The Actuary

The Newsletter of the Society of Actuaries

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ACTUARIAL SCIENCE IN 19th CENTURY AMERICA

by James H. Cassedy

Editor's Note: Dr. Cassedy is Historian with the History of Medicine Division of the National Library of Medicine, part of the National Institutes of Health. He is the author of "Demography in Early America: Beginnings of the Statistical Mind 1600-1800", to be published by the Harvard University Press this fall. His researches uncovered some of the early history of actuarial science and we are grateful to Dr. Cassedy for sharing his interesting findings with us in this article.

The beginnings of actuarial science in the United States were only pale reflections of the vigorous European developments in this field during the eighteenth century. Unlike Europe and Great Britain, America was not then an attractive locale for commercial life insurance enterprises; in fact, virtually none came into being until after 1800. Until the nineteenth century no American had the title of actuary, and Americans were not yet in a position to contribute much to the mathematical theory upon which actuarial science depends. Nevertheless, some small life insurance and annuities societies were launched, and each had an employee who did actuarial work, however elementary.

Much of the early actuarial work both in Great Britain and in the United States was done by clergymen. As a group they were frequently familiar with scientific and mathematical writings, and in addition they had a closer acquaintance with local parish registers and other vital records than had most people. They also had incentive to start life insurance societies since these were intended to serve charitable ends. British preachers who pioneered in scientific life insur-

(Continued on page 7)

New Editors

We are glad to announce the following appointments to the Editorial Staff of *The Actuary*: Peter L. Hutchings, Frederic Seltzer, and Edward H. Wells.

With more editors perhaps we will be better able to handle the increasing volume of contributions.

BOOK REVIEW

Paul A. Campbell, *The Variable Annuity, Its Development, Its Environment and Its Future*, pp. 71, Connecticut General Life Insurance Company, Hartford, Connecticut, 1969.

by Thomas Mitchell

This attractively produced booklet will serve as a very good introduction to variable annuities for all approaching the subject from a general insurance background. The copious references included should also make it of use to the actuary dealing with variable annuities.

The author introduces the general concept of the variable annuity through a discussion of retirement security and inflation. Final-pay plans and cost-of-living plans are discussed as alternatives to variable annuities for pension plans. It is refreshing to note that (although the author "admits" to being basically pro-variable annuity) both the advantages and disadvantages of the variable annuity are well discussed.

The history of variable annuities in the United States is traced from the viewpoints of the philosophical battle among insurers, the struggle for the savings dollar, and the experience of the frontrunners in the field.

The "spectre of variable annuity regulation" is rightly seen by the author as the most imposing hurdle for development of the field. A brief, but valuable, description of federal regulation of variable annuities is followed by an inter-

(Continued on page 6)

SOCIAL SECURITY IN THE UNITED KINGDOM

by F. C. Sibbald

Editor's Note: We are greatly indebted to Mr. Sibbald for this report on the new National Pensions proposals now under consideration in the United Kingdom.

The British Government has recently issued a "White Paper" entitled *National Superannuation and Social Insurance*, setting out proposals for a far reaching alteration in national pensions, in order to "stimulate public comment and debate and to serve as a basis of consultation". These consultations are now proceeding with a view to legislation during the next session of Parliament.

The existing scheme, introduced in 1948, provides flat rate benefits for flat rate contributions. Over the years, this has become inadequate for a variety of reasons, and an earnings-related benefit with earnings-related contributions was added in 1961, but its modest scale and slow maturity did little to solve the problem. The flat rate scheme suffered from the need to keep the contribution within the capacity of the lowest paid contributors. Accordingly, it has become necessary to grant supplementary benefits on a "means tested" basis to those in need.

The new scheme proposed is related to earnings and provides for contributions by employed persons of 4¾% of earnings up to a maximum of 1½ times national average earnings (about £33 per week or £1700 per annum). Employers will pay 4½% of payroll, with no earnings ceiling. There will also be a contribution from general taxation of 18% of employers' and employees' contributions. Pensions commence at age 65 for men and 60 for women and amount to 60% of his or her earnings

(Continued on page 6)

The Actuary

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GUEST EDITORIAL

IT is my firm belief that there was never a moment in the history of the insurance industry—and of others, too, for that matter—when a rethinking and reappraisal of where we stand was more necessary than it is today. My opinion, my apprehension, is whether insurance is aware of the impact which this fast-changing world is bound to exert, and is already exerting, on the fundamentals of insurance as transacted in the last two hundred years.

I started my insurance career as an actuary. But it needs no actuary to know that there is no insurance without statistics, and there are no statistics, in the sense used and necessary for insurance operations, without the recurrence of similar events.

