



# The Actuary

The Newsletter of the Society of Actuaries

VOLUME 8, No. 7

SEPTEMBER, 1974

## APOSTLES vs. PROPHETS

by David S. Williams

No, this is not a report on last weekend's game in the Ecclesiastical Football League. Rather, it has to do with your appraisal of the "world problematique", the global complex of problems popularized through the "Limits to Growth" controversy. Are you basically a "prophet of doom", or do you count yourself as an "apostle of hope"? Whether you occupy one of the extreme positions or a point somewhere in between, you are assured of the support of numerous experts, e.g.,

"The battle to feed humanity is over. Unlike battles of military forces, it is possible to know the results of the population-food conflict while the armies are still in the field. Sometime between 1970 and 1985, the world will undergo vast famines—hundreds of millions of people are going to starve to death. That is, they will starve to death unless plague, thermo-nuclear war, or some other agent kills them first."

"Even if there were no new discoveries in food-growing technology from now on, and we continued to cultivate only the very small proportion of the earth's surface now used as farmland, a raising of all other countries' efficiency of cultivation to that of the Netherlands would already suffice to feed 60 billion people."

"We can and must commit ourselves to a lower rate of growth in the use of natural resources. In one decade, 1959 to 1968, the United States alone used more resources than all the world's people in all of previous history."

"It is not reasonable to assume that general resource exhaustion will reduce industrial output ever, let alone within a few hundred years."

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## VARIABLE LIFE INSURANCE

by Robert O. Dausman

At the Spring Meeting of the Southeastern Actuaries Club held on June 13 and 14, Mr. Walter S. Rugland discussed various aspects of Variable Life Insurance including the many problems still awaiting solution.

He began his address by stating that the viability of the VLI product depends upon favorable treatment of the product by various regulatory bodies. It appears that development work by the interested companies has ceased until the regulatory picture is cleared.

He noted some possible threats to VLI. Some of them were: (1) a commission rate at mutual fund rates, (2) investment gains taxed directly to the policyholder, (3) proceeds to beneficiaries could be taxed, and (4) insurance company taxes on VLI product line could be restrictively high.

His personal feelings are that VLI, as defined today, is a weak answer to inflationary problems inherent in permanent life insurance. Since the design of this product in 1968-1969, there has arisen a new dimension to inflation and to the equity market place.

Mr. Rugland then discussed the eight pertinent development issues other than the technical aspects. They are: alternative VLI approaches, agency officer commitment, proposed amendment to Rule 3c-4 — Marketing Implications, external influences, NAIC model, VLI investment vehicles, and finally, basic questions.

1. *Alternative VLI Approaches.* Mr. Rugland felt that product designs should be the creation of a product to fill a market need. Each company needs to evaluate its market and why people buy from it. His conclusion was that a company should not

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## SOLVENCY, THE INTERNATIONAL VIEW

*Financial Guarantees Required from Life Assurance Concerns, Organization for Economic Cooperation and Development, Paris, 1971.*

by James C. Hickman

Life insurance is a serious business. Through the political process, the public long ago made it clear that it expects a high degree of stability and continuity in the operation of life insurance companies. One of the principal obligations of the actuarial profession to the public it serves, is to design and manage life insurance systems that have a high probability of remaining solvent. Consequently, any discussion of solvency standards for life insurance companies is, in fact, a discussion of the foundations of actuarial science.

To honor the chairman of the committee that prepared the report, and in response to the imposing length of its title, this document is usually referred to as the Buol report. During the time that the report was being prepared, Mr. Buol was a member of the Swiss Insurance Supervisory Service.

The OECD, the organization that commissioned the Buol report, may not be well known to actuaries. It was created by an international convention signed in Paris in 1960. Twenty four countries, including the United States and Canada, are members. Yugoslavia has a special status, different from full membership. Member countries account for about 70% of world trade and 95% of all development aid. OECD sponsors a broad program of research and technical services with the objective of achieving the goals stated in its name.

