



SOCIETY OF ACTUARIES

FUNDAMENTALS OF ACTUARIAL PRACTICE (FAP)

Module 1: Role of the Professional Actuary

Section 2: The Actuary

Actuarius to Actuary

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Chapter I: A Science is Born

To most people outside the insurance business, "actuary" means about as much as "lychnobite"¹ or "retrocessionaire."² Seldom has designation meant so little to so many. In fact, when 300 persons accosted at random in New York, Phoenix, St. Louis and Boston were asked "What is an actuary?" 63 said "someone who works with insurance tables and rates"; 7 said "someone in insurance"; 30 "something to do with insurance." Of the remaining 200, 125 answered "no idea," and 75 indicated by their answers that they had no idea either, though one of them made the whole research project worthwhile by answering "It's where they bury dead actors."

Attempts at definition bog down because the actuarial function is expanding so rapidly in so many directions. Any comprehensive definition becomes obsolescent even as it is being formulated. But essentially the actuary's concern is to apply mathematics and accumulated experience to risks and contingencies, making uncertainty less uncertain, and doing it with the highest degree of professional responsibility.

But there are other reasons why so many people look blank if the word "actuary" comes up in conversation. One is that unlike such job designations as lawyer, teacher, chemist or accountant, "actuary" offers no clue to what an actuary does. Another reason is that hardly anyone outside an insurance company or the employee benefits department of a corporation or labor union or an agency of the state or federal government has any good reason to deal with an actuary or even know he exists.

Though insurance, in one form or another, has existed for thousands of years, it has had actuaries for only about 200 years. Like most others, the actuarial profession grew out of a developing need for a kind of expertise not previously available. Several concurrent influences combined to create the demand for the services of the actuary. And since he did not exist, it was necessary for him to invent himself.

The actuarial profession had its origin in Great Britain. The most powerful stimulus to the development of life insurance was the tremendous upsurge in England's prosperity, espe-

cially among the middle classes. It was a time of exciting new developments, including the beginnings of the Industrial Revolution. There was a receptiveness to new ideas, especially financial ideas. Even wildly unsound schemes that led to disasters like the South Sea Bubble³ attracted huge amounts of money and evidence a willingness to try new kinds of financial ventures.¹⁻², etc. – Explanatory notes will be found after the final chapters.

Newly prosperous merchants, doctors, lawyers, importers, exporters and owners of factories, mills and ships could readily be shown that their budding fortunes would be withered by premature death, but only the most crudely inadequate forms of life insurance were to be had.

One of these was membership in a “dividing society,” a kind of insurer that distributed each year’s dues to the beneficiaries of members who had died during the year. At best the death benefit was indeterminate, for the amount of a member’s coverage depended not only on the amount of dues and the number of members but on the number of fellow-decedents he would have during the year he died. Lacking an extremely active membership committee, the eventual outlook was dismal, with the dues of fewer and fewer members being divided among more and more beneficiaries.

The dividing society’s plight was similar to that of the assessment insurer. The main difference was that the latter adjusted the assessment to pay a stipulated benefit, while the dividing society reduced the benefit to what could be paid out of the total of stipulated annual contributions. Both types of societies had the problem of failing to take account of the future consequences of a diminishing membership and of death rates that increased with age.

The only other life insurance available was the one-year term insurance issued by two prominent fire-marine insurers, starting in 1721, at rule-of-thumb premium rates and with no guarantee of renewal from one year to the next.

But the basic ingredients for constructing scientifically sound whole-life insurance had by then become available and were only waiting for a creative mathematical imagination to put them together. These components included Pascal’s probability theory evolved from dice and cards; Graunt’s life expectancy tables based on London “bills of mortality”; Halley’s Breslau birth and death statistics; Johan DeWitt’s annuity calculations; and compound interest techniques. All that was needed was a new breed of scientist—today he would be called goal-oriented—to take these building blocks and create mathematically sound permanent life insurance, with full confidence that there would be a ready market for it.

The first to put all these components together was James Dodson, identified as “accountant and teacher of mathematics.” It is said that he became interested in a new form of life insurance because he was angered at being rejected by the Old Amicable, a dividing society, on account of his advanced age—46. In a 1756 lecture, Dodson showed how a permanent life insurance plan should be set up, how premium rates should be calculated, and how the reserves would build up. The procedures he prescribed are still valid. Dodson died a year later while he and Thomas Simpson were trying to establish in London what in 1762 began business as the Society for Equitable Assurances on Lives and Survivorship, later renamed the Equitable Life Assurance Society.⁴ This was, in effect, the beginning of scientific life insurance.

After Dodson’s death, Edward Rowe Mores, who had some mathematical ability himself, took over as chief promoter of the embryo Equitable. Mores was an eccentric antiquarian, a man of vast learning, who was such a classics buff that he taught his little daughter to converse with him in Latin. It was he who brought the designation “actuary” into the insurance business, though with no thought of any mathematical connotation for it.

Research has failed to disclose why Mores chose “actuary” as the title for the chief administrative officer of his new company. “Secretary” was the usual title for the post in the gen-

eral run of corporations. But the Equitable was to be the first of a new kind of life insurer, and Mores seems to have wanted a distinctive title for the administrative head of this new enterprise.

“Actuary” was in use in that era for recorders in some of the British courts, but it may have appealed more to Mores because its derivation traced back to the Roman Senate’s *actuarius*, who recorded the public actions of the Senate for publication in the *Acta Diurna*, a daily gazette established by Julius Caesar in 59 B.C. So it seems likely that Mores was drawing on his antiquarian lore for a title to give an officer whose duties, as Mores defined them, would be largely to keep the Society’s membership records, financial accounts, and minutes of directors’ and policyholders’ meetings or “courts,” as they were called.

Whatever qualifications Mores may have had in mind in choosing the designation, it is evident that mathematical ability was not one of them. In fact, none of the Equitable’s first four actuaries had the technical ability to function as actuaries in today’s understanding of the designation; when the directors—who made all the major decisions—thought computations were needed, they had an outside mathematician make them.

During the Equitable’s inception and much of its early history, the company relied heavily on the help of Dr. Richard Price, a skilled mathematician who was also a philosopher and dissenting clergyman. He supported the cause of the American colonists and was a friend of Benjamin Franklin. He enjoyed high prestige in the colonies.

Price not only advised on the calculation of premium rates but showed what accounting methods should be used and how reserves for future liabilities should be computed. He also performed another outstanding service for the Equitable: he brought into its service his nephew, William Morgan, who eventually came to be regarded as the father of the actuarial profession. For once, nepotism paid off handsomely.

