tered as chronic medication suddenly become important to us; some may block or inhibit action of anesthetics while others may supplement central or peripheral action of anesthetics upon respiration and circulation. Still other drugs in the hormonal class may lead to fatality if the uninformed administers a standard anesthetic for a minor operative procedure. These are but a few of the reasons why technical skills alone are inadequate for an anesthesiologist.

It is apparent that our specialty is becoming more medically oriented; indeed some departments of Anesthesiology have been organized within the medical rather than the surgical framework of a hospital or medical school. Pharmacologists, clinical investigators and internists are joining us as parts of a team for care and study, while surgeons undertake heroic procedures upon patients who formerly would have been denied operation. In the forseeable future more daring undertakings both in Anesthesiology and Surgery are predictable.

The additional year of training proposed by the Board should not be just another year of clinical experience nor should it be a year of isolated laboratory or investigational work. We intend that a three year program will offer a minimum of twenty-four months of experience in the administration of anesthetics and that the entire program will be integrated and progressive so that each resident will have received a specific yet liberal education in all phases of the specialty. We do not intend to train teachers or investigators within this period, but we do believe that the end-product will be a competent anesthesiologist. We realize that the cost of expanded programs will present problems but this should not be a primary deterrent to progress.

It is our firm belief that if two years of training were necessary in 1940 that by 1960 at least three years will be required to inculcate a physician with the same adequacy. In this the Council has concurred since it suggested in 1955 that the period of special training in Anesthesiology after internship be three years.

The challenge of problems in Anesthesiology must be met. Resolute leadership is needed now and in the immediate future to develop patterns of education inclusive enough to guarantee adequate training of future anesthesiologists.

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President, October 1958–October 1959
American Board of Anesthesiology

Statistics and Biometrics in Anesthesia

PROGRESS in Anesthesiology during the past three decades has been gratifying. Reports of innumerable investigations have appeared in the literature, some of which employed statistical analysis and biometry. Both of the latter are now accepted tools. However, the survey by Dunn [1] of 200 medicophysiologic manuscripts revealed that in over 90 per cent of them, statistical methods were necessary and not employed, and well over half of the papers should not have been published because of lack of statistical treatment of data. Many recent articles pertaining to anesthesia revealed that authors are unfamiliar with the use of statistical analysis and biometry in their investigations. This is not conducive to progress.

Opportunities for experimentation in anesthesiology under precise experimental design are countless. Such precision is not available in many other clinical sciences. Accordingly both clinical and laboratory researchers should be aware of the importance of experimental design, of interpretation of results and of the need for consultation with a statistician. Such consultation should be sought prior to investigation because valid interpretation of results will be dependent upon the design of the experiment.

Knowledge of experimental design and interpretation is of equal importance to the clinical anesthesiologist. Anesthesiologists, the world over, are "bombarded" by numerous reports which extoll the virtues of drugs, methods, and apparatus. To avoid an uncompromising rejection or a trusting acceptance of such claims, one must adopt criteria to enable him to make a sound, reasonable and critical evaluation of the data he has before him. An

appreciation of the importance of statistical analysis and of biometry will prove to be of immeasurable value.

What are statistics, statistical analysis and biometry? The editor of *Lancet* [2] stated that "Statistics are curious things. They afford one of the few examples in which the use or abuse of mathematical methods tends to induce a strong emotional reaction in the non-mathematical mind. This is because statisticians apply to problems, in which we are interested, a variety of techniques which we do not understand." There is no justification for this 'lack of understanding.' The word *statistic*, introduced in 1749 by Achenwall, the father of statistical science, refers to a value calculated from an observed sample with a view of characterizing the population from which it is drawn. *Statistical analysis* may be defined as a branch of applied mathematics, concerned with the study of populations, the study of variation and the study of methods of reduction of data. *Biometrics*, however, is a broader and more inclusive branch of mathematics embracing both statistical method and experimental design. Specifically, it is the science of the application of statistical methods to biological observations, or the mathematical analysis of biological data. In general, biometrics is divided into two phases: (1) the design of the experiment and (2) the treatment of data. Aside from conserving time, effort and money, the investigator can obtain a rapid and efficient analysis of data with the use of statistical analysis and biometry.