The Buol report was written by representatives from ten European countries. Consequently, North American actuaries may find some of the actuarial terms

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# The Actuary

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*Published monthly (except July and August) by the SOCIETY OF ACTUARIES, 208 S. LaSalle St., Chicago, Illinois, 60604, E. A. Lew, President, William A. Spare, Secretary, and John T. Birkenshaw, Treasurer.*

*The Society is not responsible for statements made or opinions expressed in the articles, criticisms, and discussions in this publication.*

## EDITORIAL

AMONG the letters which we have never finished reading is one from a distinguished periodical which begins thus "Just to keep pace with mankind's learning curve, you'll have to know twice as much in 1977 as you know now." For the sake of present and future students, we trust that the E. & E. Committee is not enamored of this dismal prospect, and gleefully making devilish plans to double the size and scope of the examinations. Then if the *Transactions* were to double in size every three years, think of the space problems in our libraries (and maybe in our heads)! Perhaps the time has come for courses in forgetting ("disremembering") to replace courses in memory training.

Some extensions of knowledge — useful knowledge that is — are to be encouraged and there is currently an example of such extension in the Final Report of the Joint Actuarial Committee on Financial Reporting. Mr. Gary Corbett drew attention to this report in a brief and modest note in the June issue. This report may not make the Best Seller List but it should be on the required reading list of every actuary. Here can be found the history of the emergence of the Audit Guide, comments on the Guide, and an interesting record of the differences and disagreements that arose not only between the actuaries and the accountants but also among the members of the Committee. Noticeably the Committee did not write FINIS at the end of the Report but properly devoted several pages to listing Future Tasks with the further comment that others are sure to arise as the experience with the Guide grows. Mr. Corbett mentioned the importance of this report for all people concerned with insurance company financial reporting. This should not discourage our colleagues in the pension field from reading the report because they are now concerned with an Audit Guide for Pension Accounting and perhaps the history in the report will enable them to avoid some pitfalls. The report might well find a wider audience than the actuaries and the accountants. A reading of the report might convince the authorities in the S.E.C. and the New York Stock Exchange of the importance of the actuary. We also hope that a copy of the report has been sent to the NAIC.

One other current item is worthy of comment, the recently announced Bulletin Service. The service is possibly overdue and so we welcome the announcement by the Career Consultation Committee and thank them for the result of their labors. The service is being started on an experimental basis but we should be very much surprised if, at the end of the experiment, the Society does not discover that this is something we cannot do without.

A.C.W.

## LETTERS

### Actuarial Positions

Sir:

As you know, the Employee Retirement Income Security Act of 1974 has been signed into law by President Gerald Ford. The law is designed to protect workers in private industry against loss of pension rights when they switch jobs or when their pension fund is inadequately funded or abruptly terminated by the employer.

The legislation established the Pension Benefit Guaranty Corporation (PBGC) within the Department of Labor. As a result, Labor is currently hiring actuaries to help administer the program. Because actuaries are in short supply, the U.S. Civil Service Commission is conducting an intensive recruiting effort for the Federal service.

The actuarial positions are located in Washington, D.C., and have excellent advancement opportunities and fringe packages. Starting salaries range from \$12,167 to \$28,263, depending upon qualifications. In addition to the PBGC job vacancies, many Federal agencies, such as the Internal Revenue Service, have positions available for actuaries. Anyone interested in applying can get further information by calling, collect: 202/254-6200.

I would appreciate anything you can do to assist us in recruiting during this critical beginning phase of the pension reform program.

Wendell G. Mickle  
 Director  
 United States Civil  
 Service Commission

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### Cost Comparisons

Sir:

Many of us have complained about the complexity of trying to perform a "true" net cost comparison of ordinary life policies.

There is general agreement that the traditional method of comparison is simple. There is lesser agreement that it is, or can easily be, misleading, inaccurate and untrue.

The compromise offered is to take to account the value of money and, therefore, use an interest factor.

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**Letters**

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"Closer to a truth," say some of us, "but not close enough." "After all," say the technicians, "interest adjustments ignore the effect of mortality and lapse rates."

