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Presidential Address

The Sigmoidal Curve*

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IN SELECTING a title for the address of your 64th president, whose predecessors in the past 72 years have always had intriguing captions, I have arrived at one which, I must confess, may have lured you here under false pretenses. "The Sigmoidal Curve" does not refer to the anatomic structure of that name, and my paper will reveal no new surgical information about the terminal gut. The curve referred to is a mathematical one—the "S"-shaped curve of logistic elegance which graphically illustrates so many inorganic and biologic phenomena (Fig. 1). It is the curve of saturation, of the process of crystallization, of atomic chain reactions, of biologic growth, of economic cycles, and of population increases, to cite but a few examples.

The exponential law is the mathematical consequence of having a quantity that increases so that, the bigger it is, the faster it grows. A colony of rabbits or fruit flies which breed among themselves grows

rapidly until some natural upper limit is reached. Then the curve begins to level off at the top to make it "S"-shaped, otherwise known as a logistic curve or sigmoid. I shall refer to it here as it might relate to the history and future of medical specialties, with especial application to proctology, in the hope that it may, however faintly, illuminate our path and allow us to take the right turnings.

Every member of the American Proctologic Society at some time must have asked himself, "Where do we go from here?" I should like to point out to you how the history of specialism, the currently changing concepts in the delivery of medical care, and the unfulfilled and perhaps unfulfillable demand for more specialists and at the same time for more generalists, are complex problems of the highest priority.

On an evolutionary scale, specialization is a property of all living things. As it pertains to human endeavor, evidence of steadily increasing narrowing of individual skills, interests and practices, born of necessity, is well documented by archeo-

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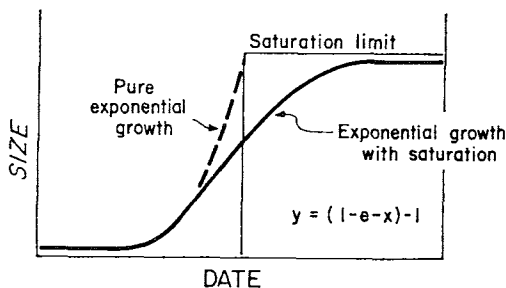


FIG. 1. The sigmoidal curve.

logic research. Were it possible to plot a curve of specialization since the beginning of mankind it would be a most interesting one. With its base line of time a mile long and its vertical ordinate the degree of specialization or number of specialists, the curve would have a slow upward trend until the last inch when it would begin to climb steeply in what is mathematically termed an "exponential" manner.

The invention of printing in 1470 and its rapid growth in Europe created a new force. In its reaction, science behaved exactly like an atomic explosion, in which a critical mass had been attained and a chain reaction produced. With the advent of printing the pace became faster, so that a person had to read all the new books in his field to keep up with the works of his contemporaries and in order to advance. Then came the scientific academy with its learned journals, in the middle of the seventeenth century. The early nineteenth century saw the introduction of scientific abstracts, which had become necessary because the journals and published papers were so numerous that no one could ever hope to read or assimilate them completely. In the last century, specialized journals became necessary in order to cope with the near autonomy of the separate disciplines. At the same time, there began the proliferation of professional scientific societies, many of them limited to one field or area. Thereafter, as the need

increased, so did the number of journals, reaching a total of about 100 by the beginning of the nineteenth century, 1,000 by 1850 and about 10,000 by 1900. We are now well on the way to the next milestone of 100,000 such journals. The number has increased by a factor of 10 during every half-century since 1750, when there were about 10 scientific journals in the world. The number of abstract journals also rose, following precisely the same law, increasing by a factor of 10 in every half-century. In 1950 the critical magnitude of 300 such abstract journals had been reached¹⁹ (Fig. 2), and scientists have become concerned about the "information problem."

