain points that deserve credit. The grader then will revise the outline and start over. Even then, credits for points still missing from the outline may be given.

After all papers have been graded, a conversion scale is developed to assign the score each candidate is to receive for that question. Generally, the best papers will receive the maximum score, i.e., the score printed on the question sheet.

Essay scores are next combined with multiple-choice scores, if any, and candidates ranked in score order. Approximately the middle 50% will have their essay papers regraded at a central grading session which all committee members attend. The top 25% and the bottom 25% will generally not be regraded, as it is assumed that those scores

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ible as my predecessors had always been on these subjects but attitudes were changing, a spirit of enquiry was abroad, and these merely ritual genuflexions were ceasing to satisfy. Matching had not been one of the foremost issues which had been speeding my pen, but as I lay in bed one Saturday morning about a fortnight before the paper was due, relaxed because it was a weekend and my paper was finished, the little cloud of doubt about matching found an empty mind in which to grow.

To understand what happened next I must explain the actuarial background in Britain in 1951. Since the dawn of the profession the problem of valuation had been in the forefront of our thoughts but our concern was solely with valuation of liabilities; life-office assets were no different from those of other concerns. That is not to say that our predecessors were indifferent to the value of the assets, but assets entered their thoughts in a different way. If you had asked a pre-war actuary what rate of interest to use in valuation he would probably have said that you should pay regard to the yield on the existing assets in so far as they went and for the rest should use your estimate of the long-term bond rate. This is plausible enough as an abstraction but it is mathematically impracticable. And so it remained as an abstraction, comfortably relegated to the periphery of our minds.

But as so often happens, wartime shook us out of our complacencies. Further, attempts by doctrinaire governments to control the rate of interest had focussed actuarial attention on the relationship of assets and liabilities. Until that time I think most actuaries had taken the simplistic view that by "matching" we meant that assets should be invested to mature at the same time as liabilities. But the threat of an artificially low rate of interest of 2% showed us that this simplistic policy would not save us from insolvency in the event of such a fall in the rate of interest: the consequent rise in the value of the liabilities would greatly exceed the rise in the value of the assets. If we invested in assets *longer* than the maturity dates of the policies, we should at least be better off.

This was the state of the game as I lay awake that Saturday morning. We were beginning to realize that the simplistic view was wrong but we did not know what was right. And progress was bedevilled by the fact that at the back of all our thoughts on valuation was the question of the right rate of interest to employ, which in turn depended in part on the actual interest receivable on the assets. The word "interest" was being used in a double sense: partly as the operator and partly as the operand. If a valuation is likened to a photograph of the fund then we were confused between the rate of interest as the spot from which the photograph was to be taken and the amount of interest to be received which was part of the scene to be photographed.

I myself had been lost in this jungle often enough and if I had set off on the old track I should certainly have been lost again. But I was lucky. I had finished with the sections of the paper dealing with valuation and was left with the single unresolved and uncluttered problem: if we have two sets of known amounts spread over time (taking the rates of mortality, expense, tax, etc. as given) what is the condition that they should be equally responsive to changes in the rate of interest? As so often, once you look at a problem straight between the eyes you find the answer staring you in the face. It was obvious that, to use the language of applied mathematics, if assets and liabilities are to be equally responsive to change they must have the same centres of gravity: or, to use a metaphor nearer home, the same mean term: or, better still, using the more careful language of pure mathematics, the condition that they must be equally responsive to changes in the rate of interest is only the layman's way of saying that they must have the same differential coefficient with respect to the rate of interest.

It follows immediately that if we start from the equation of present equality,

$$\Sigma\, v^t.A_t = \Sigma\, v^t.L_t$$

then the equation of equilibrium is

$$\Sigma\, t.v^t.A_t = \Sigma\, t.v^t.L_t$$

where A_t and L_t are the asset-proceeds and liability-outgo at time t. These equations, which are very nearly self-evident, were clearly established in my mind that Saturday morning before I raised my head from the pillow, and it is the principles which they embody to which I gave the rather impetuous title of immunisation.

That is the end of the history of the birth of immunisation, but it is not the end of the story. During the next two weeks I was busy exploring numerical examples and re-writing the early part of the paper to introduce the new theme of immunisation. I was not aware at the time that these new thoughts were affecting my attitude to more than the narrow problem of matching. My attitude to valuation itself was changing.

Perceptive readers of my paper must have been puzzled by an odd shift of attitude between the early passages on immunisation and the later sections on valuation which, although it is not apparent, were, of course, written earlier. There is for example a later passage asking what we mean by the rate of interest. The relevance of this passage must puzzle modern readers but it should please the actuarial antiquarian because it is a relic of our first two centuries when the critical problem of any valuation was the rate of interest to use.

Even more puzzling must be the later sentence (p. 298): "It is an interesting train of thought to consider what the valuation process would be if we adopted a similar basis for both assets and liabilities." This reads oddly following, as it does, the earlier passages on immunisation where the use of the same rate of interest to value assets and liabilities is the essential starting point.