But, how do you tell an individual 22% of him (my apologies to Mrs. Bartlett) will lapse after one year and 0.00078 of him will die during the year? Is he necessarily going to surrender at the end of 20 years? (What is the magic of a number indivisible by 7?)

Why not offer a simple (from the prospect's standpoint) cost index? One

which has three columns and requires an index for each of the years projected. The form of table is shown below.

We could expand the table further by showing the premium paid during the year, the accumulation of the premiums paid with interest, estimated annual dividends and their accumulation.

The suggested table is as easily calculated and printed as are the current non-forfeiture tables.

It can be used for policies whose premiums or benefits vary by duration and does not have to be limited to whole-life, level premium plans.

Lawrence Mitchell

*Termination of Policy Cost Index*

<u>Policy Year of Termination</u>	<u>Termination As a Result of</u>	
	<u>Death</u>	<u>Lapse</u>
1	xxx	xxx
2	xxx	xxx
3	xxx	xxx
4	xxx	xxx
5	.	.
.	.	.
.	.	.
.	.	.
.	.	.

Death is assumed to occur in mid-year.  
Lapse is assumed to occur at year-end.  
An interest rate of at least 4% should be used.

*Mr. Moorhead Comments:*

Ever since the days of the original Joint Special Committee on Life Insurance Costs it has been generally agreed that both a year-by-year policy analysis and an index are needed. Mr. Mitchell has given us a worthy candidate for the first of these, but I think he is mistaken in supposing that his table will do both jobs. The purpose of an index is to narrow the field so that an interested buyer will not be swamped with detailed figures of many companies.

Mr. Mitchell's distressing observation about fractions of a person lapsing and dying has already been well answered by others in recent issues of *The Actuary*. □

\* \* \* \* \*

**Response**

Sir:

Your call in the June issue for submission of material has aroused me; herewith is my offering.

Reluctance in the past to submit, or willingness to remain one of the "Silent Majority", has been based on the fear that I was incapable of making cogent remarks. One does not want to say the obvious, to repeat others' comments, to claim knowledge in subjects where others

are more experienced and expert. Often one reads an item that is so pertinent, pithy and pungent that one exclaims "That is exactly how I feel; oh! that I had had the wit to so phrase it!"

I do not claim, by this submission, to have discovered such wit in myself; rather, this submission was prompted by your invitation and the feeling that the time has come to stand up and be counted. You, of course, must be the judge whether this offering deserves a public airing.

The 50's was the Age of Anxiety, the 60's the Age of Dissent and Demonstration; and now in the 70's we have arrived in the Age of Accountability (Generally Accepted). It reminds me of the maiden aunt's demand to her errant nephew who had been out on the town all night: "Explain yourself". To labor the analogy, certainly we had no idea we were doing anything wrong.

Much has been said about Cost Comparisons and GAAP; and I can find nothing of significance to add. But, as noted above, I feel I must take a stand. So I will say this:

- (1) Cost indices will do as much for the insuring public as
- (2) GAAP will do for the investing public.

I recognize that I have taken a bold position, considering the many differences in the two situations, not the least of which is the relative sophistication of the two publics being served. But as is so often the case in actuarial matters, the many counterbalancing factors will, I feel, work to bring about equal effects in the two situations.

Only time, during which megenergy and megabucks will be expended, will determine if the eaten pudding proves out.

Thomas J. Hummel

\* \* \* \*

**The Soul of Wit**

Sir:

In these days when even actuaries require many words to convey our ideas—as witness the 1¼ lbs for *TSA*, paperback Vol. XXV, 1973 Later Regional Meetings Number—it is refreshing to observe that one Society member can set us all an example of clarity and brevity in his informal discussion.

On page D133 of the volume cited, the discussion of Long-Term Implications of AICPA Audit Guide for Life Insurance Companies by John Woody is possibly the shortest on record; yet nobody can deny that Mr. Woody has expressed his views on those long-term implications with utter clarity.