Morgan had studied medicine, but getting started in practice proved so discouraging that he readily accepted his uncle’s advice to join the Equitable as assistant actuary. A year later, in 1775 at the age of 25, he became chief administrative officer, with the title of actuary, continuing until his retirement in 1830.

Morgan disliked his title. He considered it an “affected appellation,” and at the time he acquired it, that was probably a fair description. But Morgan’s scientific and managerial ability as actuary turned a somewhat peculiar synonym for managing secretary into a prized professional designation.

Morgan was the first actuary who could be called a professional actuary in the sense that the term is understood today. Before he came on the insurance scene there were men like Dodson, Mores and Price, who were actuaries in all but name. And there were actuaries in name only, like the four who preceded Morgan at Equitable. Morgan combined the designation and the function. In creating the actuarial profession, he imbued it with two of his own characteristics: a scientific outlook that insisted on mathematical and statistical research as the basis for decision-making; and an unmuzzled integrity that made him ready to risk his job rather than go along with potentially disastrous proposals from unwisely optimistic directors and policyholders.

It was Morgan’s fame in his new scientific field that caused “actuary” to become the generic term for a person doing this kind of work and eventually lose its meaning as administrative head of a life insurance company.

Thus, it was a sort of two-horse parlay that gave us “actuary” in its present-day meaning: Mores to select it in the first place out of his vast scholarly memory-bank, and Morgan to give it an entirely new meaning from the one Mores had in mind when he selected it.

“Actuary” is now so firmly fixed in the language in the sense that Morgan gave it that any

other designation would seem strange. But of course if Edward Rowe Mores had plucked some other exotic word out of his antiquarian grab-bag, the actuary of today would doubtless be called “curator” or “pro-consul” or whatever other “affected appellation” Mores’ eccentric whimsy might have hit upon.

Outstanding among Morgan’s string of actuarial “firsts” were his setting up of a balance sheet to take account of a life insurance company’s future liabilities and his appreciation of the significance of the results; his realization of the need to carry forward a margin of surplus to prevent the policyholder dividend system from breaking down; the classifying and measuring of the available sources of profit; the recording of life insurance company mortality, and the understanding that there was such a thing as a lower “select” mortality level during the first few years after an applicant had been examined and accepted.

Morgan was also the first in a long succession of actuaries to have trouble from policyholders and directors who refused to appreciate the need of holding adequate reserves for paying future claims instead of paying higher dividends.

Besides on-the-job training, there were a number of published works,⁵ including those of Price and Morgan, to which the actuarial recruit could turn for sound educational material in the early days of the actuarial profession in Great Britain.

Legal recognition came in 1819 with an act of Parliament and with the creation of the post of actuary to the National Debt office in 1821—the first actuarial appointment in government service. John Finlaison served as actuary to the National Debt Office from 1822 to 1851, and was thus the first government actuary. When the Institute of Actuaries was organized in 1848 he became its first president. Incidentally, he also did some consulting work for companies in North America.⁶

From the 1820s onward, the title of actuary seems to have come into general use in its present-day sense among English life insurers, and the formative period of the profession can probably be dated to the first quarter of the 19th century, according to one authority.⁷

Unfortunately, neither the development of the actuarial profession, the example of the highly solvent Equitable, nor the availability of actuaries such as William Morgan as consultants forestalled the creation of a great number of unsound life insurance companies on a proprietary basis in the first half of the 19th century. Non-existent regulatory legislation, irresponsible entrepreneurs looking for quick profits, and the appeal of life insurance as an investment as well as protection all added up to a situation that alarmed legitimate companies.

As insurance chronicler Cornelius Walford commented on the era, “Companies sprang up like gnats on a summer’s evening and disappeared as quickly.”

Since many of the failures were due more to ignorance than fraud, the knowledgeable insurance experts saw a need for a central organization that could encourage the spread of actuarial knowledge and promote sounder practices among life insurance companies. In Scotland a formal association of life company managers was set up about 1834. Ten years later there was a proposal to establish a similar body in London. However, there was little enthusiasm for this among so-called first-class offices whose actuaries considered themselves the elite. They saw little to be gained by associating themselves with every Tom, Dick and Harry in the business, and they may have regarded with some suspicion and jealousy all the modern companies and modern actuaries. Therefore thirteen of them refused to go along with the formation of the Institute of Actuaries in 1848 and set up their own organization, the Actuaries Club. The Institute stressed training, examinations, and meetings for discussion of problems. It progressed rapidly despite the loss of its Scottish members, representing about one-third of the membership, who resigned because of the difficulty of getting to London for meetings. The Scots formed the Faculty of Actuaries in

1856 and obtained a royal charter in 1868.

The Actuaries Club, on the other hand, limited itself mainly to the formulation of practice and, from time to time, investigations of limited scope. Until the hatchet was buried in 1884, no member of the Institute was elected to the Club. In 1884 the members of the Actuaries Club joined the Institute and the latter received its royal charter. The Club has continued as a dining club and organization for senior members of the profession. Membership is by invitation.

Chapter II: The Personalities

Development of the life insurance business in North America lagged somewhat behind Great Britain's. What little life insurance there was in the early 1800s was written mainly in companies primarily interested in annuity, trust, or fire-marine insurance business. A few had church or hospital affiliations.

The only one of these early companies that has continued in operation is the Presbyterian Ministers Fund, chartered by the Commonwealth of Pennsylvania Company for Insurance on Lives and Granting Annuities, chartered in 1812. It was the first commercial company in the United States doing a life and annuity business exclusively. In 1823, as a way of raising money for the Massachusetts General Hospital, the Massachusetts Hospital Life was organized, with the noted mathematician and ocean navigation authority, Dr. Nathaniel Bowditch, as actuary and chief executive.

In Canada, the first actuary was Hugh C. Baker, who founded the Canada Life Assurance Company in 1847. He was its first president and later also bore the titles of actuary and manager. The available records indicate that he acquired the title of actuary in 1851 or 1852, although he acted as actuary from the company's inception, calculating its earliest premium rates.

The somewhat relaxed approach of the early life companies to the marketing of life insurance belied the rate at which the ingredients for explosive growth in the business were building up. As in England many years before, they grew out of the change from a predominantly farming economy to a financier-dominated commercial-industrial economy. Without the kinds of mutual aid typical of agricultural communities, it became critically important to have money available when a family head died.

