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**PANEL DISCUSSION  
THE EDUCATION OF THE ACTUARY**

*Panel Members:*

EDWIN B. LANCASTER, *Moderator*  
L. BLAKE FEWSTER  
JAMES C. HICKMAN  
CHARLES E. RICKARDS  
BERT A. WINTER

- A. Current trends in the number of candidates for the examinations and their implications.
- B. Current considerations with respect to educational requirements.
- C. Possible long-term trends in actuarial education.

EDWIN B. LANCASTER:

In 1947, just twenty years ago, the Actuarial Society of America and the American Institute of Actuaries inaugurated the current system of Preliminary Actuarial Examinations. In that significant move the North American life actuarial profession (1) departed from the early examination composed of ten tough Hall and Knight questions; (2) introduced early examinations based on the material usually covered in good undergraduate mathematics courses in the specified subjects; (3) retained the services of professional testing experts, the Educational Testing Service; and (4) retained the services of highly qualified consultants from the academic world to give advice on the syllabus and the examinations on general mathematics and probability and statistics.

As many of you know, the late Professor Sam Wilks, of Princeton, served as the probability and statistics consultant until his death. He was succeeded by Professor Mosteller, of Harvard, who now serves in that role. (Professor Mosteller is, incidentally, the current president of the American Statistical Association.) Professor George Thomas, of M.I.T., the author of a currently popular textbook on calculus, served as consultant on general mathematics until early this year; he was succeeded by Professor Nathan J. Fine of Penn State University.

While it is not the purpose of this panel to review a great deal of past history, it seems that a brief review of a significant event of exactly twenty years' duration is a good way to launch this presentation.

The panel has two principal purposes: (1) to report to the Society membership on current thoughts and happenings in the education and

examination area and (2) to present briefly a review and observations—current, short-term, and possible long-term—on our present education and examination system.

Bert Winter is by all counts the senior member of the Society's formal education and examination structure. He has the longest period of service of any of the currently active members of the Education and Examination Committee and the Advisory Committee and, as you know, has for some time been chairman of the Advisory Committee. It is in this capacity that he will report to us today.

Charlie Rickards has served for some years as a member of the Advisory Committee and of the Public Relations Committee. He was a member of the Committee To Review Membership Requirements. Charlie will report to us today in his capacity as chairman of the Public Relations Committee.

Blake Fewster has served the Society as a member of one of the operating education and examination committees, later as chairman of one of the special committees, the function of which was to prepare educational material following the decision to reorganize the syllabus into the E and I branches. At the present time Blake is chairman of a committee of the Canadian Institute of Actuaries, the function of which is to review the syllabus in terms of its Canadian content. It is primarily in this latter capacity that Blake will report to us today.

Jim Hickman, the anchor man on our panel, currently serves the Society on two committees. His assignment on the panel is, in my judgment, the most difficult one, that is, to view the actuary's job and the Society's education and examination process from the point of view of a member of the academic community. He has been asked to present views of a knowledgeable outsider. Jim, as you know, is a professor in the Department of Statistics of the Division of Mathematical Sciences of the University of Iowa.

**BERT A. WINTER:**

Since I have been introduced as the current chairman of the Society's Advisory Committee on Education and Examinations, it may help you to put my remarks in context if I read the description of the Committee's duties that appears in the *1967 Year Book*:

This Committee serves in an advisory capacity to the Education and Examination Committee, to other Committees and members of the Society, and to the Board of Governors, dealing with policy questions as to all aspects of the Society's examinations and syllabus for students, especially questions involving long-range considerations.

Reversing the order of that description and of the printed program for this panel, I will speak first of long-range considerations. Let us define "long range" as that future date when no present full member of an actuarial organization is actively practicing the actuarial profession in the United States or Canada, such practice being only by persons not now full members of any actuarial organization and, we hope, only by persons who by then will have become full members of the American Academy or the Canadian Institute. From this working definition, several desiderata emerge:

1. *Some* of such full members will possess the knowledge and skills to satisfy *any* of the needs for the "numerical analysis of the financial consequences of risk contingencies" of the then analogues of the present employers and clients of actuaries and, hopefully, the similar needs of governmental or private bodies not now employing actuaries.

2. *All* of such full members will possess the knowledge and skill regarded as essential on a continuing basis by government to the designing, pricing, and valuing of arrangements offered the public for the advance funding and sharing of risk contingencies.

3. Acquisition of the knowledge and skills described in item 2 should be sufficiently accessible that it is economically and politically feasible to restrict practice of the actuarial profession to those who have demonstrated by professional examination that they have acquired them.