If the Board of Governors decides to institute a Triennial Prize for verbal economy, it will be difficult for any other member to wrest the award from Mr. Woody.

E. J. Moorhead

(Continued on page 8)

## MORTALITY FLUCTUATION RESERVE AND GAAP ACCOUNTING

*Editor's Note: The Northwestern National Life Insurance Company recently prepared a position paper on the Need for a Mortality Fluctuation Reserve in GAAP Accounting for Stock Life Insurance Companies. This is an important subject and we are indebted to the Company for permission to reproduce the paper.*

In the pricing of individual policies of life insurance, it is necessary to make an assumption concerning the future mortality experience which will occur. Actual mortality experience will fluctuate around this assumed basis from year to year for several reasons, including the following:

1. A limited number of lives.
2. Variations in the amount of insurance at risk on each life. This is determined by a company's sales pattern and its retention limits.
3. Natural causes such as secular trends in mortality, flu epidemics, etc.

For these reasons, even the largest life insurance companies will experience fluctuations in mortality from year to year. It is felt, however, that most medium size and all large life insurance companies can predict reasonably well their long term mortality experience. The smaller companies which may not have significant historical experience relating to their own underwriting practices and mortality results cannot predict reasonably well their long term mortality experience.

The problem then arises that year to year fluctuations in mortality, which are expected by the company, will flow through earnings and cause misunderstanding and possible apprehension on the part of the users of life insurance company financial statements. This seems to be unfair to both the company and the users of the statements, when the company management is confident that over a number of years the relatively unpredictable peaks and valleys will average out to very close to expected mortality.

The solution to this problem seems to call for a means of avoiding these year to year fluctuations in mortality, while at the same time reflecting the true long term mortality of the company. We believe that a mortality fluctuation reserve,

based on the principles of risk theory, should be employed as the means of achieving this end.

It is important that a mortality fluctuation reserve be set up in such a way that it absorbs temporary fluctuations in mortality—be they positive or negative fluctuations—and that the changes in the reserve be outside the control of company management. That is, it should be of a "lock in" nature. The only change which should take place in the basis of a mortality fluctuation reserve is adjustment of the expected mortality measure used and then only when both company management and the company's independent accountants agree that such a change is called for.

Northwestern National has used a reserve based on the principles cited above since December 31, 1972 in statutory reporting. The calculation of the formula portion of the reserve is based on risk theory. This portion of the reserve is equal to the square root of four times the product of expected mortality and the retention limit. For more details concerning the theory of the reserve, the reader is referred to the Study Notes of the Society of Actuaries on Risk Theory.

In our practical application of the mortality fluctuation reserve, we have provided for additions to and deductions from the formula reserve in those years when actual mortality has deviated significantly from the expected. Basically, actual mortality outside the range of 97% to 103% of expected either is added to or draws on the reserve, as appropriate.

The appendix shows how this formula would have operated had the Northwestern National Stock Department been using it in the period 1962-1972.

Under GAAP accounting, we would plan to report the amount of money going into the mortality fluctuation reserve from earnings through proper footnote disclosure. We would also report surplus due to the reserve in the Surplus Change Table. Proper footnoting appears to us to adequately disclose the effect of the mortality fluctuation reserve on earnings.

We feel that our solution to this problem of year to year fluctuation in mortality does not conflict with, but is in harmony with, the objectives of various accounting and regulatory bodies. We cite the following:

### 1. The objectives of the Audit Guide tend to support us.

The new Audit Guide for audits stock life insurance companies, while not considering a mortality fluctuation reserve directly, does contain various references to conservatism in mortality assumptions as well as to actuarial opinion which we believe support the spirit and the purpose of the mortality fluctuation reserve as part of the policy liabilities for future benefits. References from the Audit Guide are as follows: (Italics are ours).