It was not until 1843, when the Mutual Life of New York and the New England Mutual started selling with something like modern aggressive drive, that the extent of the market was appreciated. The sales curve shot upward and in less than 10 years, 18 more companies had entered the business on the North American continent.

But for some years there was no upsurge in actuarial activity. A couple of companies worked up mortality tables based on local sources, but in the main the life insurers during the first half of the 19th century relied on the abundantly available mortality tables and other materials from Great Britain. It was not until 1849 that any of the new companies felt the need of a full-time mathematical officer strongly enough to go out and hire one.

In April 1849 the Mutual Benefit Life of Newark, New Jersey, engaged as "mathematician" Charles Gill, an Englishman who had emigrated to the United States and quickly earned a reputation as one of the top theoretical mathematicians of North America. He lacked any kind of actuarial background—the application of the angular analysis to the solution of indeterminate problems of the second degree, on which he had written a short book, was more indicative of his orientation. But he quickly adapted his skills to life insurance work.

Gill had been a mathematical whiz-kid and had taught school for a time in England. For most of the time between arriving in New York and joining the Mutual Benefit, Gill taught

mathematics and physics in a small college. He stayed at the company less than a year before going to the Mutual Life of New York as actuary, though for a time he worked for both companies.

Gill's first major project for the Mutual Life was preparing a new mortality table. When it started in business in 1843, the company "borrowed" the table used by the leading New York insurer, the New York Life & Trust Company—no kin, incidentally, to the present New York Life Insurance Company, formed in 1845 under the name Nautilus. This mortality table was a hybrid, based on two English tables, the Carlisle Table of 1815 and the famous Northampton Table constructed by Dr. Richard Price for the Equitable of London. These were general-population tables based on data from records in two English towns. They erred grossly in overstating expected mortality, so they were safe for life insurance, but the reverse for annuities.

At that time, important advances were being made in actuarial science in England, especially in the methods of contrasting mortality tables based upon the experience of life insurance companies rather than on general-population records. So the Mutual's board of trustees decided to send Gill to England in 1851 to learn what was being done there. The entire trip, which lasted seven weeks, cost only \$483, including \$63 for books.

Gill's new table was based on four British tables, and in spite of the size and complexity of the job he was able to get his table ready in time so new premium rates could go into effect February 1, 1853. They continued to be used for the next 15 years.

The importance of Gill's actuarial work caused surprisingly little stir among other life insurance companies in North America. At the time of his death, in 1855, no other company had a mathematical officer of anything like Gill's stature in a post of comparable importance.

In fact, even at the Mutual, the actuary's lot was not always a happy one. Unluckily, for all Gill's actuarial brilliance, his toughest problem was one that could not be solved by the angular analysis or any other mathematical approach, because it was Mutual's president, Frederick S. Winston.

Winston was regarded as "overbearing, jealous and irascible," David Parks Fackler, later one of the most famous of actuaries, was told when he joined the Mutual actuarial department in 1859, only four years after Gill's death.

The head bookkeeper confided to Fackler that Winston had been so rough on Gill, a scholarly and sensitive man, as to contribute indirectly to his sickness and early death. Since Gill died of a ruptured appendix and not of ulcers or hypertension, Winston's bullying must have been less than lethal, but Fackler's account is a sad reflection on the way that the most eminent actuary on this continent was treated by the president of the oldest and at that time largest life insurer in North America.

Gill was not the first to have trouble with his top management—as William Morgan of the Equitable of London could have testified in his day—nor was he the last. Fackler recalled that even later on, when the variety and volume of life insurance policies had brought about the employment of more mathematicians, "not a few executives of those days were inclined to regard their actuary's opinion on many vital matters as of little importance compared with their own preconceived ideas."

Though employing an actuary and then overriding his scientific conclusions was as ridiculous as hiring a dog and doing your own barking, this natural human tendency among the top brass meant that even within his own company the actuary had to be ready to fight for his rightful place in his company's councils. And, as Fackler noted, "not infrequently his position was rendered doubly unpleasant because his company had adopted some rule or

method which his own judgment condemned but which loyalty required him to defend as far as practicable.”

The financial troubles that some of the early companies got into doubtless did much to gain respect for the actuary’s advice. With regard to the actuary, company managements were somewhat in the position of the man who said his strange-looking pet was a cross between a parrot and a tiger, “and when he talks, you’d better listen.”

The slow development of the actuarial profession in North America was not entirely due to executive bullheadedness. With all the material available from England, and with companies issuing only whole life and term policies, the actuarial problems were fairly simple until after about 1860. For example, in 1848, at the end of five years in business, the Mutual Life had only whole life and term plans in force. Ten years later it was the same story except for 154 endowment policies then in force. There was not much incentive to expand the frontier of actuarial science outside the life insurance companies, whereas in Great Britain there was considerable demand for complicated calculations involving entailed states,¹ joint or survivorship annuities, and the like. It was not until after the life companies in North America began issuing policies more complex than straight life and term that much need for the trained actuary was felt.

The first generally used mortality table not derived from British experience was the American Experience Table, put into effect by the Mutual Life of New York in 1868. It was compiled by Sheppard Homans, who succeeded Gill as Mutual Life’s actuary. It showed mortality rates higher than British experience at the younger and older ages, but a great deal lower at the ages from 35 to 75.

Homans also found that the mortality experience varied greatly by type of policy. The whole-life policies on which he based his table exhibited about half the mortality rate of the shorter-term policies and about twice the rate of endowment policies. He also ascertained the degree of correlation between mortality and the region where the insured lived, as a way of checking on the accuracy of surcharges added to premiums in areas regarded as unhealthy.

While the table became known as the American Experience, it was based on data from only the Mutual Life and the Mutual Benefit Life. Other companies from which Homans solicited figures proved disappointingly coy. They were afraid that if their mortality showed up worse than average it might hurt them competitively.

Homans made it clear that the table was not meant to be an accurate representation of the experience of either mutual Life or Mutual Benefit. He also disclaimed having christened it “American Experience.” It was so designated by the New York legislature in a statute of 1868 requiring that the table be used in determining what reserves a company should hold against the need of paying claims in the future.

The specifying of the valuation basis also came to involve another consideration: Shouldn’t the policyholder who withdrew—or in the language of the day “seceded”—before his policy matured have the right to receive at least part of the reserve instead of losing everything? Most companies gave the surrendering policyholder some of the reserve, but only if he asked for it, and in any event it was not a matter of right but was granted only at the company’s discretion.

