EARLY ACTUARIAL STUDIES IN THE FIELD OF PROPERTY AND LIABILITY INSURANCE

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On this, the Jubilee of the Casualty Actuarial Society, it is tempting to assume that the fifty year period, 1914 to 1964, represents the whole extent of actuarial studies in property and liability insurance. However, many interesting studies in this field were made by actuaries prior to 1914 and it is thought that some short account of these studies should find a place in the *Proceedings* of the Society. No attempt will be made to go beyond the limited field of property and liability insurance, into such areas as accident, health, or disability insurance in which actuaries have always been active; nor will the early work in risk theory be considered within the scope of this study.

PROPERTY INSURANCE

The Reverend David Wilkie published in Edinburgh in 1794 a book *Interest and Annuities*[1] and can, therefore, be reasonably referred to as an actuary, although this was before the formation of any actuarial society. In this work he also attempted to cover the theory of fire insurance. The idea was put forward that higher rates of premium should be charged for larger dwellings because of the increase in the number of possible sources of fire – lamps, fireplaces, servants, etc. While the various schedule rating plans presently employed for rating commercial and industrial risks include charges for such features as area which are in line with the Reverend David Wilkie's thought, the method has never been used for dwellings or other class rated properties in the United States. It is of interest to note, as reported by Paul Johansen, the first President of ASTIN, in a paper presented to the XVth International Congress in New York in 1957,[19] that this rating plan is used for rural farm buildings in Denmark and the experience supports this method of rating. In the United States it has been known for some years that the dollar losses per $1,000 of fire insurance on large and small dwellings are higher than they are for medium size dwellings.

In the *Mémoires of the Société Royale des Sciences, de l'Agriculture et des Arts,* of Lille, France for the year 1834 there appears an article on the application of probability theory to fire insurance by Monsieur Th. Barrois.[2] The article runs to 198 pages and contains a great many complex mathematical formulae. It is tempting to dismiss this early work as of no practical value but, by studying in mathematical form such problems as the spread of fires in buildings of various types, the author points the way

to the possible development of certain structural charges for which classified loss data could never be developed. It is of interest to note that in the author's discussion of the problem of losses due to arson he uses Daniel Bernoulli's theory of relative values which has been applied in recent work on reinsurance.[20].

The next study of fire insurance by an actuary which has come to the author's notice was in 1847 by Mr. W. E. Hillman, actuary of Star Assurance Office.[3] He attempted to develop rates from the statistics for fires in London according to various trades over the years 1836-1845 compared with an estimate of the number of buildings exposed for each trade. Although this study did not lead to a practical ratemaking technique, it drew attention to many of the problems involved in scientific ratemaking for fire insurance.

The early issues of the *Journal of the Institute of Actuaries,* first published in London in September 1850 under the title of the *Assurance Magazine* by two eminent actuaries, Charles Jellico and Samuel Brown, contained numerous papers on fire insurance of which a number were presented at meetings of the Institute of Actuaries. However, most of these were not written by actuaries and were largely descriptive in nature so they need not concern us. Note must be made, however, of the work done in this field by Samuel Brown himself. Samuel Brown was the third president of the Institute of Actuaries (1867-1870) and was an indefatigable writer on all aspects of actuarial work. He wrote on mortality studies, including mortality in the U.S.A., probability theory, decimal coinage, sickness insurance, the investment of insurance company funds, as well as fire insurance. His first paper on fire insurance[4] was in 1850 and is a fascinatingly detailed study of the fires in London from 1833 to 1849. We learn, for instance, the frequency of fires not only by month of the year, but by days of the week and by hours of the day. We learn that about 4% of the fires were total losses. Fires are separately analyzed by occupancy and by extent of loss, and an exposure base is also established of the number of buildings in various occupancy groups. Fires are also analyzed by cause.

Samuel Brown again discussed fire statistics at the International Statistical Congress in London in 1851 where he suggested uniformity between countries in the collection of data for various branches of insurance. It would appear that the fire insurance companies resented this mere actuary taking an interest in their ratemaking because he later mentioned to another actuary "his extreme disappointment that the course of his investigations on this subject was stopped by the determination of the fire offices to refuse

him all information whatever." (Reported in the discussion of Cornelius Walford's paper of 1879.)[6]

In 1856 another actuary, Thomas Miller, who had considerable experience in fire insurance, made some interesting proposals for the collection of fire insurance statistics.[5] He was well aware of the difficulties of developing an exposure base for fire insurance due to lack of insurance to value, the operations of the average clause, and having more than one company on many risks. He showed how such difficulties could be overcome and ended his paper with these words,

> "there is no reason why the Offices should rest contented with imperfect data, when their own books can supply them accurately, and in the greatest abundance; and if some experienced members of the profession could be induced to cooperate in arranging a comprehensive and simple classification of risks, the individual Offices or such of them as approved of the idea might analyze their own business in conformity with that model; and were it thought advisable, their united statistics might be collected for the benefit of the profession generally."