- a. Page 68, first new paragraph states, "The inclusion of a provision for *the risk of adverse deviations* in arriving at reasonably conservative assumptions will cause some profits to emerge over the life of the contract as risks are eliminated . . .".
- b. Page 69, "limited payment contracts . . .", middle of the page, "and *the risk of adverse deviations* . . .".
- c. Page 70, end of paragraph continued from previous page, "However, *the risks of adverse deviation* with respect to the mortality and withdrawal assumptions are more significant than is the case with whole-life contracts."
- d. Page 76, the second paragraph of the Mortality section reads, "The mortality assumption to be used in determining annual reserve additions in conformity with general accepted accounting principles should be based on realistic estimates of expected mortality. As in the case of other estimates, *provision for adverse deviations should be included.*"
- e. Page 96, fourth new paragraph, "Unlike statutory reserves, for which the factors for many plans are published, a company calculating reserves in conformity with generally accepted accounting principles should develop its own factors based on *assumptions that are reasonably conservative and that include provision for the risk of adverse deviation* from such assumptions." For purposes of mortality assumptions we are suggesting a larger than one year time period.



## Variable Life Insurance

(Continued from page 1)

- plunge right into VLI without considering the other approaches available to protect against inflation or to provide growth through equity investments.
2. *Agency Officer Commitment.* The Marketing Department's reaction, feelings, and commitment toward the marketing of VLI is essential to its success. There is no benefit for a company to build a beautiful "Edsel" insurance policy.
  3. *Proposed Amendment to Rule 3c-4—Marketing Implications.* The current SEC proposal is to give the SEC direct control of how to regulate VLI in order to provide the investor protection "substantially equivalent" to the 1940 Act. Some of the implications from this are that this Amendment may result in restricting the sales load, necessitating a free-look provision, offering high early cash values, and disclosure of fees and asset charges. The SEC wants protection against "excessive management, administrative and sales charges."
  4. *Your Representatives.* The life insurance industry is very active in the VLI discussion scene. Much effort is being extended by the industry in order to obtain a favorable and equitable treatment from the various regulatory bodies. As of the present time, 51 companies have representatives on either the Variable Contracts Committee, Sub-Committee for Federal Regulation, and the Sub-Committee for State Regulation.
  5. *External Influences.* A complex sequence of events must occur before VLI can become a reality. There are a number of interested parties, all of whom have their fingers in the pie and all having different views, i.e. the insurance industry, NAIC, SEC, IRS, and the mutual fund industry. The interplay of thoughts and actions of these various groups may eventually be resolved only through legislation (both state and federal) and litigation.
  6. *NAIC Model VLI Regulation.* Mr. Rugland listed 23 unique features of the Model Regulation. Most of these are additional requirements other than those currently existing for fix-

ed benefit policies. This Model Regulation affects the marketing of the product, the product design, and the administration of the product.

7. *VLI Investment Vehicles.* It appears that VLI separate accounts will be exempt from the 1940 Act registration, although the states may adopt new regulations affecting them. There are two basic VLI separate account approaches which may be followed by insurance companies:

- (a) Fully managed separate account — a separate account which directly owns a diversified portfolio of common stocks.
- (b) Flow-through separate account — a separate account which directly owns shares of only one stock, such as, a mutual fund.

Mr. Rugland listed the advantages of each of these separate account approaches. The performance of the separate account and its consequent effect and the consequent effect of VLI may very well affect other very important areas of the company, such as agency morale, competitiveness of company products, etc.

8. *Basic Questions.* Mr. Rugland pointed out the many questions which need to be individually answered by each company before the development of a VLI product. These questions revolve around the following topics: (a) corporate structure, (b) issues—pricing and product design, (c) investments, (d) sales, (e) administration, (f) broker/dealer, (g) underwriting and policy issue, (h) legal, (i) systems, (j) accounting, (k) federal and state taxation. □

## Apostles vs. Prophets

(Continued from page 1)

"There is no longer any excuse to pretend ignorance of the menace (of global collapse of human affairs) ahead of us, of the profound wrongness of the present direction in which humanity persists in moving, by inertia or by narrow motivation."