Because of this great profusion of literature and knowledge, an interesting trend has developed: in many fields, personal communication between those interested in a particular problem has taken the place of publication for a wider audience. One might say that this is a throwback to medieval methods of communication. As Elkinton⁶ has said, "Too many words." It is no news to the physician that he is steadily losing ground against the rising tide of medical reading matter that threatens to engulf him. Quite aside from the enormous floods of advertising material, commercial "throwaway" publications, and pharmaceutical brochures that pour in on him daily, the conscientious physician is faced with an ever-increasing number of *bona fide* medical journals and news magazines that by sheer numbers overwhelm his capacity to keep informed of new developments in his chosen field of interest. Week by week and month by month the pile of unread journals grows higher on the side of his desk. The result is frustration. He has too much to read. The physician, of course, is not alone in his difficulty. The world in general and the scientific community in particular are buffeted by an information explosion that presents great difficulties, as well as benefits, to human society. But the

physician is subject to particular stress because of the urgency of the problems he must deal with—sick patients and the issues of human health, if not life and death, require that he learn as soon as possible of new advances in medical diagnosis and treatment. For the physician, be he practitioner or investigator, the exponential growth of medical literature is especially distressing in the fixed framework of his daily schedule.

We are all keenly aware of the necessity of digesting not only the original papers and abstracts in our own journal, *Diseases of the Colon & Rectum*, but also those which appear in related gastrointestinal, surgical, and general medical journals pertinent to our field. It is conservatively estimated that at least 5,000 different journals are published in medicine and the related sciences.¹⁴ It would be quite impossible for anyone with broader interests to accomplish this feat.

In addition, international and national meetings, such as ours here today, as well as regional and local conferences in which highly specialized information is transferred, have become more frequent and more necessary.

These considerations are, in themselves, arguments for the increasing necessity or at least desirability of the practice of proctology by proctologists

At the same time, it has been pointed out that one must not “dig himself deeper and deeper into his narrow pit until he thinks the rim of his hole is the horizon of knowledge.”²¹ We are always compelled to beware of the tunnel vision to which specialization may lead.

Historically, medical specialization has developed partly in response to an expanding economy. There was the problem of keeping up with advanced technics, technological improvements, and new medicines. One answer to the professional man’s dilemma has been specialization. He could

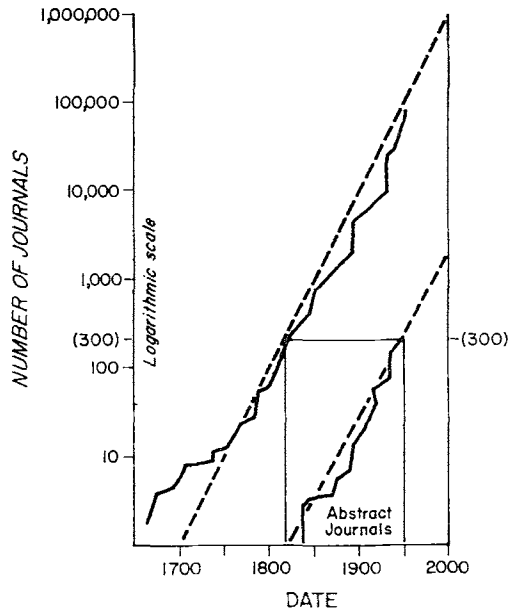


FIG. 2. Growth in the numbers of scientific journals (from Price, D. J. de S.¹⁹)

not hope to know it all, but he could limit himself and become more proficient and knowledgeable in some areas. In India, specialization was developed at an early date, and in Egypt, in the sixth century B.C., each physician applied himself to the treatment of but one disease. In ancient Rome specialization was also a common practice. The trend was reversed in the early Renaissance, when critics said that specialization was making physicians lose their perspective on life.