It was in connection with the reserves and the rights of withdrawing policyholders that Elizur Wright, Massachusetts insurance commissioner 1858-1867 and one of the most spectacular personages of life insurance history, charged into the life insurance business.

Most pictures of Wright, taken fairly late in life, show a bearded patriarchal type. Nothing could give a more misleading impression of Wright at the peak of his very considerable

powers. A militant consumer advocate, he could be thought of as the Ralph Nader of his day, except that he was a lot more colorful.

On a business trip to England in 1844, Wright's researches on behalf of the Massachusetts Hospital Life Insurance Company took him to the Royal Exchange in London, where he witnessed the auctioning of life insurance policies of impoverished men who were unable to continue paying premiums on them. Though there was no contractual obligation on the insurer to pay a surrender value, this kind of situation struck Wright as monstrously unjust, and he returned to America determined to take action against it.

Distracted by his other crusades, like slavery, alcohol and the tariff, Wright didn't get around to life insurance until eight years later. Then, on behalf of six life insurance companies he compiled a set of net valuation tables² showing the reserve a company should hold at the end of each year of duration of various types of policies at specified issue ages.

Wright was a prodigious worker. With the help of his son Walter and his daughter Lucy—both of whom later became actuaries—he completed the job in just two years. The staggering number of calculations involved can be gleaned from the fact that the published work comprised 203 pages of net valuation calculations. Wright's tables, it was estimated, enabled an unskilled clerk to find the answers ten times as fast as a professional actuary could without the tables. Moreover, the tables made it possible for non-actuarial officers and board members to understand what was going on and determine for themselves whether the company was solvent.

Wright acted as a consultant to life insurance companies in both Canada and the United States and was a storm center in the business until his death in 1885. He even won the respect and the admiration of actuaries who disagreed with some of his ideas, like the correct basis for the portion of the policy reserve to be given back to a surrendering policyholder. But he, more than anyone else, was responsible for compelling companies to deal more liberally with withdrawing policy holders as a matter of right, rather than just leaving the amount of surrender value to corporate generosity. In 1861, he persuaded the Massachusetts legislature to pass a law to that effect with respect to Massachusetts-domiciled companies; in 1867, a similar law was passed for out-of-state companies. It was not many years before other states fell in line, and non-forfeiture values, providing cash or a continuation of the face amount of the policy for a specified time, or a reduced amount of insurance paid-up for life, became the accepted basis everywhere in Canada and the United States.

About the same time, actuaries began to turn their attention to the determination of the formulas for the equitable allocation of dividends under the policies of mutual companies whose conservative rates assumed the eventual return to the policyholders of the excess monies in the form of dividends. Except for the Canada Life, which based its dividend formula on the British pattern of reversionary bonuses,³ the practice of mutual life companies in North America was to pay dividends equal to a percentage of premiums paid. This system became obviously inequitable, especially as insurance plans proliferated and the age distribution of policyholders covered a wider spectrum.

Ideal equity would be a dividend scale such that each "class" of policyholders (categorized by entry age, duration of policy, kind of contract, etc.) would be charged with its fair share of mortality costs, policy reserve buildup and company expenses, and receive back the remainder of the gross premium as dividends. For the Mutual Life dividend distribution of 1863, David Parks Fackler, the assistant actuary, devised what became known as the contribution plan of dividend allocation.

This plan conceived of the dividend as being composed of three elements: savings that resulted from the mortality for the "class" being less than predicted by the mortality table;

from investment earnings on reserves and surplus attributable to the “class” being higher than the assumed rate of interest; and from expenses for the “class” being lower than those assumed in the “loading” or markup added to the net premium to take care of expenses and contingencies.

The contribution plan, also known as the three-factor formula, was soon generally adopted throughout the life insurance business in North America and is still widely used.

However, interest in non-forfeiture values and equitable dividends was overshadowed for a time by a revolutionary development hatched in the same year as the Mutual Life’s contribution dividend formula. In order to meet the competition provided by Mutual Life’s high dividend scale, the Equitable Life Assurance Society of the United States adopted the tontine⁴ basis for paying dividends. During the so-called tontine period—10, 15 or 20 years—no dividends were paid to policyholders and withdrawing policyholders were paid no surrender values. Instead, money that would have been paid was accumulated to the end of the stipulated tontine period and paid out to policyholders who were still alive and had kept their policies in force. Those who had surrendered their insurance and the beneficiaries of policyholders who had died during the tontine period got no part of the accumulation. Under later tontine policies, only the dividends were held back and accumulated in the tontine pot.

Tontine dividends produced a bitter rift in the life insurance business. They brought problems for the actuarial profession, but they were more moral than mathematical—even Elizur Wright conceded that tontine dividends were sound enough mathematically.

Leading actuaries took opposing stands on tontines. Sheppard Homans, who had left the Mutual Life after a row with Gill’s nemesis, President Winston, joined the Equitable and was the main architect of the tontine plan, in which he believed implicitly. Many others considered it an invention of the Devil. Elizur Wright, while conceding its mathematical validity, denounced it as “life insurance cannibalism,” whose sole function was “to make the rich part of the company richer by making the poorer part poorer.”

As it turned out, whatever the tontine plan may have taken from the poorer policyholders, not much of it got to the richer ones unless they were among those in a position to benefit from the extravagant spending that the buildup of tontine funds led to in some companies. Tontine dividend policies were subsequently outlawed.

Chapter III: Formation of the Actuarial Society of America

Around 1860 there developed an increasingly felt need for the professional actuary’s services, and actuaries more and more recognized the desirability of having a professional society. Such an organization would permit actuaries in different companies to exchange ideas and possibly to pool experience for mortality studies of groups like overweights, underweights, and persons with family histories of poor health or early death. Most important, it could provide for an educational program that would interest young math-sharks in actuarial work and then ensure their competence through examinations.

Several attempts were made to form such a group, but they proved abortive. The deterrent, however, was not apathy or failure to appreciate the benefits of a professional association. It was mainly the problem of what to do about the actuaries—some of them in prominent companies—who were not actuaries at all in any conceivable professional sense. The presence of such individuals in a professional actuarial organization, perhaps holding high office, would have created an awkward situation.

By 1888, though, the situation had altered materially. Elizur Wright, whom it would have been embarrassing to exclude, had died in 1885, and changes at the Mutual of New York and New York Life meant that the three largest companies—the other being the Equita-

ble— now had actuaries who were fully qualified for membership in a professional society.