"Even if the balance of the probabilities were on (the side of the *Limits to Growth* report) with respect to the imminence of disaster there would still be an overwhelming argument for further delay . . . we can afford to waste another decade even if we

## Deaths

Harold Garabedian  
Ralph Keffer  
Robert C. Morrow  
G. Robert Mullans  
Gary Olson  
Samuel Winn

only have another century . . . simply because the consequences of a mistake would be so grave if 'Limits' were wrong."

The extraordinary divergent opinions exemplified above suggest that some of the alleged experts in this field are perverting Ruskin's dictum by manipulating facts so as to create misleading impressions. The debate has therefore been counter-productive in that it has furnished a superficial reason for government inactivity and created a range of attitudes among the populace ranging from frustration to boredom. In view of this, can a study of the "world problematique" by the actuarial profession serve a useful purpose?

To find the answer to this question, we need not look beyond our professional responsibility, i.e., to assist our employers and clients in making wise decisions in the face of long-term future uncertainty. Does this not require us to be well-informed in this general area, and to have some appreciation of the socio-economic restructuring of our society that may prove necessary?

Consider also the tools of our trade—projections, probabilities, and correlations (not to mention the more advanced Operations Research techniques utilized by our technically more proficient colleagues). Do these not specially qualify actuaries to develop a reasoned appraisal of and response to the "problematique"?

Because of your unavoidable responsibilities as a forecaster, these questions deserve your careful consideration. Whether you speak as an apostle of hope or a prophet of doom, your comments and opinions will be welcomed.

The topic will be further explored in a panel session at the annual Society meeting in New Orleans. Some excellent background reading is available, e.g., *Toward a Steady-State Economy*, a book of essays edited by Herman E. Daly, published in 1973 by W. H. Freeman and Company, and available at most University bookstores. □

## Solvency

(Continued from page 1)

employed a little strange. The objective was to study how solvency standards for life insurance companies might be aligned in order to promote international insurance operations. The Foreword of the report stresses that the report does not commit either the member governments or OECD itself. Nevertheless, Chapter V of the report does go so far as to propose a procedure by which the participating countries might devise a multinational system of solvency standards.

Although the United States and Canada were not represented on the Buol committee, the report has much to say to North American actuaries. In the United States we are engaged in another of our periodic reviews of solvency standards. In this review, it would seem prudent to study the ideas of our European colleagues.

What are the innovative ideas in the Buol report? First of all the main problem of valuing life insurance liabilities is divided into two subproblems. The first subproblem concerns solvency standards for insurance portfolios consisting of life, endowment, and annuity policies with significant savings elements. For such portfolios a traditional actuarial solution, reserves based on a strengthened interest rate assumption, is recommended. For other life insurance portfolios, where the mortality risk is predominant because the portfolio is young, or because it consists of short term or complementary insurance such as accidental death or disability, a special risk theory based reserve is recommended. The force of the recommendation is to produce a special risk reserve that consists of a constant amount plus an amount proportional to the total premium in force.

Because the problem is familiar and has been rehashed recently in connection with the determination with the interest assumption for the released from risk reserves required by GAAP accounting, North American actuaries will probably study paragraphs 61, 62, and 63 with particular care. In these paragraphs, the question of a basic valuation interest rate and its strengthening is discussed. Other than a fixed maximum rate, the report recommends that the basic valuation rate be a function of a twenty year moving average of the effective annual rate of yield on life insurance assets in

the country in question. Certain modifications of this basic rate, to allow for recent interest rate trends, are suggested. After the basic valuation rate is determined, it is strengthened by reducing it by 20%. Appendix I is devoted to demonstrating that this strengthened rate will produce safety margins adequate for significant changes in mortality and management expenses.