These statistics are based on a static world, on a world whose mechanisms and therefore probabilities of all sorts of happenings remain fundamentally the same. But the world in which we live has been in the last few decades, and will very likely continue to be for the rest of our century, a dynamic world.

Has this anything to do with the venerable trade of Insurance? To pretend that it has not, is, I believe, the greatest danger we face and the most serious mistake we could make.

Insurance or assurance in all its lines has at all times been in the closest interests of mankind, in intimate relation to the needs and wishes of and the threats to the individual, to society, to the economy. How could we hope for further success in the fine role we are called upon to play if we should close our eyes to a new world overflowing with untold changes in matters technological and sociological?

Not only the future, even the present, is no longer an image of the past. Ethical and moral standards, century-old traditions, are today shaken or even fall like autumn leaves, rightly or wrongly. All this itself reflects on the behaviour of man, his duties and his needs.

Somehow my confidence in the fundamentally retrospective method of transacting insurance is shaken, too. By "retrospective" I understand the creed that by learning what happened in the past we know pretty certainly what is likely to happen in the future. In short, I am afraid that statistics have ceased to provide us a sound basis for insurance in many lines.

The alternative of course would be a *prospective* approach to our business—no doubt an extremely difficult aim to achieve. One would virtually have to feel one's way into the future, to guess what is likely to come, when, in what quality and quantity. Impossible? Well, are not so many industries in both the secondary and tertiary sectors in very similar positions? Do *they* look back and go on producing what they always produced? Are we really as modern and awake an industry as we like to think we are?

Many of the ideas I have tried to outline may sound a little too pessimistic, and yet I know that I am not alone with these ideas and that many a bright youngster—of whom, thank heavens, our industry has no lack!—is digging with enthusiasm and perseverance in this direction.

Nothing in my business life would give me more satisfaction than to see the day dawn when such endeavors bear fruit to the benefit of one of the finest service industries of modern or ancient times, and hence to the welfare of mankind.

Max E. Eisenring

Note: Our Guest Editor is Dr. Max E. Eisenring, Chairman of the Board of the Swiss Reinsurance Company, Zurich. Dr. Eisenring was recently elected to the Insurance Hall of Fame and we are privileged to present excerpts from his acceptance speech. We are grateful to Dr. Eisenring for the opportunity to present some of his ideas to our readers.

LETTERS

Cost of Insurance

Sir:

Much attention is being devoted these days to what is described as "the cost of life insurance." Pressure to devise a "defensible and simple" method of comparing the "cost of insurance" among companies stems mainly from legislative sources, and is motivated by consumer-oriented considerations.

The efforts to find an acceptable method for making cost comparisons are commendable. But I think they are misdirected and very much off target. What really is needed is a way to determine what is a *Fair Price* for Life Insurance.

Comparing costs among companies is nothing more than ranking companies by an arbitrary measurement that has very little to do with the buyer's real concern. Let me point out that other investigations and disclosures have not revolved around the ranking of the prices of competitors, but around other matters. Examples:

(1) Automobiles — safety features.
(2) Tobacco — health hazards.
(3) Equity Products — prevention of sales misrepresentation.
(4) Welfare Plans — disclosure requirements in great detail but related only to the particular plan itself.

In considering the question of "fairness" for life insurance, the whole product-price-service complex must be examined. Briefly, here are some major elements in the matter of "fairness";

(a) The buyer must receive the product (and servicing of it) which he thinks he has bought. This is a major point in the life insurance business, because receipt of the benefit and service typically occurs after the sale, and in many cases, long after it.

(b) The product (and service) must contain the qualities and safety features which experts know are essential, but which unsophisticated buyers might ignore.

(c) There are intangible "utility" elements which can cause a buyer to believe that his price is fair. These include his feelings toward the company an agent, the nature of the service rendered to him, and the feelings he has about

(*Continued on page* 3)

Letters

(Continued from page 3)

the benefits he has bought.

The theory of "utility" is something we, as actuaries, could study more than we do. Our business is based on a belief that a dollar in benefits is worth more than a dollar in premiums — measured in terms of utility to the buyer. I was interested to discover that Dr. Belth's very latest paper (*The Relationship between Benefits and Premiums in Life Insurance* — March 1969 issue of *The Journal of Risk and Insurance*) observes that utility considerations, which he has not included, would substantially alter his numerical results.

It might be worth noting that state regulatory authorities, over the years, have done much to bring fairness to the product-price-service complex of our business. One recent example is the quite widespread prohibition of coupon, founders, and other "gimmick" policies. This type of regulation strikes me as parallel to the new federal safety standards for automobiles.