The fact was that at the time the paper was delivered my mind was in a state of transition: the principles involved in immunisation on which I had accidentally stubbed my toe were still confined in my mind to the subject of matching and had not seeped through to the general problem of valuation. But it can only have been a matter of weeks before the new thoughts broke through to flood the whole scene. In the middle of that same year, 1952, my company started the first of a series of valuations which continues to this day and which we call "estate" calculations. The essential point is that we use the current long-term rate of interest to value both assets and liabilities. We use full-blooded gross-premium valuations incorporat-

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ing, as best we can, our estimate of the future. These calculations were of course for internal purposes only, which was as well because any high hopes of added inspiration were quickly dashed by the great volatility of the answers. It is true that much of the volatility is due to our high proportion (now over 70%) of investments in common stocks and real estate, but the erratic behaviour of bond yields in recent years has also been a contributory factor.

Thus an exercise which started as an attempt at scientific precision proved to be a lesson in human fallibility. The fact is, of course, that we cannot foresee the future. The fluctuations in world interest rates during recent months have confounded all expectations. But if we cannot see the future for three months ahead what are we doing when we value contracts which run for thirty years or more? The answer, of course, is that the word "valuation" is a gross misnomer: we are totally incapable of "valuation" in the ordinary sense of the word. Our so-called valuations can be no more than transient statements of value in the particular conditions of the moment.

Misled no doubt by the relative tranquility in those earlier days our predecessors continued to pursue the holy grail of a perfect system of valuation. The clear realization that the dream is unattainable comes with a sense of release. I now accept that neither we, nor any regulatory authority, can see thirty years into the future and thus evaluate that future. Our "valuations" are conditional statements made on the particular hypothesis contained in the valuation basis. They are photographs taken from one particular spot. The basic lesson which immunisation theory taught me was that for a valuation to have even that limited validity the photograph of the assets and liabilities must be taken from the same place. □

THE ACTUARY'S FRIEND

"The true advantage of the micro-computer is that it gives back to the actuary the flexibility he lost when mainframes came in, well protected from outside interference by armies of data-processing personnel."

Gary Chamberlin in FIASCO, Nov. 1981

Alfred Baker

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drawn to probability as the basis for life assurance."

It is recorded that this pioneer had his own portable lectern which his students sometimes would toss out of the window before his arrival. Spying it, he would remark that some ruffians from Engineering must have done so; a student volunteer would then go down and bring it up.

Ed. Note: Stories, specially reminiscences, of other actuarial teachers of bygone days who have put the stamp of their influence on actuaries of yesterday or today, will be welcomed. □

Letters

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Recorder's Problem

Sir:

As Recorder at a 1981 meeting, I have learned to substitute facts for appearances. Consider the following—"Appearance" in each case being the Society's editing and typing instructions for Recorders:

Appearance: "In all cases the Moderator and Panelists will be providing you with well edited copies of their remarks."

Fact: Moderator and Panelist A had no copies of their speeches. Panelist B sent me only an outline. Panelist C asked that I send *him* a copy of his speech as it would be useful for his future speeches.

Appearance: "The tape of your session should help you in your final editing of their remarks."

Fact: Transcribing each and every word was tedious and time-consuming; the many technical terms meant that it could not be done by a secretary alone.

A Recorder who has to transcribe twenty typewritten pages from a tape is being taken advantage of. I recommend that Moderators see to it that the instructions are made to come true.

Benjamin E. Feller

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BENEFICIARIES OF INFLATION

Our November Query asked which groups, in addition to debtors and those blessed with amply indexed incomes, seem to have profited most conspicuously from the past decade's inflation. This yielded contributions from Larry Bartlett, Steve P. Cooperstein, Darrel J. Croot, Gerald E. Cuddihy and Harvey Sobel, a group heavily concentrated in the early letters of the alphabet; no display of interest in this question was shown by any actuary who qualified before 1957.

Nominees for inflation winners in categories other than those in the query were:

Capital (at least more than labor):

"The ratio of income to capital stock has been increasing, probably over 30 years. This results from inflation exceeding anticipated inflation."

Holders of Mercedes automobiles.

The Government—City, State and Federal—because of tax-bracket creep. One correspondent confined this to the Democrats for no stated reason. Another cited liberal congressmen who were thus able to enact substantial give-away programs.

A reader, pleading no time to research the technicalities, contented himself by nominating the descendants of those who owned this continent before the Europeans discovered it. He was, it seems, too busy to explain why.

Mr. Cuddihy, undertaking sociological analysis, offered a possible explanation of inflation that would show who has benefited from it, applying the premise that post-World War II babies, raised indulgently by parents compensating for their own depression privations, became accustomed to getting what they wanted. Now in adulthood, these children continue to demand privileged treatment, and their parents, now the nation's leaders, offer no resistance but go along indulging them. Current inflation, not a villain in itself but a measure of the resulting transfer of wealth from the parents' to the children's generation, is a consequence much more of parental attitude than of tinkering by the central bank and the government.

E.J.M.