Chapter III contains the discussion of the special risk reserve. This chapter will seem novel to many North American actuaries. Nevertheless, the basic proposition that reserves proportioned to net premiums may not be adequate for young companies or for risk portfolios in which the claims risk dominates, has been expressed by several members of the Society of Actuaries. The development of the formula for the special risk reserve, which is stated in paragraph 80 of the Buol report, is discussed by Ammeter in "The Solvency Problem Risk Life Insurance," *ARCH* 1972-3. A sketch of the development also appears in Appendix IV of the Buol report. The collective risk model is used with a negative binomial distribution for the number of claims and a gamma distribution for the individual claim amounts. With the asymptotic probability of ruin fixed at .005, a set of reasonable and conservative estimates of the parameters of the risk process are derived. The final result is a special reserve formula with two terms. The constant term depends on the average claim size and the safety loading, while the variable term depends on the total premium and the safety loading. The report also wisely provides for grading the special risk reserve down to zero for companies for which pure risk insurance is a relatively small part of its total business.

Measuring liabilities is only one half of the job in determining solvency. An estimate must also be made of the present value of future income from investments. The report restates conventional views on valuing bonds, direct loans, mortgages and real estate. It also provides some useful information about European practice in valuing assets. On the especially perplexing issue of valuing common stocks, the report suggests 80% of market value or adjusting market value by the application of a reduction factor that depends on the quotient of the year end stock market index and the three year average of year end stock market index values. The enforced re-

duction that might occur shortly after the purchase of common stocks would seem unreasonable to some, even if for the laudable purpose of conservatively measuring solvency.

On two issues of interest to North American actuaries, the committee took an equivocal stand. The first concerns the use of modified reserves (Zillmerized reserves) to provide at least partially for the amortization of acquisitional costs. This practice is an established part of North American valuation practice. Yet the Buol Committee could not agree upon either support or opposition to modified reserve systems. The conventional arguments are reviewed in paragraph 49 and Appendix III is a primer on amortizing initial expenses by way of the reserve system.

The second troublesome issue concerns the degree of emphasis to be placed on the interdependence of the rate of interest used in valuing future payment streams arising from insurance liabilities and investments. The development of a theory of matching between these future cash flows is probably the principal contribution of British actuaries to contemporary thought on insurance management. After acknowledging the validity of the British view on the importance of the degree of matching, the report concludes that the British system probably cannot be exported. The relaxed regulatory system, the highly developed capital markets, with ample long term investment opportunities, and flexible surrender values seem to be unique to Britain and this may limit the applicability of matching ideas to the United Kingdom.

Besides providing fresh insights into a perpetual actuarial problem, the Buol report forcefully brings several questions to the attention of North American actuaries. Can the two key ideas (fixing valuation rates as a strengthened rate determined by a statistical formula, and a special risk reserve for small portfolios in which claims risk dominates) be implemented in our rapidly changing North American economy? And, of course, there is a dual question. What are the penalties for not adopting a more flexible solvency measurement system which might employ some of the novel ideas of the Buol report?

*This report may be purchased for \$3.00 from, OECD Publication Center, Suite 1207, 1750 Pennsylvania Avenue, N.W., Washington, D.C. 20006. □*

## Letters

(Continued from page 3)

## The Theory of Interest

Sir:

At the risk of annoying my Department Head at The College of Insurance, let me rush to the defense of Mr. Kellison and, also, clarify for my students some of the confusion inherent in the letters in the June issue.

There are two reasons why Mr. Kellison need not have admitted to any flaw in formula (3.27) of his text, *The Theory of Interest*.

1. Page 8 of his text warns, "Hereafter, unless stated otherwise, we will use compound interest instead of simple interest."
2. In any event, the formula still holds for simple interest as long as  $a(t) = 1 + it$  is properly applied relative to a constant point of origin of  $t = 0$ .

Mr. Garfield in his Formula I uses a variable "origin" point, thus calculating the accumulation at simple interest from the date of deposit and then applies Formula II, using the mathematical accumulation function of  $a(t)$  which accumulates from  $t = 0$ . Both Formulas are correct within the ground rules under which they are applicable.

Finally, both writers have attributed the different results as arising from different *comparison* dates. Kellison defines a comparison date (cf. his page 37) as "The common date . . . to which payments are accumulated or discounted." Since the comparison date in both Formulas is at  $t = n$ , the comparison dates can hardly be called "different". I submit that both men really meant different "origin" points in the application of the Formulas.