Fairness in the product-price-service complex is not easy to define, but its existence can probably be inferred if (a) new customers are attracted to the product in reasonable numbers over an extended period of time (i.e., a period long enough for the experiences of early buyers to become known to later prospects), (b) old customers tend to become repeat buyers, and (c) persistency is relatively good.

There is an opposite side to the fairness coin; the price should also be fair to the company and the agent.

A price which is fair to all parties is probably in the vicinity of the highest price which is considered fair by the buyer; such a price could be called "the optimum price." The author's paper, *Prices and Profits,* is partly devoted to the determination of such a price.

There may be some need for a simple "cost of insurance" formula, of the ranking type, for use in special situations such as replacement or "twisting." However, if it has the radical simplicity of the methods usually considered it would be an inadequate measure of fairness in the entire product-price-service complex, and this fact should be clearly recognized.

J. M. Bragg

More on the CIA

Sir:

In the spirit of international cooperation I have set to work to help E. R. Vogt (see Letters, *The Actuary,* March) find a suitable substitute for the acronym CIA for the Canadian Institute of Actuaries. My first solution was to change the name to *Society of Actuaries in Canada,* but came a cropper on the conflict with SAC, another foreign body.

While the CIA (one of them) has tried to keep it under wraps, these two examples call attention to the rather serious situation in Canada today: There is an acronym gap between Canada and the U.S. All the good ones have been preempted by Washington. As we might expect, Canadians have risen to the challenge and developed new approaches where larger segments of fewer words are used, as exemplified by EXPO.

Any number of solutions fall out if we use this technique. Suppose, for example, we exploit the possibility of using only "Canadian" and "Actuaries". Pick the first three letters of each and we get a name with a nice confident ring to it, CANACT. The more musical members of the Institute may prefer to use the four beginning and four end letters and produce CANARIES. This one is recommended as less likely to conflict with anything the U.S. may come up with now or in the future.

I assume Mr. Vogt is offering a suitable prize to the winner of this competition, say a free trip to Goose Bay.

Ardian Gill

* * * *

Sir:

Besides those aspects of CIA mentioned by Mr. Vogt, I think there are a couple of others which are even more sinister.

Some members of CIA have close and continuing contacts with counterparts outside Canada in a number of countries. Even worse, some members have managed to obtain official positions in a related international organization. Shades of SPECTRE!

I am tempted to suggest the acronym CANINACT—Doggone!

William S. Connell

Government Regulation

Sir:

I was the panelist Paul H. Jackson referred to in his letter to *The Actuary,* January 1969. I did not make the statement he quoted. Further, the misquote was gratuitous. Mr. Jackson may wish to refer to my remarks as now published in *TSA XX,* D620, in order to better acquaint himself with what I said.

Mr. Jackson cites examples where, in his opinion, it would be equally absurd for the government to regulate as to regulate pensions. When any of the examples he cited begins to affect public policy to the extent that private pensions now affect public policy the federal government most certainly will propose regulation.

He cites additional examples which, I infer, he considers to be clever illustrations of the absurdity of extending federal legislation into new areas of private pensions. He uses the specious argument that if it is necessary to regulate private pensions then why not regulate "individual salaries," "three square meals," "children," "baths," and "breathing."

Mr. Jackson appears to have forgotten the Federal Minimum Wage Laws, the Fair Labor Standards Act of 1938, the Labor Management Relations Act, the Food and Drug Administration which assures standards of manufacturing purity and truthful labelling, federal meat inspection laws, the Federal Food Stamp Program, the Children's Bureau of the Department of Health, Education and Welfare which supervises child welfare service, the Social Security Act which provides Aid to Dependent Children, the Federal Water Pollution Control Administration, the Oil Pollution Act of 1961, Public Health Service regulations, and the Motor Vehicle Air Pollution Control Act.

Thomas L. Wills

* * *

Integration Regulation

Sir:

James F. A. Biggs points out (*The Actuary,* March) that under the new Integration Regulation 1.401-3 (e) and Revenue Ruling 69-4 covered compensation categories refer to the year in which employees attain age 65 rather than the year in which they retire. However, the

(Continued on page 4)

Letters

(*Continued from page 3*)

Internal Revenue Service has indicated informally that if employees first become eligible to retire at a later age, the age in which they first become eligible to retire may be used instead of age 65.

Donald S. Grubbs, Jr.