Regarding point 1, the Committee on Research has been actively exploring mathematical techniques, not now part of the armamentarium of the typical actuary, that may lead to new and better methods of performing the work of the actuary. The results of such explorations are communicated to the membership by panel presentations, such as the one this afternoon and those at several other recent Society meetings. In the opinion of the Advisory Committee, as informed by the Research Committee, the extent of such additional techniques now clearly useful to actuaries and the current availability of suitable educational material for learning these skills do not justify, in the near future, the creation of a third branch, additional to the E and I branches, in Parts 9 and 10. This is surely, however, one of the long-term considerations with which the guiders of the Society's educational and examination system need to be most alertly concerned.

Another aspect of this question of additional mathematical skills is of more immediate concern. Data developed by the Research Committee make it seem likely that there are substantial numbers of young men in our educational institutions getting training in the use of modern computers for numerical analysis, systems design, and simulation. Clearly,

young men with such training can be useful to the insurance business if they can acquire the necessary knowledge of that business. It seems to many of us that it is in the best interest of both our profession and the insurance business that these young men be motivated to acquire that necessary knowledge through the actuarial education system. This has suggested to us the desirability of deleting from the syllabus those portions of finite differences of limited usefulness under modern conditions and of replacing them in Part 3 with computer-oriented numerical analysis. The Education and Examination Committee is currently investigating two facets of the feasibility of this proposal—educational material suitable for those candidates who have not had college courses on the subject and examination questions that will distinguish the “solvers” from the “appreciators.”

As you must have gathered from Ed Lancaster's introductory description of his qualifications, Professor Hickman's views on all aspects of this question of additional mathematical skills should be of great interest to all of us.

Let me turn now to item 2—the essential knowledge required of *all* life actuaries. The trail on this question was blazed about ten years ago by the Society's Committee To Review Membership Requirements, chaired by Gilbert W. Fitzhugh. The distinguished nature of this committee is indicated by the facts that, in addition to Chairman Fitzhugh, three of its members (Wilmer Jenkins, John Miller, and Andrew Webster) have served as president of the Society and four more (Kenneth MacGregor, Wendell Milliman, Charles Spoerl, and Ronald Stagg) as vice-president. The Fitzhugh committee, on the basis of its intensive review of the education and examination procedures of the Society, recommended that the Syllabus of Examinations be changed to its present form of five Associate-ship Examinations, three Basic Fellowship Examinations, and two Specialized Fellowship Examinations with E and I branches. The Fitzhugh committee work on this question bore further fruit upon the organization of the American Academy, whose bylaws specify as the educational requirements for an applicant for admission to the Academy after 1972, as a life and health insurance and pension major, essentially the content of the first eight of the Society's examinations.

Moreover, the detailed research of the Fitzhugh committee, and of the earlier Beers committee, which developed the education and examination committee structure and procedures that the present Society has employed since its founding in 1949, has proved of interest and value to other actuarial organizations more recently addressing themselves to the problems of formulating educational requirements for admission and of

designing procedures for the education and examination of candidates with diverse educational backgrounds—spread over a wide geographical area—and with varying ability and willingness to take the substantial time (from vocational and family responsibilities and understandable recreational needs) required to master a thorny thicket of principles and the facts necessary to their practical application.

As Ed Lancaster has told you, Blake Fewster will, later in this panel presentation, comment on these same topics from the Canadian point of view.

I would now like to consider briefly the most immediate aspect—whether enough young actuaries are now successfully coping with the Society's examinations. The Fitzhugh committee studied the future needs for actuaries and evolved as an objective for the new recruiting education and examination system being recommended that it produce, by 1969, a total number of 2,000–2,300 Fellows. Projecting from the 1,542 Fellows of the Society on December 1, 1966, and the 115 Fellows since admitted as a result of the November, 1966, and May, 1967, examinations, it would appear that some 435, or just under twice the recent annual rate, would have to be admitted as a result of the November, 1967, through May, 1969, examination sessions, in order to attain the minimum Fitzhugh committee objective of 2,000 Fellows by December 1, 1969. It should be realized, of course, that a considerable part of this ten-year period, of which the Fitzhugh committee was speaking, was consumed in implementing its recommendations and providing a fair transition period from the old to the new syllabus. Nevertheless, the results for the most recent examination year were relatively unaffected by these transitional influences. It seems clear, then, that we have a problem. What should we do about it?

First, in view of the complex and rapidly changing insurance business, embedded in national economies with the same characteristics, that our new Fellows must now and will in the future have to face, I strongly recommend that we *not* lower our examination standards.