With David Parks Fackler, who had left the Mutual of New York and become an actuarial consultant to a number of companies, as chief organizer, the new society came into being in April 1889 at New York. Sheppard Homans was elected President and Fackler First Vice President. Among the 38 charter members were four Canadians, one of whom was included on the five-man governing council. The Canadians continued to play an important role in the society as well as in its successor organization; the first president from Canada was Thomas B. Macaulay, elected in 1899.

Almost the only point calling for more than routine discussion was the choice of a name. The first suggestions were American Actuarial Association and American Actuarial Society. However it seemed to some that “American” would give the appearance of limiting the society’s scope to the United States, whereas “of America” would have the continent-wide connotation that was desired. All present agreed, and “The Actuarial Society of America” became the name.

Right from the start, the governing body—the Council—took pains to make sure that nobody was admitted who was not qualified. Attention was paid not only to professional attainments of candidates for membership but also to character and reputation. This contributed much to the Society’s standing and promoted a desire to belong. Membership was limited almost entirely to those who had been engaged for some years in actuarial work and occupied positions as actuaries or assistant actuaries of their companies, or held positions of comparable actuarial importance.

Admission by examination was instituted in 1896, when the Society was seven years old. The examinations provided for admittance to the Society as Associates and later advancement to Fellowship. This plan resulted in the creation of a large Associate membership, most of whom went on to qualify as Fellows. The existence of the Associate member category meant that many companies, especially the newer ones, which previously had no actuary on their permanent staffs, were able to obtain the services of young men with good actuarial training and experience. This benefited the companies and the entire business. The Society’s educational program also included the introduction of actuarial-content courses into a few colleges and universities.

The formation of the Actuarial Society and the opportunity it gave actuaries to consult with colleagues outside their own companies meant that the actuary was much less obliged to rely on his own unsupported judgment than he had been before the Society supplied a forum. The long delay in getting the Society organized meant that there was a backlog of operational problems the actuaries wanted to discuss.

It is not surprising that in the Society’s early years the papers submitted and the discussions at the meetings were largely of the how-to-do-it variety. They dealt with such problems as more equitable ways of computing cash-surrender values and other benefits payable to withdrawing policyholders; systems of allocating dividends among policyholders; the proper basis of computing the “loading” on net premiums to take care of expenses and contingencies; the effect on policy costs due to the tendency of withdrawing policyholders to be healthier than the ones who clung to their insurance through thick and thin, and other down-to-earth problems calling for practical answers rather than mathematically “elegant” solutions. Treatment of these practical kinds of problems was of special benefit to the smaller companies that had previously been forced to do without the benefit of actuarial advice. Right from the start, the Society published a record of its proceedings, including papers presented and the discussions that took place.

Chapter IV: Landmark Developments and Growth of Actuarial Organizations

Before the formation of the Actuarial Society of America, the history of the actuarial profession on this continent could be told in the achievements of a few outstanding actuaries: Gill, who was the first full-time mathematical officer of a life company and who elaborated the basic techniques for formulating mortality tables; Homans, who followed the trail blazed by Gill and compiled the American Experience Table; Fackler, who conceived the contribution basis for an unprecedentedly equitable apportionment of policy dividends; Emory McClintock, whose annuity tables were used until comparatively recent times; Wright, whose experience qualifications may have been a little weak but who advanced the equitable treatment of withdrawing policyholders by many years.

But with the advent of the Actuarial Society of America, the whole development of the actuarial profession in North America changed dramatically. It quickly became too big and too multi-faceted to be the lengthened shadow of any one man. It had its heroes, but they were largely unsung—mainly because there were so many of them—the authors and the reviewers of papers, the discussers, the devisers of examination questions, the readers of examinations, the committee members who conceived and supervised the many special studies of mortality and morbidity. Teamwork largely superseded the star system.

The education and testing of potential actuaries, already briefly mentioned, helped to meet the actuarial-talent need that resulted from the growth of life companies in number and size. This growth was in turn a consequence of the rapid rise in general prosperity. Among the significant developments that followed the formation of the Actuarial Society were:

Numerical rating in the risk evaluation of life insurance applications

Inter-company specialized mortality studies to determine how far companies could safely go in insuring those with health impairments, family histories of poor health or early death, or occupations regarded as hazardous—among the latter being potential motherhood

The New York legislature's 1905 Armstrong investigation of the life insurance business, which exposed scandalous abuses in the management of the "Big Three" New York companies: Equitable, Mutual and New York Life

Formation of the American Institute of Actuaries

Group insurance

Creation and growth of specialized actuarial groups in the casualty insurance and fraternal society fields

World War I Life Insurance

Total and permanent disability insurances

Improvement in annuitant mortality

Numerical rating risk evaluation: In the early years of the life insurance business in England, the application form of the "Old Equitable," as the Equitable of London was called, included the words, "I am not given to drink or any other intemperance... I am not subject to any disorder which may tend to the shortening of my days."

Early life insurance companies in North America made a similar effort to confine their sales to what were known as "first-class" or "standard" risks. The Provident Mutual Life had as one of its stated objectives the insuring of members of the Society of Friends and "others of like careful habits." Only a few of the largest insurers made a cautious try at insuring, for an added premium, persons with questionable personal or family health histories or those engaged in what were considered hazardous occupations. Yet company manage-

ments came to realize that if these risks could be safely written at premiums commensurate with the added hazard, it would add substantially to sales, help the field force and above all provide a service needed by the public.

An innovation that added considerably to the accuracy and rapidity of appraising the risk involved in accepting an applicant for life insurance was the system of “numerical rating,” which made use of data from Actuarial Society mortality studies. Factors having a bearing on the desirability of a risk were assigned numerical weights derived from studies of mortality experience. When totaled, these gave a pretty accurate idea of whether the applicant should be rejected, accepted at the standard rate or accepted at a higher rate and, if so, how much higher.

The numerical rating method of risk evaluation, which came into widespread use in North America, lessened the need for subjective judgment in risk appraisal and greatly facilitated the classification and insurance of substandard risks.

Inter-company specialized mortality studies: The first of a long series of studies, the Specialized Mortality Investigation, 1901-1903, pooled 38 companies’ experience on 98 classes of risks, classified by amounts insured, personal and family health characteristics, nationality and place of residence. It was the most comprehensive work of this kind ever undertaken by any actuarial body in the world up to that time. An even more comprehensive study, the Medico-Actuarial Investigation, was undertaken a few years later in cooperation with the Association of Life Insurance Medical Directors of America.