* * * *

Idea for Transactions

Sir:

On a newspaper a professional writer, the reporter, assembles the facts of his assignment and writes his article. This then goes to a rewrite man for a thorough overhauling before it goes to the editor for final changes. How different this is from our *Transactions* where editing is minimized to the greatest extent on the not unjustifiable assumption that he who advances the frontiers of our knowledge is entitled to choose his own words. Small wonder that some of us may think of the *Transactions* as a reference work rather than as a means of keeping up with developments in the many aspects of our profession.

Your February editorial emboldens me to suggest a change to improve the *Transactions*. My idea is that gradually the Committee on Papers would develop a panel of individuals found competent to rewrite the papers submitted. The rewrite panel member would send his version, plus comments, to the author. The author would then decide what changes he would make and return the paper to the Committee. Experimentation might eventually show whether or not the rewrite version would be given to the Committee to guide its decision as to the author's final version.

The only safeguard that occurs to me as necessary is that an author should make his first attempt reasonably acceptable. It is not the function of the rewrite man to prepare a finished product from a hasty draft.

I think all I am suggesting is that two heads are better than one. It may follow that improving the *Transactions* will encourage more members to write papers for it.

Ralph E. Edwards

WHAT'S AHEAD FOR BUSINESS — EFFECTS OF INFLATION

by David A. Jeggle

A meeting of the Actuaries Club of Philadelphia was held on April 15. Lawrence C. Murdoch, Jr., vice president and senior economist of the First Pennsylvania Bank spoke on *What's Ahead for Business.*

Mr. Murdoch discussed some of the effects of inflation. Obviously this includes the declining purchasing power of the dollar but some additional problems are created:

- Profits and taxes are overstated in view of the rising prices. Between the time materials are purchased and the time they are sold as part of a finished product, the sales price may well be higher than that justified by the original cost of materials.
- Depreciation schedules are inadequate to cover replacement costs.
- Business plans, especially facto and home construction, are accelerated in anticipation of continuing inflation.
- Retail sales are reduced. We are actually in a period of declining sales, measured on a per capita basis and adjusted for inflation.
- Interest rates must be increased (a) to offset the reduced value of money that is used to repay obligations, and (b) in response to the usual laws of supply and demand.
- An unhealthy emphasis is placed on the performance of common stocks rather than on earnings, dividends, etc.

It is very difficult to judge when and how fast to move away from inflation.

One of the primary reasons for the recent weakening in the stock market is that investors are convinced that the government is going to attack inflation. As the inflationary psychology diminishes, blue chips will benefit but performance stocks will suffer.

Mr. Murdoch sees the following situation for the coming year:

The overall economy will level o largely because of the action taken b the Federal Reserve Board last December; this has corrected the error they made last summer. No downturn is expected during 1969.

There will be a seasonal decline in interest rates. However, we are now on a new plateau and the demand for funds will keep interest rates at about their current level.

The current unemployment rate of 3.4% will increase to 4% or 4½% by the end of 1969, as a result of the slower economy referred to above. About one-half of the unemployed are simply between jobs.

The stock market, by next April, will be higher than this April.

The dollar will eventually be devalued, because the price of gold is staying out of line. We will gradually move away from the gold standard, which is now meaningless except for the psychological impact. However, it may take 20 years to complete this process because of political pressures.

So many people are interested in t Federal budget that President Nixon will not be able to cut it effectively. There may be a small surplus, but not $5.8 billion. □

BOOK REVIEW

F. Bayo, *Termination Experience of Disabled Worker Benefits Under OASDI*, 1957-1963. Actuarial Study No. 65, March 1969, Social Security Administration, Washington, D.C. pp. 27.

This study presents the first analysis of the disabled-worker benefit termination experience that has been observed under the Old-Age, Survivors, and Disability Insurance program. An analysis is made in broad form (all ages and sexes combined) of the death and recovery experience by calendar years for 1958-67. The gross death rates have been decreasing slowly, while the gross recovery rates have been increasing slowly. The gross total termination rates (deaths and recoveries combined) have remained relatively stable in the last seven years.

A detailed analysis is presented by sex, age, and duration of disability based on the combined experience for cases that started in 1957-63. The termination rates are compared to those obtained in the Railroad Retirement system and are about 5 to 10% higher. Annuity values based on these rates are presented for various ages at onset of disability, at several interest rates.

A copy of this report may be obtained gratis by writing to Robert J. Meyers, Chief Actuary, Social Security Administration, Washington, D. C. 20201. □

TAXATION OF VARIABLE ANNUITIES

by William H. Crosson

The U.S. Treasury Regulations provide that whenever the amount received under a variable annuity is less than the amount excludable, the taxpayer has the option of redetermining the excludable amount. The result of the election of the option is to spread the deficiency as an addition to the excludable amount evenly over the remaining duration of the annuity. The incidence of the additions will depend on the timing of the election and the final results may differ.