Second, we must try even harder to improve and to make accessible to more candidates our education and examination procedures. Discussions such as those held by the conference last month and the Canadian Institute last June and those that we hope will take place in coming months in actuaries' clubs around this country should afford valuable guidance as to means of making these improvements.

Third, we must improve and step up our recruiting procedures. The Society's efforts along these lines are primarily under the guidance of the

Public Relations Committee, and Charles Rickards will describe them to you in a moment. I wanted to give you first, from the reports to the Board of the Education and Examination Committee, the record of how we have been doing recently:

	Total No. Candidates Sitting for Parts 1, 2, and 3
November, 1962—May, 1963.....	3,535
November, 1963—May, 1964.....	4,198
November, 1964—May, 1965.....	4,174
November, 1965—May, 1966.....	3,847
November, 1966—May, 1967.....	3,438

A November Part 3 was first given in 1963, which accounts for the sharp rise to the 4,198 peak for the examination year ending in May, 1964. The total has since declined, first slowly and then more rapidly, to a 3,438 total for the most recent examination year—18 per cent below the peak.

CHARLES E. RICKARDS:

Bert Winter has told you about the place of the Advisory Committee in our educational process and has given you figures showing the downward trend in the number of candidates sitting for Parts 1, 2, and 3. While part of this is due, we feel sure, to the present military situation (since the number of Canadians sitting for the examinations had not decreased, at least through 1966), it points up the need to do all that we can to stop and reverse this trend.

The responsibilities of the Public Relations Committee in this area are:

1. To make students in high school and college aware of our profession.
2. To supply them with adequate information about the requirements for membership in the Society and the intellectual and financial rewards derived from it.
3. To enable them to determine whether they have the potential for success in the actuarial field.
4. To enlist the support of educators and college placement officers in encouraging able young men and women to choose the actuarial profession for a career.
5. To pass on to the Board of Governors, the Advisory Committee, and the Education and Examination Committee suggestions which we receive in the course of our activities.

Perhaps the first awareness a young student has that there are such people as actuaries is when he participates (if, in fact, he does) in the High School Mathematics Contest, which is given each year under the

direction of the Mathematical Association of America with the cosponsorship of the MAA, the Society, and Mu Alpha Theta (M.A.TH.), a high-school and junior-college mathematics club. Harrison Givens, a member of the Public Relations Committee, is also a member of the Advisory Committee for the contest, and he enlists the assistance of other members of the Society who help in the administration of these tests in their local areas. Local actuarial clubs aid in this effort and frequently award prizes to the winners in their areas. Last March, 285,000 students took these tests in 6,700 high schools. Roughly 2 per cent of these were Canadians; the rest were from the United States. Each received a folder in which the Society is identified and which invites further inquiry. Over fifty members of the Society played some part in the conduct of these tests.

Another way in which a high-school student can learn about actuarial work is through two publications of the Institute of Life Insurance. The Public Relations Committee has collaborated in the writing of these publications, and they contain appropriate references to the Society.

At the college level we have two very important items—the Actuarial Aptitude Test and our booklet, “The Actuarial Profession in the United States and Canada.” Through our very important Subcommittee for the Promotion of the Actuarial Aptitude Test, under the chairmanship of Bill Odell, contacts have been established at some 209 colleges and universities, and arrangements have been made for the giving of the test there under appropriate security conditions. In this work we have been greatly aided by the co-operation of our local actuarial clubs, which have provided members to serve as contacts with educational institutions in their areas. Because of the relatively smaller number of universities and colleges in Canada and the close contacts which Canadian actuaries maintain with them, there is less need for the test at these institutions, but it is used by the Canadian companies in their recruiting efforts.

Previously contacts at United States colleges and universities were made primarily through the departments of mathematics. Currently we are also endeavoring to work more through placement officers, who are frequently not only more interested but also in a better position to know about qualified students who are not mathematics majors and to acquaint them with the attractive opportunities in the actuarial field.

Our booklet, “The Actuarial Profession in the United States and Canada,” has been well received. It is in its second edition. All of the first printing of 25,000 has been distributed, and 4,928 copies of the updated second edition have been sent out. Incidentally, although the booklet is distributed free to colleges, it is substantially self-supporting because of purchases by insurance companies and actuarial firms.

Another of our objectives, of course, is to have as many students as possible actually take the early examinations while still in college. This has been primarily the function of the Education and Examination Committee, but we have recently established closer liaison with that Committee so that our releases can be co-ordinated and made as effective as possible. As many of you know, letters and display posters announcing the examinations are sent annually to the colleges. In this connection also we are in the process of making certain that our contacts at the colleges are made aware as quickly as possible of the names of any students at their respective institutions who were successful in passing examinations. This will become easier to do with the completion of the job of putting the Society's examination data on tape.