The next study[6] of interest to actuaries was a review presented to the Institute of Actuaries in London in 1878 of the scientific application of data to the purpose of deducing rates of premium for fire insurance by Cornelius Walford, who was not only an actuary and a statistician but also an attorney. In addition to his numerous and discursive papers, Walford was the author of the great Insurance Cyclopaedia, a mine of information on insurance history, which he never lived to complete. Walford attempts to show how the germ of a scientific approach to fire ratemaking developed over the years quoting not only from the actuaries I have referred to but many other writers on fire insurance on both sides of the Atlantic.

The first volume of the *Transactions of the Actuarial Society of America* contains a paper presented in 1890 by an early member, Walter S. Nichols, on the actuarial elements involved in fire insurance. Despite its title the paper contains little of actuarial interest.

In April 1892 the *Bulletin de l'Institut des Actuaires Francais* contained a note on the mathematical theory of fire insurance by Monsieur P. Soulier.[8] This is of interest because an attempt is made to develop theoretical charges for the various structures due to the spread of fire from one portion to another. The problem of a row of connected houses is considered and also of structures of various number of stories.

In a paper read before the Fire Underwriters' Association of the Pacific in 1904, Albert W. Whitney, then Professor of Mathematics at the

University of California, set out a theory for establishing lines of insurance, that is, the amount of coverage an individual company should carry at its own risk. Professor Whitney, a charter member of the Casualty Actuarial Society and an Associate of the Actuarial Society of America, played a leading role in the development of Workmen's Compensation Ratemaking. This paper is reviewed by Walter S. Nichols in Volume 9 of the *Transactions of the Actuarial Society of America*.[9] Professor Whitney shows how lines must be chosen so that the probable fluctuation of loss shall be proportional to the index of profit-stability of the class. Because some classes have been traditionally more profitable than others, line levels used in practice are more controlled by the attractiveness of the business than by fluctuation of loss considerations, but it seems probable that as fire ratemaking becomes more scientific and we get away from traditionally profitable classes and traditionally unprofitable classes, this actuarial approach to setting line levels may be used.

The next paper in the realm of fire insurance to which reference will be made is also by Professor Whitney and was presented at the VIth International Congress of Actuaries in Vienna in 1909.[10] The general subject matter under discussion was, "Upon what principles and by what working methods should Fire Insurance Statistics be compiled?," a question which is most topical today. Professor Whitney's paper develops, from studies of the distribution of partial losses, the rates which should be charged under a coinsurance clause. The tables contained in the paper show the distribution of partial losses for eight classes of risk based on the loss experience in San Francisco during the years 1899-1903 and provide an interesting comparison with the studies which Miss Salzmann presented at a recent meeting of the Society.[21]

Another paper by Professor Whitney appears in Volume 12 of the *Transactions of the Actuarial Society of America*.[11] This paper discusses the theory of schedule rating and shows how to handle mathematically the three important elements in fire ratemaking – the ignition hazard, the combustion hazard and the damage hazard.

At this time the importance of the actuarial aspects of workmen's compensation was increasing rapidly and those actuaries who were interested in non-life actuarial studies had little time to work on the problems of fire insurance. As a result, the formation of the Casualty Actuarial Society in 1914 coincided rather surprisingly with a decrease in the interest of actuaries in property insurance and very little actuarial work was published in this field from 1914 to 1951.

LIABILITY INSURANCE

The origin of the Casualty Actuarial Society lay in the pressing need in the first and second decades of this century to develop rating plans and loss reserving techniques for liability and workmen's compensation insurance. The ideas of employer's liability and of workmen's compensation stem from England and Germany, with the British Employer's Liability Act of 1880, the German Compensation Law of 1884, and the British Compensation Law of 1897, but soon spread to the rest of Europe and the United States of America. Eleven papers on workmen's compensation insurance were presented at the Second International Congress of Actuaries held in London in 1898 and papers on compensation or employer's liability appear in the *Proceedings* of the IVth Congress (New York 1904), the Vth Congress (Berlin 1906) and the VIth Congress (Vienna 1909). The early literature in this field was devoted almost entirely to a discussion of non-actuarial aspects of the plans, and need not be reviewed here.