When the amount received is less than the excludable amount for two or more successive years, should the taxpayer make the election following *each* such year, or make the election only after the end of the succession of such years? It is easy to demonstrate that the election should be made each year (for a life-contingent annuity), and this demonstration rests on the fact that a life expectancy at any given age is less than one plus the life expectancy at the next following age.

The regulations give an example of a situation where the annuity amount falls short of the excludable amount in two successive years, with the election being made after the second year. Shown herewith are the calculations for this example as given by the regulations, and if the election is made each year.

Example: Variable Life Annuity, Annual payment in arrears, purchased by a male, aged 64, for $20,000.00. Payments received are:

At the end of the	
1st year	$1,000.00
2nd year	0
3rd year	1,500.00

Expected Return Multiples, adjusted for annual payment in arrears are:

Male Age	*Years*
64	15.1
65	14.5
66	13.9

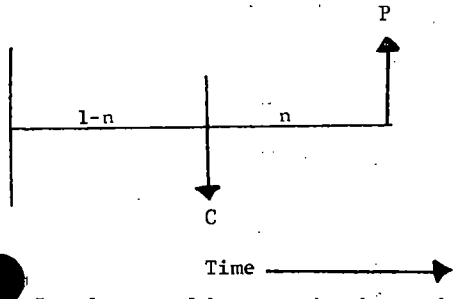
		One Election	*Successive Elections*
First Year	Excludable Limit $\left(\frac{\$20,000}{15.1}\right)$	$1,324.50	$1,324.50
	Amount Received	1,000.00	1,000.00
	Amount Excludable	1,000.00	1,000.00
	Excludable Carry-forward	324.50	324.50
Second Year	Addition to Excludable Limit $\left(\frac{\$324.50}{14.5}\right)$	—	22.38
	Excludable Limit	1,324.50	1,346.88
	Amount Received	0	0
	Amount Excludable	0	0
(A)	Excludable Carry-forward	1,649.00	1,346.88
Third Year	Addition to Excludable Limit $\left(\frac{A}{13.9}\right)$	118.63	96.90
	Excludable Limit	1,443.13	1,443.78
	Amount Received	1,500.00	1,500.00
	Amount Excludable	1,443.13	1,443.78
	Amount Includable	56.87	56.22

Admittedly, the regulations stipulate that the election may only be made when some amount is received under the annuity during the year. The receipt of $1 in the second year would satisfy this requirement and would not materially change the situation. □

SHORT SALES AND INTERNAL RATE OF RETURN CALCULATIONS

by Peter A. Marks & J. L. Dake

In the January issue of *The Actuary* Mason Hess cites an interesting case of return on investment determination. The problem he develops revolves around specifying when the *cash flows* take place.



Let the period between the short sale and the end of the transaction be one time unit. Furthermore, let the period between the instant that the short sale is covered (C) and the end of the transaction (P) be n units, $n<1$. In the case presented by Mr. Hess, he cites that if Tom sells 100 shares of stock Y short on 12/31/66 at $10 a share and covers on 12/31/67 at $8 a share, the interest rate cannot be found by solving the equation $-100(1+i)+800=0$.

This seems obvious, since the $1000 cash inflow and the $800 cash outflow both occur at 12/31/67. What we intend to show is that if a short sale is actually covered at any instant before the time at which the proceeds are received, a reasonable interest rate can be determined. Let n be the period between the cover and the receipt of the proceeds. If P is the proceeds from the transactions and C is the cost of covering, we get the following equation defining the present value of the transactions, at the time of the initial commitment.

$$\frac{C}{(1+i)^{1-n}} = \frac{P}{(1+i)^1}$$

or

$$\frac{P}{(1+i)} - \frac{C}{(1+i)^{1-n}} = 0$$

The problem cited by Mr. Hess arises when we take the limit of this expression as $n \to 0$ then

$$\lim_{n\to 0} \frac{P\,(1+i)^{1-n} - C\,(1+i)}{(1+i)^{2-n}} = 0$$

$$= \frac{P\,(1+i) - C\,(1+i)}{(1+i)^2} = 0$$

$$= \frac{(P-C)}{(1+i)} = 0$$

Thus as n approaches zero, the solution to our equation, i, approaches positive infinity. By the proper choice of our time horizon and definition of the cover and inflow we can determine the proper rate of return on a short sale. It does not seem inconsistent that the *rate* of return is infinite if the cover and inflow occur at the same *point* in time since return on investment is a time concept, i.e. a *rate*. □

United Kingdom

(*Continued from page* 1)

up to *half* national average earnings plus 25% of the remainder up to the ceiling of 1½ times national average earnings. Thus a person's entitlement is based on earnings throughout working life.