With regard to the future there are two matters which the Committee has been discussing. The first of these is the major one of getting more young people to take our examinations, an especially hard nut to crack. There have been suggestions that we should do more at the high-school level, but to date it has seemed that the cost of preparing and distributing suitable material would be disproportionate to the benefit derived from such action, particularly in view of the uncertainty which envelops most young people at high-school age about the choice of their ultimate fields of activity. We are continuing to explore this subject, however. We have recently learned through Bartley Munson, of the Aid Association for Lutherans, about summer institutes for secondary-school teachers of science and mathematics which are conducted at various colleges under the auspices of the National Science Foundation. For the institute held at Lawrence University at Appleton, Wisconsin, last summer, Bartley arranged a visit of some thirty or forty mathematics teachers to his company and had the opportunity to talk to them about the actuarial profession. About one hundred and twenty institutes for mathematics teachers were held last year. When we learn of the location of next year's institutes, we will explore the feasibility of continuing and enlarging on the excellent beginning which Bartley has made. You will be interested, I believe, in the following two sentences from a letter which I received from the director of this program: "Assisting high school teachers to become informed about the actuarial profession for the purpose of counseling with their students is entirely appropriate and should be very useful to both the teachers and the profession. On the other hand, we would be less pleased if the purpose of the contacts with the high school teachers were to recruit them away from the field of teaching." In other words, "Hands off, please!"

The other matter that the Committee has been discussing relates to



the co-ordination of public relations activities with other actuarial bodies, most notably the American Academy. Some changes in the conduct of our affairs will undoubtedly be desirable. It is too early yet to know exactly what they will be.

In closing, I would like to say that our Committee welcomes and, in fact, is anxious to receive suggestions on how we can improve our performance in this and all our other areas of responsibility.

L. BLAKE FEWSTER:

I am asked to reflect the thinking of a national body, most of whose members are also members of the Society of Actuaries. Just as education and examination matters are frequently discussed within the Society, there have been from time to time over the last several years many such discussions in the Canadian Institute of Actuaries and its predecessor organizations. And, as in the Society discussions, many different opinions have been expressed. It is, therefore, very dangerous to assume that one can give an absolute reflection of the Canadian viewpoint, but I am going to try to outline some of the background that has led to an education project which is now in process. I hope that, if there are any comments about what I have to say, they will not come exclusively from Canadians.

The Society owes a debt to the officers of its Education and Examination Committee, who so generously donate time and effort to the work of the Committee. The fact that we are able to conduct such an intensive program on a volunteer basis is quite unique. Otherwise, the cost of our education and examination efforts would be much higher. Because of the volunteer nature of the Society's education and examination work, the Society examinations can expect to reflect the resources of and developments in some of the larger United States companies that so generously permit certain actuaries to devote a large percentage of their time to these matters. All of us should be grateful for this.

In spite of attempts to display principles in our educational material, it is only natural that reference to specific statutes or practices is necessary from time to time to illustrate the underlying principles. It has usually fallen to a United States member of the Society to prepare such references based on United States statutes and practices. This sometimes results in a Canadian member of the Society having more familiarity with United States matters than with those of Canada. Of course, any gaps of this nature in our education can be filled in once the ordeal of the examinations is completed and we can turn to the problem of learning our jobs. However, in Canada thoughts have sometimes been expressed that the Society education and examinations are slanted too much to the

United States point of view. This is, of course, a debatable point, since the business involvement of many members of the Canadian Institute of Actuaries is of an international nature and a knowledge of United States practices is a necessary requirement in any event.

Nevertheless, with the federal incorporation of the Canadian Institute of Actuaries in 1965, its members have become more sensitive to the responsibilities carried with this incorporation. The Canadian Institute of Actuaries now has the right to award the degree of F.C.I.A.—Fellow of the Canadian Institute of Actuaries—and must assure that those so honored are fully qualified to practice in Canada. The Canadian Institute of Actuaries cannot conscientiously recommend itself for accreditation and licensing unless it can say that its members have attained proper standards of knowledge in the fields in which Canadian actuaries will exercise responsibility.

Further, from the standpoint of Canadian students, when practical references are necessary in educational material, more profit will be derived from a course which is at least in part related to their practical experience. For life actuaries the most common method of qualification as a member of the Canadian Institute of Actuaries is to obtain Fellowship in the Society.