Harold E. Dow

\* \* \* \*

## The Theory of Interest

Sir:

In the June 1974 issue, Messrs Garfield and Kellison discuss the problem "What is  $s_{\overline{n}|i}$  at rate  $i$  simple?"

The question of how to value annuities at simple interest has been a subject of controversy for many years. I have always approved of the attitude of Hall and Knight (*Higher Algebra*, p. 204) who say "In finding the present value of annuities it is always customary to reckon

on compound interest; the results obtained when simple interest is reckoned being contradictory and untrustworthy."

An interesting reference on this point appears on pp. 335-336 of JIA I. In a paper "On the equivalence of Compound Interest with Simple Interest paid when due," Augustus De Morgan refers to the apparent paradox that a perpetual annuity at simple interest is of infinite value if the perpetuity is valued as

$$\frac{1}{1+i} + \frac{1}{1+2i} + \frac{1}{1+3i} + \dots$$

He then shows that the value of a perpetual annuity or of a terminable annuity is the same whether money makes simple or compound interest. (Actually, his demonstration is valid only for an annuity with level payments with the first payment at the end of one interest period.)

The term "simple interest" means that interest is never allowed to be earned on interest. If we think of principal as being deposited in a savings account, we must think of the interest earned on that principal as being deposited in a separate savings account. The second account is not interest bearing. If one chooses to ignore the advice of Hall and Knight and to insist on valuing an annuity at simple interest, it will be found that different present values,  $a_{\overline{n}|i}$ , can be calculated based on different assumptions as to the proportion of each annuity payment to be taken from the interest bearing savings account and the noninterest bearing savings account. The smallest value of  $a_{\overline{n}|i}$ , which agrees with the value at compound interest, is obtained when it is assumed that the noninterest bearing account is fully depleted every time a payment is made. The maximum value of  $a_{\overline{n}|i}$  is obtained when it is assumed that no withdrawals are made from the noninterest bearing account until the interest bearing account has been fully depleted. The value of  $a_{\overline{n}|i}$  obtained by summing  $\frac{1}{1+ti}$  is an intermediate value,

falling between the two extremes. The situation is complicated, but the same principles apply, if the annuity payments are not level or if the first payment is deferred.

Based on the above, I have answers to the question raised by Mr. Garfield. My first answer is to accept the advice of Hall and Knight and not try to value annuity payments at simple interest. If

my first answer is not accepted, my second answer is that Formula I is correct because it is more direct. I would not that the answer given by Kellison problem 3.1 (b) on page 64 of his text is only one of a range of correct answers, and not the one I would prefer.

J. Alan Lauer

## DISABILITY INSURANCE

We have an announcement from the Boleslaw Monic Fund Foundation about the prize award for 1974. The subject for which papers are invited is Disability Insurance.

The announcement comments on the developments in disability insurance and points out that there is a growing body of opinion that non-cancellable disability insurance based on fixed premium rates cannot justifiably be transacted by a private insurer in view of possible changes in the underlying risk situation. The general question to which authors should address themselves is whether a private insurer retains the right to adjust premiums in the light of changing circumstances; how can the need for such adjustment be diagnosed in good time; and how can the amount of adjustments be determined by actuarial methods and/or methods based on credibility theory.

The subject is one to which actuaries in both Canada and the United States have paid considerable attention and this should encourage entries from members of the Society. Complete information can be obtained from the Secretary, Mr. William A. Spare. □

## "THE ACTUARIAL REVIEW"

We welcome the issue of a new actuarial publication, *The Actuarial Review* which will be the quarterly Newsletter of the Casualty Actuarial Society. We hope that many of the Society of Actuaries members will be interested in this new publication and they can obtain copies of the June and October issues without charge on application to The Actuarial Review, Casualty Actuarial Society, 200 East 42nd Street, New York, N.Y. 10017. The annual subscription is \$2 which will become payable with the December issue.

*The Actuary* wishes the new publication every success.