However, by the seventeenth century various specialties again began to be detached from the main trunk.³ Modern specialization dates from the eighteenth century, when obstetrics, orthopedics, and pediatrics split off from surgery and medicine. By the time American medicine began to develop, specialization was accepted as proper in Europe, and the Americans copied the European example. The trend was well established by the time of the American Revolution. By 1835, St. Mark’s

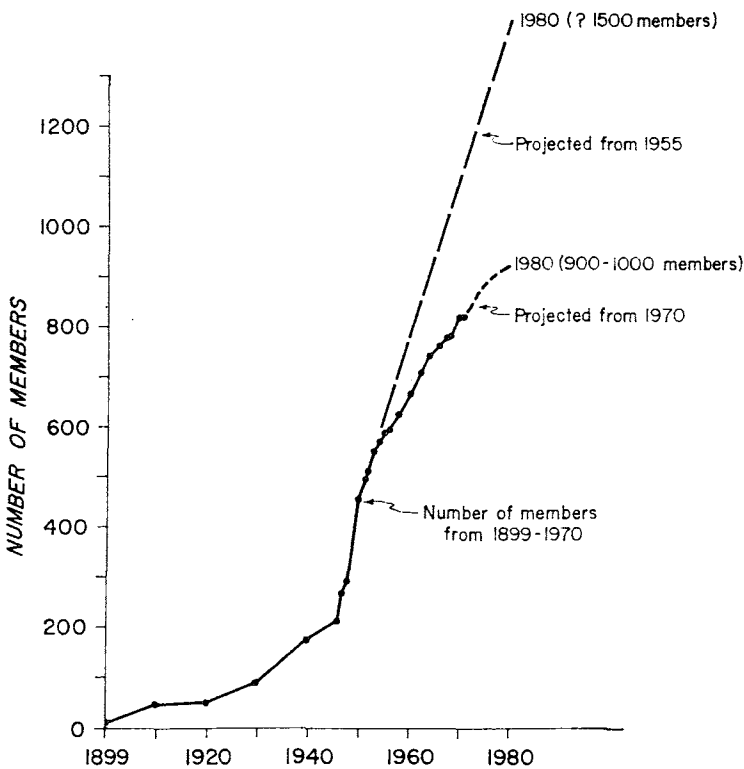


FIG. 3. Numbers of members of the American Proctologic Society (1899-1970). Projected from 1955 and from 1970.

Hospital for the Cure of Fistula, Cancer and Other Diseases of the Rectum had been founded and, by the time Joseph MacDowell Mathews became interested in specializing in proctology in 1887, it was already a renowned institution.^{11, 20} In 1869, the American Medical Association adopted a resolution which began, "Resolved that this association recognizes specialties as proper and legitimate fields of practice." The Flexner Report of 1910 gave medicine a healthy and needed push toward the teaching of the basic sciences and this, in turn, eventually led to more science orientation and specialty orientation in medical schools. In 1930 the Specialty Boards were established. However, the steep rise in the exponential curve of the growth of specialties came after World War II, both in the number of different specialties and particularly in the number of specialists practicing them.

If one considers the number of members of the American Proctologic Society as being representative of the total number of specialists in our field, again we find the characteristic graph (Fig. 3). The number of members increased by 250 per cent between 1946 and 1952. But note the trend toward flattening at the upper right. Is this the beginning of the "S"? It must be emphasized that, if it is, this trend in no way indicates a lessening of total interest in our field, a lessening of demand, or a lessening of necessity, but is a reflection of American social, economic, demographic and medical-manpower phenomena. It does, though, confront us with a dilemma in the delivery of adequate care in our field.

"Recognized" specialties now number 34, although the actual number is considerably greater than that. There are also more than 4,000 specialists in "non-recognized" specialties in the United States.^{9, 10}

The proportion of doctors who were specialists in the United States increased from 20 per cent in 1931 to 73 per cent in 1968! (Fig. 4, Table 1).