One extreme solution might be to have the Canadian Institute of Actuaries administer its own set of examinations. However, it is desirable to avoid the duplication of effort that would result from the operation of two examination systems on this continent. A single system, in addition to being more economical, offers a greater breadth and depth of coverage of actuarial matters. Also, a single system gives greater prestige to its graduates.

If a single examination system is to continue, it should then be responsive to change from time to time. In my own association with the Society's Education and Examination Committee, I have always observed a willingness to accept recommendations that will enrich the education of actuarial students and produce better actuaries. Educational problems have always been of concern, and we are now trying to arrive at a satisfactory solution to the particular one of Canadian content in the Society's syllabus.

The Canadian Institute of Actuaries is most anxious that the Society continue as an international organization. From an educational standpoint the Canadian members of the Society through the Canadian Institute of Actuaries are now working very seriously toward upholding the duties that go along with being members of the Society. To this end a concentrated review is now under way by the Canadian Institute of

Actuaries in co-operation with the Society Committee to review the Canadian content in the study material for Parts 6-10 of the present Society syllabus. It is our hope to make recommendations which would improve the Society course of reading from this viewpoint by introducing such new material as necessary but, where possible, reducing the amount of material required to be committed to memory, thus concentrating more on principles. This may involve modification of existing material or the addition of new Canadian subject material.

While all topics of Parts 6-10 are being reviewed from the Canadian standpoint, there are certain ones in which significant differences in practice exist in the United States and Canada. Just to mention two of them, for example:

1. *Social insurance*.—Just as changes in the United States must be noted, recent changes in social benefits in Canada are important in the education of an actuary.

2. *Taxation*.—The general topic of taxation in Canada will be receiving special attention over the next many months as a result of the Report of the Royal Commission on Taxation, more commonly referred to as the Carter Report. This report outlines a whole new philosophy of taxation, and the discussions involved and eventual results will be of interest to all members of the Society. If changes in tax legislation do take place, some material on this topic could quite likely become a part of the education syllabus.

We will want to bring and keep the educational material on these and other matters up to date. The Committee of the Canadian Institute of Actuaries is just completing its initial review of the Society syllabus, and certain recommendations are being considered concerning changes which might be made to the Society educational material to improve the coverage of Canadian subject matter. These recommendations will be and are already being discussed with members of the Society's Committee, and, when the necessary over-all agreement is reached concerning proposed syllabus changes, members of the Canadian Institute of Actuaries will then undertake to have any revisions to material in the *Study Notes* prepared.

At the moment it appears that there may be some increased coverage of Canadian material necessary without, however, much increase in the amount of educational material that students will need to cover. It is hoped that within the next two or three years some modification in the present Society educational material will result.

We are optimistic about the results that will be obtained. While perhaps initially this project came about to satisfy Canadian problems, it is hoped that some over-all benefit to the Society's educational material

will result. It might be felt that the interests of Canadians could be satisfied by having optional questions in the Society syllabus dealing with Canadian subject matters. However, this could deprive non-Canadian students of important information and prevent useful comparisons of United States/Canadian positions on certain topics. Instead, the intention is to make improvement in the coverage of Canadian subject matter which will be of benefit to all students and not just to those in Canada.

These remarks cannot be concluded without recognizing that the Society already has a well-established examination system. It is hoped that we can continue to look at the Society as an international organization responsible for education and examination with parallel organizations like the Academy of Actuaries and the Canadian Institute of Actuaries being responsible for the accreditation and licensing of actuaries.

JAMES C. HICKMAN:

*Actuarial Science Is Concerned with Mathematics*

Periodically in their private conversations and public discussions actuaries become introspective and seek to identify the characteristics of their profession. If at these times they follow the usual investigation method of politicians and social scientists, they will take a survey of some convenient, if not random, sample of actuaries and inquire how they spend their professional lives. This apparently scientific approach seldom produces a succinct characterization of the actuarial profession. The reason for this failure is simply that in our dynamic North American economy actuaries are working on an amazing variety of technical problems and are providing professional and managerial guidance to a multiplicity of private and public enterprises. Sample survey does not seem to be the proper research tool for arriving at the essence of actuarial science.

The difficulties in identifying the singular aspects of a profession by enumerating what its members do are not unique to actuarial science. For example, members of the clergy are frequently engaged in teaching, business management, money raising, and counseling—work which is only indirectly related to their traditional spiritual duties.

It is suggested that perhaps the great professions may be sorted out by identifying the key elements in the body of knowledge that each profession develops and applies. In the case of actuarial science it appears that this key element is the profession's reliance on mathematical and statistical tools for approaching economic problems involving uncertainty and management problems involved in systems for mitigating the financial consequences of this uncertainty. This does not mean that an actuary is necessarily a creative mathematician any more than a clergyman is

necessarily a scholar in the field of New Testament Greek. It does mean, however, that the actuarial profession is concerned in a very fundamental way with mathematical methods. This concern indeed is the most singular attribute of the profession, and it has been reflected in actuarial education programs in North America and throughout the world.