These investigations and later ones, including the Occupational Studies of 1926, 1937 and 1967, the Medical Impairment Studies of 1929, 1931 and 1936, the Blood Pressure Studies of 1925 and 1938, and the Build and Blood Pressure study of 1959, have not only accumulated a unique comprehensive body of knowledge about the incidence of mortality and put the writing of substandard life insurance on a scientific basis but also have contributed in an important way to medicine and public health.

The specialized mortality investigations are supplemented by a continuing flow of information on current mortality and morbidity through the Reports issues of the Transactions. These reports were begun when the Society of Actuaries was formed in 1949 (See Chapter V, page 47)* and supply working material on a scale unparalleled elsewhere.

Scheduled for publication in 1975 is a comprehensive Mortality Monograph which has searched medical and related literature to assemble significant data on the effects of a wide variety of medical impairments on mortality.

The Armstrong Investigation of Life Insurance: The early years of the twentieth century were a time of wild corporate growth, monopolistic practices, and a “public be damned” attitude among the powerful. It was an atmosphere conducive to the managerial abuses that occurred in some of the life insurance companies, notably the “Big Three” in New York—Equitable, Mutual and New York Life.

What had been a private feud between officers of a couple of the companies erupted into the open, and the result was the famous 1905 Armstrong investigation by a committee of the New York legislature. It was also known as the Hughes investigation, after its counsel, who some years later was a losing Presidential candidate and subsequently Chief Justice of the United States.

The actuarial profession was involved more in drafting the remedial legislation that followed than in giving testimony before the committee, but one bit of actuarial testimony provided some startling publicity. At one of the sessions, a company actuary was explaining the function of the loading in the premium. The reporter for the old New York World did not appreciate the fact that, in life insurance, “loading” is a technical term for the nec-

essary provision in the premiums for expenses and unforeseen contingencies, not an addition for profit to the company. As a result, the World's account of the testimony made it appear that the actuary had been forced to admit the shameful fact that premiums were "loaded."

To prevent a recurrence of the kind of shenanigans that had been brought out at the Armstrong hearings—largely extravagant selling expenses—the New York legislators were prepared to enact laws that would have put the life insurance business into a straitjacket. Fortunately, the Armstrong committee got the advice of a committee of actuaries who were able to keep the legislation in New York—and later in other states as well—from being needlessly drastic as it would certainly have been without their help.

**Note: The retyped excerpt does not include Chapter V, page 47)*

This advisory role was not handled as an Actuarial Society project, but as President William C. Macdonald said at the Society's 25th anniversary celebration in 1914, "It is not unfair to conclude that it was by reason of the good relations between the members within the Society that their united effort was made possible and effective."

This was an important advance for the actuarial profession, even though it fell short of specific legal recognition of the actuary and his function. It placed actuaries in the role not merely of mathematicians and statisticians but of professionals whose views on how life insurance companies should be regulated in the public interest were being sought by the lawmakers of one of the leading insurance-regulatory states.

American Institute of Actuaries: But if the Armstrong investigation brought new recognition to the actuarial profession, it also brought about a division in the actuarial fraternity. The jolt that the investigation handed the largest eastern companies greatly intensified the push to form new companies in the mid-west and southern United States.

The problem that this new development created for the actuarial profession was that in spite of its training and examination program, the Actuarial Society of America couldn't come close to filling the demand for actuaries on the scale needed by all these new companies. Because not nearly enough actuaries were available who had passed even the ASA Associateship examinations, the new companies were forced to rely on those whose skills were developed on the job rather than in the courses prescribed by the Actuarial Society. Hence, relatively few actuaries of the newer companies were members of the ASA.

At the close of the 19th century there were 40-plus legal reserve life insurance companies, most of them in the east, and it was among these eastern companies that the Actuarial Society's membership was concentrated. But within a decade, 150 more companies had been formed in the midwestern and southern United States. Moreover, the actuarial problems and interest of these new companies differed in some respects from those of the established eastern life companies. For one thing, most of the new insurers were stock companies issuing "non-participating" policies, whereas most of the eastern companies were mutuals. The mutuals had a built-in safety margin, since their more conservative gross premiums contemplated a return to the policyholder of unneeded premium via the dividend, whereas for the "non-par" or non-dividend-paying policies of the stock companies, the gross rate was the final rate. As time went on, however, many stock companies wrote dividend-paying in addition to or instead of non-par insurance.

The outcome of this acute need for many more actuaries—actuaries with a largely stock-company, non-par orientation—was the formation of the American Institute of Actuaries in 1909, with headquarters at Chicago.

In spite of this division in the actuarial fraternity, there was a pleasing absence of jealousy and suspicion. A pattern of harmonious cooperation soon emerged, followed by joint ac-

tion in various studies and publications, and in meetings, education and examinations.

Group Insurance: The long uptrend in prosperity that fostered the formation of so many new life insurance companies after the 1905 Armstrong investigation led not only to the need for a new actuarial organization but also to another development of first importance. This was group insurance, which started off in a modest way with group life insurance and accident-and-sickness coverage for the Montgomery Ward mail order firm of Chicago but was destined to assume vast proportions, not only in life insurance, but in health insurance, pensions and other forms of employee benefits.

In the early years of the 20th century, most workers were so poorly paid that not many could afford even burial insurance. Even in plants where employee mutual benefit societies existed, the death payments were pitifully small. As the anti-social practices of many major corporations came into the spotlight of crusading authors and socially oriented politicians, some of the more enlightened employers began to wonder uneasily if maybe they should not do more for a deceased worker's widow than offer condolences and pass the hat at the plant.

Montgomery Ward was one of these employers. Its first ideas for mass coverage of its employees seemed unworkable, but after extensive negotiations the actuaries of the Equitable Life Assurance Society of the United States worked out a feasible plan with the Ward management. It is generally regarded as the first group case, though it took so long to negotiate that it did not go into effect until July 1, 1912, and in the meantime a couple of smaller cases had been wrapped up and put in force. In the Ward case, the life insurance was written by the Equitable, the accident and sickness coverage being placed with the United States Branch of the London Guarantee & Accident.

Considering its novelty and its rapid spread, group insurance at the outset presented remarkably few actuarial problems. The main ones were what rates to charge, how to allocate dividends equitably and especially how to utilize the group underwriting and administration principle so as not to treat the application and record keeping with respect to each covered employee in all the detail customary in connection with insurance applied for individually.