Now what is happening? A new socio-economic trend is emerging. Major medical eras in this century have been classified as: 1) the General Practice Era, 1910-1940; 2) the Specialty Era, 1940-1959; 3) the Scientific Era, 1959-1968; 4) the Community Era, which dates from 1968.⁷ New concepts and actual realization of comprehensive health care, the primary physician, the physician shortage, student attitudes, the roles of the university and the teaching hospital, federalization and politicization of medicine, group practice, strictures of the economy, legal factors, universal health insurance and technological advances are rapidly changing the *status quo*. Health expenditures have risen from 12 billion dollars a year to more than 60 billion dollars in the last 20 years, a fivefold increase, even though higher prices account for half of the increase. An important characteristic of the health industry is the increased role of government at all levels in the financing of health services and in the financing of the plants, equipment and trained manpower which make up the industry. In 1969, 37 per cent of all health care expenses came from public funds. In this decade we shall see rapidly escalating costs and rapidly increasing public involvement.

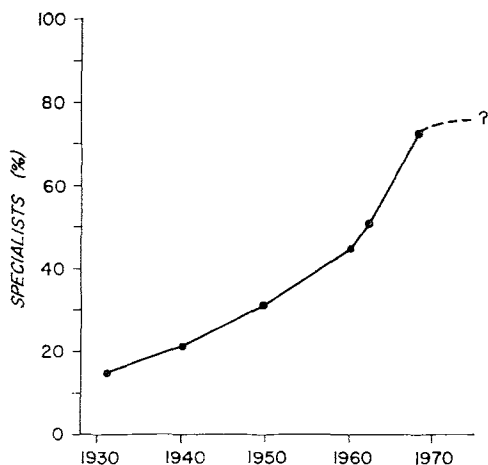


FIG. 4. Percentages of physicians who were full-time specialists in the United States, 1931-1968.

It is claimed that 50,000 more physicians are now needed and 70,000 more will be needed in 10 years, and that the 9,000 physicians currently graduating every year are not nearly enough to meet the requirement of today's population, not to mention the 20 million more people expected to be born in the next decade.⁴ The projections of the Census Bureau foresee a U. S. population of 320 million by the year 2000. M.D. degrees granted this year represented an increase of about 20 per cent over the figures 10 years ago, and current estimates show that an increase in enrollment of as much as 50 per cent is needed, and even greater increases will be

TABLE 1. Percentages of Physicians Who Were Specialists in the United States from 1931 to 1968^{9, 10}

	1931	1940	1949	1960	1962	1968
All full-time specialists	15.5 per cent	20.7 per cent	30.4 per cent	45.9 per cent	59.1 per cent	73 per cent
Part-time specialists and general practitioners	76.1 per cent	67.2 per cent	53.5 per cent	34.1 per cent	30.6 per cent	22 per cent
In training programs	4.5 per cent	11.6 per cent	11.4 per cent	15.1 per cent	14.1 per cent	Included in above
All physicians	158,406	178,643	206,277	249,989	259,105	308,630

necessary in the future. Although the magnitude of the deficiency has been disputed,¹⁵ the general opinion is that there is indeed a medical manpower shortage, and measures to overcome it are well under way. It is estimated that, in 1980, there will still be a shortage of 26,000 physicians.² During the last three years the number of places in freshman medical classes has been growing by 400 to 500 each year. A major factor has been the Health Manpower Act of 1965, which first provided direct Federal support for medical education. In the period just before the passage of this Act, new places were being added at an average rate of only 92 per year.¹⁷

John Millis, in his prestigious report,²² says,

What is wanted is comprehensive and continuing health care, including not only the diagnosis and treatment of illness but also its prevention and the supportive and rehabilitative care that helps a person to maintain or to return to as high a level of physical and mental health and well-being as he can attain. Few hospitals and few existing specialists consider comprehensive and continuing medical care to be their responsibility and within their range of competence; and not many of the present general practitioners are qualified to fill this role. A different type of physician is called for.

The practice of law, like the practice of medicine, now requires specialization, but in a modern law office it is a generalist rather than a narrow specialist who takes the leading role and earns at least equal prestige.