Frequently actuaries face management problems that involve personnel and political and legal aspects that are not amenable to mathematical approaches. When confronted with such very real, and often vital, problems, it is easy for the perplexed actuary to wish for a shift in the center of gravity of the profession's body of knowledge in the direction of the problem that then faces him. Although this is a natural desire, it is good for the actuary who entertains such thoughts to ponder a moment on what are the truly unique aspects of his professional equipment.

#### *Necessity To Keep the Syllabus in Step with Mathematics Education*

Once we have established the fundamental concern of the actuarial profession with mathematical methods, it follows that the profession is required to monitor developments in mathematics education and in the application of mathematics in other areas. For several generations the high-school and college curriculum in mathematics was one of the fixed points in the education world. However, in this century there has been an explosive increase in the body of mathematical knowledge. Especially in the post-Sputnik years there have also been frantic revisions in mathematics education in an attempt to permit students to master enough mathematics so that they can use the new tools and even create new mathematics before they reach retirement age. Once the fundamental concern of the actuarial profession with mathematics is accepted, these developments become of direct concern to the actuarial profession.

Perhaps at this point it would be helpful to pinpoint some of the trends in mathematics that seem particularly relevant to the actuarial profession.

1. *The general acceleration of the mathematics education program.*—This is well known to anyone with school-age children. This acceleration has brought into the high schools topics previously taught in colleges and into undergraduate courses topics previously reserved for graduate students. This acceleration has not been achieved without cost. Computing and manipulative skills do not receive the stress that they once did, and, because the ability to calculate and to perform standard algebraic manipulations is a valuable skill in solving many practical problems, this change in emphasis has made it difficult for a mathematics major to move smoothly into the actuarial examinations and into actuarial jobs. In order

to speed the march to new ideas, many topics are treated much more abstractly than they were in the past, so that traditional topics often appear as special cases of more general ones.

2. *Growth in the number of paths through the undergraduate mathematics program.*—For many years integral and differential calculus constituted a common course for all students with mathematical interests. Although this training remains vital for most such students, parallel sequences of courses with stress on algebra now exist. These alternative paths, particularly those that stress topics from the algebra of matrices, have become very important for many students contemplating work with multiple dimensional data. For example, multivariate analysis in statistics and linear programming in the operations-research area are accessible only to those with a background in matrix algebra.

3. *Growth of statistical methodology and the expansion of the application of statistics.*—Mathematical statistics is largely a product of the past forty years. Thanks to the efforts of our Education and Examination Committee, and their eminent consultants, the educational program of the Society has kept up with the rapid development of the subject matter. However, recent years have witnessed the development of statistical methods appropriate for problems where relative frequency interpretations of probability make no sense and which permit—in fact compel—the quantification of prior knowledge. These methods have been introduced to the Society by Donald A. Jones in his paper entitled “Bayesian Statistics” (*TSA*, Vol. XVII).

4. *The awesome impact of high-speed computing equipment.*—Before an audience of actuaries one does not have to recount the revolution that the development of high-speed electronic computing equipment has created in insurance administration and in completing classical actuarial computations. Perhaps the correct impression may be imparted by saying that this equipment has had a similar impact on all areas of applied mathematics. It is not simply that digital answers may now be cranked out by classical methods that were previously, in the days of high-priced numbers, economically unfeasible. Instead, the very approach to research in general is being changed. Not only may the computer analyze the experiment, but in many situations it may perform the experiment itself. Examples already exist in North American actuarial literature (Boermeester’s paper in Volume VIII and Collin’s paper in Volume XIV of the *Transactions* are such examples) in which Monte Carlo methods are used to solve the difficult distribution problem that arises in risk theory.

These four trends are not exhaustive; the speaker is incapable of producing such a definitive list. Rather, these four points were produced to

indicate the dynamic relationship that must exist between the mathematical sciences and actuarial science. To attract the students that the actuarial profession needs to discharge its responsibilities, it cannot let its education program get far out of the mainstream of undergraduate mathematics instruction. Even more important, however, the actuarial profession must not overlook mathematical methods that may yield new insights into the profession's problems. In order to keep track of developments in mathematics and to have a vehicle for communications with other professional groups in mathematics, the Society recently became an affiliate member of the Conference Board of the Mathematical Sciences.