Casualty Actuarial Society: At about the same time that group insurance was starting to emerge and as part of the same burgeoning social consciousness that brought it into being, came workmen's compensation insurance laws. Before these were enacted, a workman's only recourse in the event of an on-the-job accident or illness was the employer's liability law. These laws were almost worthless except in cases of gross negligence on the part of the employer, and even then recovery involved court action and no assurance of collecting. Negligence on the part of the employee himself or a fellow worker was excluded as a basis for claim. The workmen's compensation laws provided for a specified scale of payments irrespective of proof of negligence.

These laws presented new kinds of actuarial problems for insurers which were sufficiently different from life insurance actuarial work so that life actuaries tended not to be interested in them except for those who were with life companies that did a workmen's compensation business.

So it was that in May, 1914, a group of men meeting as the statistical committee of the Workmen's Compensation Service Bureau of New York decided that in view of the problems presented by the new workmen's compensation laws, what was needed was a separate professional society. On November 7, the Casualty Actuarial and Statistical Society of America was formed with 97 charter members. (In 1921 "and Statistical" and "of America" were dropped.) Of the eleven charter members who became presidents of the Casualty Actuarial Society, seven were life actuaries; one was a past president of the Actuarial Society of America and one had served on the ASA Council.

The interest of the casualty actuaries came to include more than just workmen's compensation, and in 1950 the Society's charter was amended to embrace all lines other than life. Though the Society included a number of fire insurance actuaries, the members decided that "casualty" was a broad enough designation to include fire and "fire" need not be part of the Society's name. Like the life insurance actuarial societies, the CAS early instituted a system of Fellows and Associates, with admission to each category by examination.

Like the life insurance actuary, the actuary in a casualty and fire insurance company handles such matters as reinsurance, expense allocations, optimum size of field offices, cost of incentive programs, dividend analysis, company financial objectives and goals, and reviewing other companies' operations. He also has responsibility for contingent contracts governing the basis on which an agency's loss experience affects the amount of its commission payments. Much of the time of a casualty-fire actuary is spent in analyzing statistics and developing rates and rating plans, which can be highly complex. If a company uses rating-bureau services, the actuary may represent his company on the various rate-making committees of the bureaus and advise his company of the adequacy of the rates filed by the bureau when they are applied to his company. He may also present company filings to state insurance departments and participate in subsequent discussions.

Disability Income Problems: The lavish prosperity that followed World War I during the 1920s and ended in the 1929 stockmarket crash brought a vexing problem in the 1930s with additional policy provisions in life insurance for disability income. This was a type of rider that usually provided \$10 of income per month per \$1,000 of face amount of life insurance. The income was to be paid after a 90-day waiting period in the event of total and presumably permanent disability. Many policies carried such high monthly-income provisions that after the depression set in, thousands of policyholders who could get themselves certified as "disabled" were much better off staying that way than trying to go back to work.

Losses on disability insurance aggregated hundreds of millions of dollars before tapering off to negligible amounts, and they dented the batting averages of the actuaries who had given the green light to the rates and the amounts issued in relation to income. What emerged was the realization that underwriting such disability insurance is a totally different ball-game from underwriting life insurance. Above all, the monthly benefit must be at a level in relation to normal income where there is little temptation to fakery.

Improvement in Annuitant Mortality: In the 1930s, a heavy run of annuity sales and a reduction in interest rates led the actuaries to devote considerable attention to annuity business. Actuaries had long realized that annuitants had a way of living longer than the general run of citizens, longer even than the carefully selected buyers of life insurance. This is why separate mortality tables were used for annuity calculations and these were updated from time to time based upon past experience.

It became clear that this alone was not sufficient to keep step with the level of mortality that would eventualize in the future as the monthly income was paid out under an annuity contract newly entered into. Something more would have to be done if annuities were to be soundly priced.

Analysis of experience for successive calendar periods showed a consistent pattern of annuitants living longer, that is, of progressively lower mortality rates. It was clear that such a trend was likely to continue and that it would be necessary to consciously anticipate this improvement in the development of annuity mortality tables. The result was a new technique of table construction that involves the introduction of a specific set of factors to project and thus take proper account of probable future mortality improvement.

Excerpt from Chapter V

Operations Research and Electronic Data Processing: A government project that brought far-reaching consequences for actuarial science had nothing whatsoever to do with insurance. This was the work of the anti-submarine warfare Operations Research Group set up in 1942 by the United States Navy.¹ Its personnel, numbering more than 80 by the war's end, was drawn mainly from physics, mathematics and actuarial science, but included men from other scientific fields as well.

Initiated at a time when German U-boats were having phenomenal success, operations research analysis provided important conclusions about the effectiveness of various anti-submarine measures and also the probable reactions of U-boat commanders that might necessitate modification of these measures. Punch cards were used in preparing much of the data, and the functions calculated included the operational life expectancy of a U-boat, an unescorted merchant vessel and a convoyed merchant vessel. It was found, for example, that the larger the convoy the greater the probable safety of its ships.

Other projects included analysis of operational results obtained with special weapons, study of the relative U-boat hazard in daylight, in the dark of night, on a moonlit night, at dusk and at dawn.

One of the probability-analysis problems closely studied by the Operations Research Group was the determination of the best depth-charge patterns for naval vessels to use in attacking a U-boat. Physical characteristics of the depth charges and the U-boats were known from previous tests or were assumed. Thus, the problem was to place a given number of depth charges so as to maximize the probability of sinking the submarine. With the lethal radius of a depth charge a known quantity, as were the probabilities of various possible U-boat positions, the likelihood of sinking the U-boat with any given pattern of charges could be directly computed, and those patterns having the greatest probability were selected for use.

The disposition of escorts, the use of radar, and the tactics to be employed in protecting a convoy presented a similar problem. The area around a convoy within which a submarine might launch an effective attack was first determined. Then various dispositions and tactics were tested to determine the combination most likely to detect and neutralize a submarine before it could enter the area. A similar method was used in constructing search plans to enable naval vessels to reestablish contact with a submarine once located and then lost.

Operations research was especially valuable in making radar more effective. For example, one man designed a radar-barrier across the South Atlantic that enabled a handful of planes to detect several German blockade runners.

Attacks by Kamikaze planes presented a particularly difficult problem because of the shortness of time available to detect the attack and take countermeasures. Here, too, operations research was used effectively in improving the defense against these attacks. A theory of anti-aircraft screening was developed from which could be determined the optimum disposition of guns and ships under various circumstances. The effectiveness of different types of evasive action was examined by statistical analysis of a large number of Kamikaze attacks.

During the war, the naval Operations Research Group had as members five Fellows, two Associates and nine students of the Actuarial Society of America and the American Institute of Actuaries, one Fellow of the Casualty Actuarial Society and one state insurance department actuary.