In the United States of America in 1896 seven companies engaged in employer's liability insurance set up the "Liability Conference." Some interesting information on the early operations of the Conference can be obtained from the Report on Examination of The Workmen's Compensation Service Bureau by the New York Insurance Department (1913), which tells us:

> "The Liability Conference decided to organize a statistical bureau, to inaugurate standard premium rates and to adopt standard policy forms. The first manual issued by the Conference was not based upon any exact scientific data and represented in a large degree the underwriting judgment of the members of the Conference. The second manual issued in 1898 provided for eight different schedules, classified according to industries, and also contained a differential in the rates charged in the various States. By a comparison of loss ratios, it was discovered that the loss experience in some States was more favorable than in other States; for example, the losses in the eastern States were not as high as compared with the losses sustained in the west and southwest. This was due to the fact that the physical and legal hazards were not equal in all the States and the Conference in constructing the 1898 manual took cognizance of such difference in hazard.
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> "The manuals issued by the Liability Conference in 1901 and in 1904 were based upon the combined experience of the members of the Conference, after detailed study of the same by the committee. The method of deducing rates from such experience was devised by Mr. Frank E. Law, and has since been published under the title 'A Method of Deducing Liability Rates.' This method was adopted by the Liability Conference in determining premium rates for the use of the members of the Conference for a period of ten years, from 1901 to 1910."

Frank Law was a charter member of the Casualty Actuarial Society

and his method of deducing liability rates was published by The Spectator Company in 1908.[13] The kernel of the method was:

> "The experience for the country at large was accordingly adopted as the basis, and the differences between States ignored for the time being. This gives the broadest possible basis to work upon and 'smoothes out' many of the inequalities and divergences due to narrow local and State experience. The adoption of this plan necessitates a procedure consisting of two separate and distinct steps: (a) determination of rates or list prices to be printed in the manual, and, (b) determination of the differentials or discounts off of the list prices for each of the several States."

It is noted that Mr. Law recommends that experience be reported by limits, that losses be reported by type, that the policy year method be employed with unallocated claim expenses distributed to year by formula. Development factors for losses, trend factors for experience, and pure premiums, are all part of his plan which was extraordinarily well conceived and has stood the test of time.

In 1909 there was an important conference on workmen's compensation at Atlantic City to which some of the future charter members of the Casualty Actuarial Society, such as M. M. Dawson, contributed and in 1912, two future charter members spoke on workmen's compensation at the Commonwealth Club of California. One of these was Albert H. Mowbray, a Fellow of the Actuarial Society of America and later President of the Casualty Actuarial Society. At this time many of the future charter members of the Casualty Actuarial Society were very actively engaged in getting compensation insurance launched on a technically sound basis.

In 1910, in England, William Penman wrote a detailed paper on the calculation of loss reserves under employer's liability contracts.[14] This was the first contribution of any importance on liability insurance to appear in the *Journal of the Institute of Actuaries.*

In 1913, I. M. Rubinow, the first President of the Casualty Actuarial Society, published a book *Social Insurance.*[15] The book, which runs to over 500 pages, grew out of a series of 15 lectures he gave at the New York School of Philanthropy in the Spring of 1912 and was the leading textbook on Social Insurance for some years to come. This is claimed to be the first university course in Social Insurance and covered Industrial Accidents, Sickness, Old Age, Invalidity, and Death, and Unemployment.

In 1914, A. H. Mowbray presented to the Actuarial Society of America a paper on the criteria for testing the adequacy of rates for workmen's compensation insurance[16] in which we find references to such features as budgeted allowances for acquisition expenses, a feature which was to

play an important role in casualty ratemaking for many years. Mr. Mowbray held in answer to the question, "If rates are considered for groups rather than individual companies, for what rates of expense should they provide?"

> "In the writer's opinion there is but one answer to this question. If the rate is to be pronounced adequate for an entire group, it must be adequate for the marginal or least fortunately placed company. Therefore the expense rates used must be not less than those of that company. Otherwise that company must be excluded from the group. Clearly a rate which does not make sufficient provision for its expenses could not be adequate for such a company according to our definition of adequacy."

(Your author expressed a similar view in writing on fire insurance in 1951[18] at a time when he was unaware of Mr. Mowbray's statement.)

In the same volume of the *Transactions,* Harwood E. Ryan, another Fellow of the Actuarial Society of America and a charter member of the Casualty Actuarial Society wrote on "A Method of Determining Pure Premiums for Workmen's Compensation Insurance"[17] and many other persons, who were to be charter members of the Casualty Actuarial Society, were writing and speaking on social insurance and particularly compensation insurance. It has been impossible in this short review to mention the work of many other eminent actuaries, such as J. H. Woodward, actuary, and W. W. Greene, assistant actuary of the New York Workmen's Compensation Commission, William Leslie, actuary of the California State Compensation Insurance Fund, and B. D. Flynn of the Travelers Insurance Company, each of whom later became President of the Casualty Actuarial Society.

The time was clearly ripe for the formation of a new society to provide a forum for these actuaries and others who were concerned to provide a proper scientific basis for casualty insurance. These were men of outstanding ability and inquiring minds. They have set us a tradition of brilliance that we must strive to follow. On November 7, 1914, in the city of New York, the Casualty Actuarial Society was born.

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