*Emphasis on Examinations at the Expense of Education*

Up to this point we have discussed the relationship between mathematics and actuarial science. Let us now turn to some more general matters.

Actuarial science in North America has perhaps relied more heavily on a set of intensive written examinations for selecting and educating its members than have other professions. This system has, thanks to a high sense of professional responsibility of a long line of actuaries, worked amazingly well. Nevertheless, this reliance on examinations has tended to create in the minds of some students, and, I regret to say, some teachers and executives, the warped view that success on the examinations is an end in itself. The objective of actuarial education is not the passing of actuarial examinations but the training of professionals who can successfully solve real problems with actuarial methods.

In order to attract able students to the actuarial profession, our education and examination program must not create the impression that the challenge and opportunity in the profession are limited to the passing of examinations. No prospective actuary should feel that, comprehensive as they are, the current syllabus covers the total body of actuarial theory and defines the limits of application of actuarial methods.

*The Possible Long-Range Necessity To Transfer Portions of the Effort to the Universities*

Although the actuarial profession may be unique in its application of mathematics to insurance problems, there is little reason to believe that the educational experience of other professions is irrelevant to actuarial education. The fact is that in the past century law, medicine, and engineering have transferred most of their educational activities to the universities. Abe Lincoln studied law by working and reading in a law office.

Perhaps unfortunately, this path into the legal profession is now largely closed.

The relatively small size of the actuarial profession and the Anglo-Saxon tradition of reliance on self-study and rigorous examinations have, up until this time, precluded a similar transfer for the actuarial profession. Nevertheless, as the size of the actuarial profession and the problems of carrying out a vast education and examination system by squeezing time out of the schedules of already-busy actuaries both grow, the profession would be prudent if it examined both the advantages and the disadvantages of concentrating more of its educational efforts in universities. The advantages of such a shift are the advantages of specialization that can be recalled by any beginning economics student—certain actuaries could concentrate on educational activities. The paramount disadvantage is the problem of maintaining standards in a pluralistic educational system such as exists in North America.

*The Paradox of the Twin Objectives of Technically Competent Actuaries and Successful Managers*

It is probably not surprising, in view of the fact that success on the actuarial examinations requires both some intelligence and some perseverance, that many actuaries find themselves in general-management positions. In these positions they often find that their essentially technical training is only indirectly relevant to the complex problems that they face each day. It is probably natural that one in such a position would entertain thoughts of carrying out an educational revolution to smooth the path of the next generation of managers.

The problem raised here is a very basic one. Is it in fact possible for any formal educational program to directly prepare a student for general management? Such a program would have to impart the skill in selecting, directing, and inspiring other men, the rich variety of background experience, and the taste for management that characterize a successful executive. It is not altogether clear that such a program is possible. Let us acknowledge that the tools for making decisions, some of the historical background needed for good decisions, and even some minor classroom-type combat experience with decision-making can be built into an education program. Yet this seems to fall short of being adequate for turning a fresh college graduate into a seasoned manager. Perhaps it is more realistic to confine actuarial education to those topics which may be incorporated into a formal education program and to accept on faith that a certain number of those who complete the program will acquire the requisite experience and the taste for management.



*Competition for a Fair Share of the People with the Necessary  
Training and Aptitudes*

All North American actuaries are concerned with the recent decline in the number of students enrolled for the preliminary examinations. The obvious answer, as it apparently is for so many things, is that the Vietnam war is to blame. Not only have increased draft calls reduced the pool of civilian manpower but the war has also accelerated research and development projects that require men with many of the same characteristics as those of successful actuarial students. The draft is obvious to all; the associated increase in the demand for talented young people in science-related industries may not be so obvious if you do not read the help-wanted ads or frequent college placement offices.

In the long run, hopefully trusting that the current defense buildup is a local condition, I would conjecture that the actuarial profession's success in fulfilling the professional sex urge to reproduce itself will be correlated with its success in convincing students of the intellectual challenge (the fun is not limited to taking exams) and the social usefulness of the profession.

MR. LOWELL M. DORN: We are aware of the special interests of Canadian actuaries in actuarial education. A similar problem exists in the consulting field. What is the thinking of the Education and Examination Committee about additional specialized examination subjects in the consulting field?

MR. WINTER: As Mr. Fewster has said, there was a long period during which Canadian members of the Society were giving valuable help in making the examination system generally responsive to the needs of Canadian actuaries. This was before the relatively formal arrangement that he is heading came into being.

With respect to consultants, we are really in the first period. There is no formal arrangement. One of the key reasons for developing the E and I branches under the Fitzhugh recommendations was to enable a student who ultimately wants to work in public practice to spend as much of his study time as possible on material that would relate directly to his future practice.