However, to take account of changes in the purchasing power of money, it is proposed firstly, that pension rates will be reviewed every second year and increased to compensate for rises in prices, and secondly, that an individual's earnings shall be "revalued" from time to time in line with changes in national average earnings to take account of general living standards.

Full maturity is achieved after 20 years, with transitional pension rates based on proportions of the old level and the new, according to the number of years of "new" contributions paid.

The scheme involves a redistribution of income, from the young to the old, from the higher paid to the lower paid, and from men to women (since their contributions and benefits are calculated on the same basis, but women receive their pensions at age 60, and live longer).

Pension Funds

There is, however, in Britain a very highly developed system of occupational pension funds, self-administered in the case of some of the largest companies, but many others run by life assurance companies on behalf of employers. These vary in the benefits provided and can be tailored to meet the conditions of the particular employment. A good pension scheme can provide a pension of two-thirds of final salary. It is estimated that in 1967 the additions to such funds provided no less than two-fifths of all net personal savings and thus play a vital part in the development of the economy. It is therefore unthinkable that such a structure should be gravely impaired by the effect of an unfunded "pay-as-you-go" national scheme.

The government has recognized this situation and the White Paper pays tribute to the highly successful pioneering efforts of the occupational pension funds and envisages a continuing partnership between the State and the occupational schemes. Accordingly, the White Paper provides for an element of "contracting out" of part of the State contribution and benefit for those who have an adequate occupational pension scheme which will provide "preservation" rights on change of employment. The terms for contracting-out were not stated in the White Paper but are one of the matters now being negotiated between the departments concerned and interested parties, including the self-administered funds and the Life Assurance offices. □

Reprints and Subscriptions

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Book Review

(*Continued from page* 1)

esting discussion of the influence of this regulation on corporate organization and product design.

The description of state regulation has two misinterpretations of the Model Variable Annuity Regulations adopted by the NAIC. The Model proposes minimum grace, reinstatement, and nonforfeiture provisions appropriate to variable annuities *only* where these provisions are required for fixed deferred annuity contracts in the state. Also, the Model imposes a limit (a-49) on the mortality table used for determining annuity benefits only where mortality experience is *not* guaranteed by the company.

The author gives considerable material on product design, to which I will add a few comments. He discusses whether there should be distinct investment pools for retired lives and active lives. This has generally been decided in favor of only one pool.

In setting the Assumed Interest Rate (AIR), there are considerations involved other than the likely long-term performance of the stock market, such as state regulation of the AIR and competition with fixed-dollar annuities.

Of necessity, the product design chapter does not cover the many variations among products offered by different companies. The author describes current general practice for the most part. In his discussion of the combination of fixed and variable annuity contracts, it should be pointed out that most such contracts allow changing the percentage allocation of premiums between the fixed and variable portions from time to time. However, on many contracts the transfer of funds already allocated to a given accumulation is limited because of fear of investment selection on the fixed-dollar segment.

It should also be added that the SEC is now asking for daily determination of unit values. This will require adjustment by the many companies now using the weekly determination described by Mr. Campbell.

Valuation of Liabilities

Mr. Campbell also discusses the valuation of liabilities for variable annuities. He properly identifies the problems involved, although some aspects are more complex than he indicates.

The book contains a valuable analysis of the large potential markets for variable annuities, to which I would add two comments. Companies whose life insurance contracts contain an Annuity Option to purchase single premium annuities at favorable rates with contract proceeds will, in effect, be offering a variable settlement option on all of their current insurance portfolio if they adopt a single premium immediate variable annuity product. The other significant development has been the introduction of flexible premium payment requirements with most periodic premium deferred individual variable annuities. This will be particularly valuable in various tax-qualified situations.

The author is to be congratulated on making a substantial contribution to the literature on variable annuities. The booklet will be helpful to many people, perhaps most of all to the students, since portions of the book have been selected as reading material for Part 9I. □

19th Century America

(*Continued from page* 1)

nce provided the working models and sometimes practical direction to the American pathfinders in this field.

The formulations of probability theory by Pascal and Huygens were not unknown to a few seventeenth century Americans, while the eighteenth century contributions to this subject by scholars such as the Bernouillis or Abraham De-Moivre could be found in some colonial libraries only a few months' ocean trip after European scholars received them. Some early American intellectuals read and understood such writings just as some read and understood the works of Sir Isaac Newton.