The development of electronic data processing from an experimental device into a practical operating tool was greatly accelerated by wartime needs, and the Operations Research

Group made all possible use of EDP for important computations that with previously available methods would have taken a prohibitive amount of time and manpower. In this connection, it is interesting to note that as far back as 1936 an English actuary, E. William Phillips, in a paper published in the *Journal of the Institute of Actuaries (Great Britain)* described the characteristics of a high-speed computer that might employ electronic components and would use the binary number system, which is basic to electronic data processing equipment today. Phillips suggested that such computing devices would be important to the insurance business.

Growth of Group Insurance: The fringe benefits boom resulting from the wartime wage restrictions in the United States kept mounting after the war, and the variety of group insurance and pension plans also grew in response to the increasing public and labor-union awareness of the value of such coverages and the concept of a total compensation package that comprised salary plus benefits. Weekly benefits in the event of temporary disability, the health coverages such as hospital, surgical, medical, x-ray and laboratory expense insurance, catastrophe (or major medical expense as it is now more popularly termed), long term disability—these are some of the benefits in the panoply of group coverages.

Group actuaries have been diligently developing new concepts and new methods to provide clients with what they want. For example, in the group field, it is possible to obtain coverage that states benefits in terms of survivor income benefit payments to widows (or widowers) and dependent children rather than a flat amount of coverage. For years, of course, the flat amount of death benefit could be paid in monthly installments, including a life annuity, but the survivor income payment plan makes it easy and attractive to dovetail the pay-out with the family's need for monthly income, and follows the pattern of Social Security survivor benefits.

The tremendous growth in group health coverages written by insurance companies and the Blue Cross/Blue Shield type of organizations has brought about new concepts of flexibility in this field. There are plans in which the employer maintains the insurance records and pays claims for certain benefits; there are other arrangements under which very large employers self-insure their liability up to high limits, with an insurer handling the claims because of its nation-wide facilities and its expertise in dealing with claimants, doctors and hospitals. There are special rating arrangements whereby the insurer and large groups "negotiate" the total premiums with an additional amount to be payable in the event of losses that exceed those projected by the group actuary.

Such flexibility is desirable but presents problems and challenges to the group actuary who is involved with setting rates, monitoring experience and maintaining equity among the various classes of policyholders.

The group health insurance boom got a late start compared with group life insurance, but total premium income on health now far exceeds that for group life.

Group pensions, the third great segment of the group business, have existed since the inception of the American Express Company retirement plan in 1875. Another milestone was the setting up of civil service employee retirement plans around 1913, but pension plans for employees of private corporations amounted to very little until the 1940s. In 1950 the total assets of all employee pension plans of public and private employers were \$12 billion. In 1960 they reached \$50 billion, and at the 1973 year-end they stood at \$200 billion.

Note: Chapter VI and Chapter VII have not been included in the retyped excerpt.

Explanatory Notes

Chapter I

¹Lychnobite: One who works at night and sleeps by day. From the Greek “lychnos,” a lamp.

²Retrocessionaire: A reinsurer that receives retrocessions. Retrocessions are a share in the business (or “cessions”) that another reinsurer has received, usually from the insurer originating the business. Any additional recipients in this risk-bearing chain are also called retrocessionaires.

³South Sea Bubble: A speculative mania that raged in England for nine years before ending in widespread financial disaster. It started with the incorporation in 1711 of the South Sea Company, which obtained a monopoly of the British trade with South America and the Pacific Islands. The company also arranged with the government to take over part, and eventually all, of the national debt of £51,300,000, most of which was in annuities sold by government. The aim was to get the annuitants to exchange their annuities for South Sea stock, issued at an inflated price. The company’s success led to the formation of hundreds of imitators. A wild orgy of speculation brought the inevitable crash.

⁴The Equitable of London and the Equitable Life Assurance Society of the United States, which was founded in 1859, are not affiliated.

⁵The first major work on actuarial science in general was Dr. Richard Price’s “Observations on Reversionary Payments,” which went through seven editions from 1771 to 1812, the number of editions indicating the extent of the book’s influence. William Morgan’s “The Doctrine of Annuities and Assurances on Lives and Survivorships” was published in 1779, with a second edition in 1821. Actuarial technique was developed and codified in Francis Baily’s “Doctrine,” published in 1813, a general survey that is more closely knit and more mathematical than Price’s book, and Joshua Milne’s “Treatise” (1815) provides a close analysis of experience and a mathematical development of the subject that seems typical of the actuary’s approach to his science (M.E. Ogborn, “The Professional Title of Actuary,” *Journal of the Institute of Actuaries [Great Britain]* 1956.)

⁶One of these clients was the New York Life & Trust Company (no connection with the present New York Life Insurance Company).

⁷M.E. Ogborn, *op. cit.*

Chapter II

¹Entailed estate: One for which the owner has specified a line of inheritance, usually his lineal descendants or a designated class thereof.

²Net valuation basis: One that presumes that premium income will be on a net basis, that is, it excludes from the calculation any “loading” for expenses and contingencies. This naturally results in a stronger reserve basis than if it were assumed that the entire gross premium would be available to meet future claims.

³The Canada Life declared dividends every five years, giving each policyholder an additional amount of paid-up whole life insurance relating to the original amount of the policy and the number of premiums paid by him since the last previous declaration. The amount added was made a percentage of the insurance. For example, for the 1885 declaration a \$1,000 policy on which one annual premium had been paid received a bonus addition of $2\frac{5}{8}$ percent, or \$26.25; a policy on which two annual premiums had been paid received twice as much, and so on; those who had paid five premiums, along with all older policies, received

five times as much.

⁴Tontine: The word is derived from the name of Lorenzo Tonti, a 17th century Neapolitan banker who, while living in Paris, invented a scheme to raise money for the state. The original plan had no connection with life insurance. Each subscriber to a fund received an annuity, which increased as the number of members was diminished by death, until the last survivor received the entire income. At his death, the remainder of the fund went to the state. A tontine set up by Louis XIV lasted 4 years, with the last survivor drawing a total of \$367,500 from an original investment of \$1,500.

Chapter III – None

Chapter IV – None

Chapter V

¹All the material on this topic is adapted from “Actuaries in the Operations Research Group, U.S. Navy,” by Gordon D. Shellard, in Volume III of the proceedings of the Centenary Assembly of the Institute of Actuaries (Great Britain). The Institute of Actuaries, London 1950.

Chapter VI – None

Chapter VII – None