Indicative of the trend toward comprehensive health care is the statement by the President of the American Medical Association, Dr. Bornemier, that more doctors can be created in the years to come if university medical schools stop spending so much money and manpower on scientific research, if they turn their laboratories into classrooms, and if their scientists turn to practicing medicine. He proposes a drastic shortening of conventional medical training.¹⁸

There is a renaissance of interest in fam-

ily practice among medical students and a concurrent increase in the number of undergraduate family practice programs in the United States.⁸ A bill to appropriate 225 million dollars to establish departments of family medicine in medical schools and teaching hospitals has been passed almost unanimously by both houses of Congress. Of interest are the career choices of students entering Harvard Medical School. In 1966, on admission, 2 per cent chose to be "family physicians." In 1969, the figure rose to 22 per cent. In 1966, 60 per cent chose "full-time faculty." In 1969, 16 per cent did so.⁷ In a program at Santa Rosa General Hospital, affiliated with the University of California Medical School, the program for a family medicine internship now has 60 applicants for six positions, whereas five years ago the competition was almost negligible. It is also anticipated that the increasing number of so-called "minority" students will produce a trend toward community medicine when they graduate. The first-year class at the University of California Medical School, San Francisco, totals 136. Of that number, 34 are black, brown, or Indian, and at least another 10 are Orientals. The percentage of minority students entering medical schools in the United States has almost doubled in the last three years.

One might call this trend, about which so much is now being said and written, the "practicalization" of medicine, that is to say, a pragmatic philosophy which emphasizes the delivery of medical care, de-emphasizes research, and at least aims to shift the balance of energy expended in the two areas. It is important, then, to note at this point that the specialty of colon and rectal surgery is essentially a practical one, the fundamental aim of which is to provide patient care of a high degree of excellence in our field. This is by no means to say that our specialty is static, or that

continued research is not necessary. Quite to the contrary, it is in the vanguard of application of all the dynamic advances of modern surgery.

Now, while these trends toward the formation of a sigmoidal curve of specialization are occurring, the number of certain specialists has also increased. As an example, in many of the specialty fields there are specialist/population ratio curves which are quite the reverse of the positive exponential one to which I have been referring. For instance, in general surgery, the ratio of certified surgeons to population *decreased* from 1:83,000 in 1940 to 1:11,000 in 1970, and it is projected to be about the same in 1980.¹ We may anticipate that many young surgeons will enter less general fields of surgery such as colon and rectal surgery and, indeed, this is already occurring.

To determine with some degree of accuracy the actual quantitative demand for specialists in proctology, one must use a demographic technic employing "Stand Metropolitan Statistical Areas."^{12, 13, 23} Such a study of surgical manpower is now under way.⁵ However, I will refer to a report¹⁶ based on a survey which I presented before the Society in 1966, in which I pointed out that, in the previous 35 years, there had been a more than threefold increase in the number of full-time specialists in proctology, and that there had been a similar increase in the number of diplomates in the previous 16 years, but that, when one compared the number of diplomates in practice with the residents then in training programs and estimated the number of diplomates needed by 1970, the extent of the indicated shortage of diplomates could be classified as "heavy." It was then estimated that the number of diplomates needed by 1970 would be 950, whereas the number today actually is 401.

I shall not elaborate here on the success of our many certified training programs

and of our American Board of Colon and Rectal Surgery, our salutary relations with general surgery and its organizations, the exclusive recognition of our Society by the American Medical Association and governmental bodies, the attainments of our Advisory Council of the American College of Surgeons, and the persistent deficiency in teaching in the field of proctology in medical schools, or mention the ever-present and ever-increasing public demand for specialists in proctology. These subjects, while pertinent to this discussion, have been well dealt with during the past decade.

We have now seen how, historically, there has been a proliferation of specialties, including our own, which appears to have followed a well-defined curve. I have only superficially indicated the very complex factors which inexorably have determined, are determining, and will determine the pattern. As they apply to the field of colon and rectal surgery, we can look forward with confidence to increasing professional, governmental, and "consumer" recognition and demand for specialists in our area, always with the understanding that the ideal of perfection of health care can never quite be reached, but never failing to note that the top of the sigmoidal curve is not flat but is always inclining upward.

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Memoir

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