The concern of European mathematicians with general probabilities was one thing; the specific interest of some of them in life probabilities was another. In 1662, the non-scientist, John Graunt, in his *Natural and Political Observations Made Upon the Bills of Mortality*, suggested something of the pattern of life probability which could be found from an analysis of parish gisters or of bills of mortality. The uggestion remained only a hint until some of the astronomer-mathematicians of the Enlightenment extended their search for order, divine or otherwise, from the celestial universe to man's earthly domain. Astronomer Edmund Halley in 1693 calculated his famous life expectancy table from Breslau mortality data. Following Halley, other astronomers such as Deparcieux, Wargentine and Laplace, produced studies of life probabilities along with their other scientific work, but none influenced early American actuarial science as much as Halley.

Halley and Others

Halley's work appeared first in the *Philosophical Transactions* of the Royal Society. Subsequently, it was frequently discussed, not only in the *Transactions*, but in the London press and in periodicals like the *Spectator*, where the commentator Joseph Addison helped give it common intellectual currency. Amer-cans had access to all of these publica-ions and through them, at a fairly early date, they were in a position to appreciate statistical analyses of life expectancies or of other demographic phenomena and to look into such matters themselves.

Some colonial economists and scholars thus began trying to calculate the ratios of population increase. A few physicians were concerned with longevity in the American environment and with the probabilities of death after small pox inoculation and, before the end of the century, some statesmen found use for actuarial formulae in regulating the finances of the new republic.

Like European astronomers, early American scholars who were interested in astronomy were also sometimes interested in the probabilities of life and death but, like the Rhode Island clergyman scientist, Ezra Stiles, they commonly believed that colonial American mortality statistics were not complete enough to use as an actuarial base for life insurance or annuities. Other clergymen acknowledged this shortcoming but went ahead anyway.

Response to Needs

The beginning of life insurance in America, much as in Great Britain, was a humanitarian response to the needs of people. The colonists gradually came to recognize the distress of some elements of the population. An early census of Boston revealed that one-sixth of the population of that city was composed of widows, many of them poorly provided for. To aid such groups, two such otherwise incompatible spokesmen as the eminent Puritan divine, Cotton Mather, and the young printer's assistant, Benjamin Franklin, both advocated for the colonies some arrangement as the "Friendly Societies" which had been proposed by Daniel Defoe. In response to these and other pressures, several societies were ultimately established in the various colonies, some of them simple charities, but a few with annuities or other insurance plans.

Early America was fortunate in escaping the speculation and fraud which plagued the emergence of such groups in England, although eighteenth century New Yorkers had their Tontine Coffee House. Still the colonists generally avoided involvement in tontines and similar money-making schemes of the day. They also escaped the rash of well meaning but scientifically unsound funds which prevailed in England before 1770.

We probably cannot attribute this good fortune to any superior wisdom on the part of our colonial forefathers. More likely, it was due at least in part to the lack of money for speculative purposes. Equally important, the earliest American life insurance schemes had the best possible model and the best scientific advice available in Great Britain at that day.

When in the early 1770's the Rev. Richard Price published his *Observations on Reversionary Payments*, exposing the weakness of life insurance and annuity schemes, he was able to point to only a single plan operating on sound scientific principles. This was the Fund for Widows and Orphans of Ministers of the Church of Scotland. Begun in 1744 with calculations based on Halley's table, it proved a successful and reliable enterprise.

Presbyterians

Only 15 years later, in 1759, Philadelphia Presbyterians closely copied their Scottish brethren when they established their own Presbyterian Ministers Fund. Although Philadelphia, unlike most other colonial cities, had by this date a fairly well documented record of mortality, the organizers based the fund upon the accumulated Scottish experience in conjunction with Halley's tables for Breslau. Perhaps it was a calculated gamble, but it turned out successfully when the life expectancy of Presbyterian clergymen in the then wilderness proved to differ little from that of Presbyterian ministers back in Scotland.

The first President of the new Fund was the preacher and educator, Francis Alison. He was also *de facto* actuary, although he had little more mathematics than the average well-educated clergyman. The Rev. John Ewing, who eventually took over the actuarial work from Alison, was an educator as well as a clergyman, and in addition had a broad scientific interest in mathematics, surveying, and astronomy. Not until the 1790's did a non-clergyman, Robert Patterson, Professor of Mathematics at the University of Pennsylvania, undertake the scientific guidance of the Fund.