In the development of educational material for the advanced subjects, particularly the E branch in Parts 9 and 10, we had very valuable help from people who are working as consultants. We have members of the Advisory and Examination committees who are practicing as consultants. What we are trying to do is to keep the examinations suitable for the edu-

cation of consultants and other actuaries who will work in public practice, but, of course, we do not have a formal arrangement similar to that which has been developed with the Canadian Institute of Actuaries.

**MR. HARLOW B. STALEY:** Is the Committee currently reviewing the advisability of putting material relating to the use of computers on the syllabus?

**CHAIRMAN LANCASTER:** I believe that Mr. Winter covered this in part in his presentation. This is a matter on which I can also speak from my own knowledge. The question of replacing some of the material on finite differences, which goes back to precomputer days, with some on computer technology has been before the Committee for some time. The difficult part of this is the inadequacy of text material, which is the problem that we always encounter.

The Education and Examination Committee is now actively reviewing two texts, and I think that you will see some changes in this respect in the near future.

**MR. JAMES L. CLARE:** Much discussion has concerned knowing specific facts of Canadian content. Since these facts become obsolete so rapidly, does the panel favor a further swing toward general principles and problem-solving, particularly in the specialized exams? If so, how fast and how far? Or, are things just right the way they are?

**MR. WINTER:** I would like to point out that, while fundamental principles are apparent in our education and, indeed, professional skill, most of the questions that we are called upon to answer in advising our employers and clients have to be answered in terms of "When does the plane leave?" This is a very ephemeral fact. And, while it is inevitable that the facts you have learned do change, the technique of applying a fundamental principle to the facts of today's problems is so central to what we do that some facts have to be included in our educational process to make it of any practical value.

As Mr. Fewster said, we are trying once again to reduce the emphasis on ephemeral facts in the Canadian examination material. Even in the Fitzhugh committee ten years ago one of the considerations was this concept of separation between basic and specialized material. One of the things that was done should appeal particularly to the Canadians. All the thorny facts of standard nonforfeiture laws were removed from the basic examinations and transferred to Parts 9I and 10I. Therefore, some-

one whose primary interest was in employee-benefit matters could escape without ever having to go through that particular thicket.

There are many other examples in the Fitzhugh arrangement of the syllabus, but it remains a problem. I suspect that, in spite of all our efforts, there will always be a feeling that there is too much emphasis on specific facts in any given examination.

MR. BRUCE E. NICKERSON: Dr. Hickman, as I understood him, took the viewpoint that the actuarial profession was primarily that profession concerned with mathematical computations and their economic application. Mr. Fewster presented a very valuable point concerning the subject of the Canadian content of the examinations. These two speakers, however, seemed to display a rather opposite point of view as to the nature of the profession—whether it is concerned as a general professional body with mathematical subjects or whether it is concerned with the specific problems of the life and health insurance industries and their consulting organizations.

I would like to ask Mr. Winter whether the Advisory Committee has any intention of trying to clarify, for us and for future members of the Society, what the resolution of this apparent schism will be.

MR. WINTER: I think that Mr. Fewster, Dr. Hickman, and I are all agreed that what we are trying to produce is an educational system for an international professional society. This system should produce young men who meet all the needs for people whom we would like to regard as life actuaries in the United States and Canada.

Those of us who work for such a society or its committees have to be conscious of the pluralistic nature of the functions of the society. We have to produce an educational system that is responsive to all the professional needs of the actuary and does not concentrate on a particular aspect of actuarial employment. So we cannot really avoid this schism, since it is almost a built-in part of our problem.

MR. JOHN C. MAYNARD: I regard the last comment as pointing not to schizophrenia in our profession but to its strength. An actuary is part mathematician and part businessman, and his power arises because he is both. It is natural that his training should require him to attain a mastery of both mathematical and practical affairs.

DR. CARL H. FISCHER: This is a practical question addressed primarily to Mr. Rickards. In talking about the recruiting of actuaries, he

mentioned the fact that there are now many more opportunities available for mathematicians outside the actuarial field and that this draws people away. I will concur in that, but would like to know whether the Society or any of its committees have given any thought to this question? There are rather generous scholarship funds available for most of these other mathematical disciplines, and the scholarship money is, in my opinion, pulling a lot of people away. We may not want to buy actuaries, but maybe we are going to have to. Has any thought been given to the possibility of raising scholarship money for prospective actuaries?

**CHAIRMAN LANCASTER:** I believe that there are a number of companies that do offer scholarships as individual companies, but the Society as such has not directed its attention specifically to this question.