(*Continued on page* 8)

19th Century America

(*Continued from page 7*)

The Presbyterian Ministers Fund not only proved itself to its members but proved to Anglican clergy in the Middle Colonies that such schemes were workable in the colonies. Thereupon, the Provost of the College of Philadelphia, the Rev. William Smith, in close consultation with Alison and Ewing, drew up a similar plan for his Anglican colleagues. Like the Presbyterian Fund, it was based upon the Church of Scotland Widow's Fund experiences (the organizers knew full well from Price that some additional risk was involved in using that experience). Unlike the Presbyterian Fund, which has survived to the present day, the Anglican Fund continued only a few years. The voluntary exile of many Anglican clergymen during the Revolution disrupted the plan before its scientific soundness could be demonstrated.

In New England

In New England, Congregational clergymen were also interested in some sort of life insurance coverage, but they hardly got around to discussing it seriously before the American Revolution broke out. By then Price's notable *Observations on Reversionary Payments* had been published in England and, as a result, Price's ideas played a major role in the New England discussions.

In 1772, only a year after Price's book appeared, the Rev. William Gordon, of Roxbury, Mass., published a short treatise on life insurance, the first in the colonies. Drawing its technical data from Price and its organizational details from British societies of the day, Gordon's plan provided a handy blueprint for potential colonial annuity societies. Scientifically, it was remarkable mainly for its suggestion, attributed ambiguously to Price, that no mathematician or actuary would be needed if the technical directions were carefully followed. Apparently New Englanders were not impressed by this do-it-yourself life insurance scheme. Anyway, with a war on their hands soon after it appeared, such matters had to wait.

After the Revolution, the Massachusetts Congregational Charitable Society finally, in 1785, launched a serious inquiry into annuities plans for clergy and the Harvard faculty and their widows. The committee of inquiry was headed by the President of Harvard, Joseph Willard, and included Judge James Sullivan and Harvard Professor of Divinity Edward Wigglesworth. Wigglesworth, who had begun making statistical projections of population trends in his spare time before the Revolution, carried most of the burden of the inquiry.

Wigglesworth

The mortality experience of the Church of Scotland Widow's Fund, appropriate as it was for Scotland, was not in the judgment of Wigglesworth an adequate basis for underwriting life annuities in America. In order eventually to get away from dependence upon this inappropriate experience, Wigglesworth persuaded the newly-created American Academy of Arts and Sciences to seek out the mortality record of a substantial part of New England through questionnaires to the clergy and physicians of Massachusetts and New Hampshire.

In the meantime, since such data-gathering and their analysis would require several years, he had to rely upon some interim base of mortality experience. From records of Harvard graduates, Wigglesworth determined mathematically that clergymen and college professors lived appreciably longer than the general populace. His inquiries to Price brought a confirmation of this fact. Price also agreed that Swedish life experience, for which tables were available, was closer to that of the Harvard graduates than was the Scottish experience.

With Price's advice on these and other matters, the Committee proceeded to draw up an annuity plan. While it was promptly accepted by the Congregational Charitable Society, it never had the chance to demonstrate its soundness because in the uncertain economic and political climate of the mid-1780's, the plan never obtained sufficient subscribers to get started and was ultimately dropped.

First Table

Despite this setback, Wigglesworth made good use of the mortality statistics which were unearthed by the American Academy's extensive questionnaire. In 1789 he studied the data which had come from 62 committees; this turned out to be a substantial cross-section of New England experience. From this data he was able to construct his well-known table of life expectancies, the first in the United States for a general population.

Wigglesworth's table was an important intellectual achievement for early America. Although it was probably the major eighteenth century contribution to scientific life insurance on the part of the American clergy, neither this nor other intellectual activities led rapidly to a large expansion of life insurance. Not until the nineteenth century was well under way did substantial American growth take place, and then much of the impetus came from commercial life insurance enterprises reaching out to the larger public. These new enterprises increasingly needed actuaries who were not only expert but full-time, and in this development the part-time clergymen-actuary had a noticeably diminished role. □

ACTUARIAL CLUB MEETINGS

May 26, Wisconsin Actuaries Club—Spring Meeting

May 28, Seattle Actuarial Club

May 28, Actuaries Clubs of Boston and Hartford—Joint Meeting

June 3, Actuaries Club of New York Junior Branch

June 4, Fraternal Actuarial Association, St. Louis.

June 5, 6, Regional Meeting, Society of Actuaries, St. Louis.

June 8, Seattle Actuarial Club

June 10, Actuaries Club of Hartford, Field Day.

June 12, Baltimore Actuaries Club

June 12, 13, Canadian Actuarial Institute, Annual Meeting.

June 12, 13, Southeastern Actuarial Club

June 19, Chicago Actuarial Club, golf outing

July 10, Baltimore Actuaries Club

July 12, 13, Southeastern Actuaries Club, Hot Springs