The growing significance of the use of statistical analysis and biometrics is exemplified, not only by their daily use in commerce, industry and biological sciences but also by the appearance of (a) *journals*,* (b) excellent basic *texts* [3, 4, 5] (c) scholarly *manuscripts*,[6] and (d) *courses* in medical statistics, quantitative medicine and biometry. Two texts [3, 4] and the instructive articles by Mainland [7] are highly recommended for anesthesiologists.

Certain methods employed in statistical analysis and biometry are becoming commonplace and should be familiar to anesthesiologists. However, it is the principal indication and usefulness of these methods that should be understood rather than the procedural mathematics. The cardiologist must be able to interpret the electrocardiogram properly and need not know how to repair the electrocardiographic machine. Some of these methods are: (1) X^2 (chi-square). This test may be used to determine whether an observed series of frequencies differ between themselves, or from a series of frequencies expected on some hypothesis to a greater degree than might be expected to occur by chance; (2) frequency distribution; (3) Student's *t* test; (4) mean deviation; (5) standard deviation; (6) probable error; (7) null hypothesis; (8) variance; (9) analysis of variance; (10) analysis of covariance; (11) double-blind method, and (12) ridit analysis and transformation.

Appearing in this issue of ANESTHESIOLOGY are two studies by Bellville, Bross and Howland describing their methods for evaluating antiemetic agents. The first paper is devoted entirely to the planning and design of the study as well as to the statistical methods used to analyze the data. The second discusses the results of their study and the interpretation of the figures. This work is an excellent example of the application of biometric principles. Bias was kept at a minimum. The questions to be answered and the methods of measurement were decided prior to the study. A placebo was included to define sensitivity. The approach to scoring of patients is clearly discussed and the variable factors limited. The patient population is defined. Through the use of a specific statistical analytical method—namely, ridit transformation—the resulting data were analyzed for "significance." Finally, the authors point out the limitations and inaccuracies inherent in their methods.

Statistical analysis and biometrics help the investigator eliminate prejudice and avoid predetermined conclusions. The use of randomization, balancing of samples and the double-blind method have made possible objective studies based on a high measure of predictability which are virtually free of bias and chance. How many readers of periodicals realize that the use of inappropriate statistical technique has either failed to demonstrate significance where such significance exists or has

* Biometrika in 1902, Biometrics Bulletin in 1945.

demonstrated "significance" where none actually exists?

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NEONATAL BLOOD PRESSURE Observations on the blood pressures of 20 normal, newborn infants, during the first 24 hours of life, have been studied by the sphygmomanometer method previously described. A significant fall in the systolic blood pressure has been observed. The fall ranged from 14 to 54 mm. Hg, the mean fall being 32 mm. The causes of the fall in pressure may be due to an opening up of the pulmonary vascular bed, secondary to satisfactory expansion of the lung. It may also be due to changes in the calibre of the ductus arteriosus. (*Ashworth, A. M., and Neligan, G. A.: Changes in Systolic Blood-Pressure of Normal Babies During the First Twenty-Four Hours of Life, Lancet 1: 804 (April 18) 1959.*)

INFANT DEATHS Autopsies on twelve infants who died suddenly and without apparent cause demonstrated characteristic findings in the thorax. There were petechial hemorrhages in the lungs, heart, or thymus of all; the lungs were congested, and pink frothy fluid could be expressed. Experimentally, rats were subjected to sudden blockage of the airway. A fatal apnea was found to occur within 15 to 35 seconds. Autopsy of these rats showed similar intrathoracic petechial hemorrhages and pulmonary congestion. The study substantiated the view that sudden death in infants may be the result of temporary respiratory obstruction, due to spasm of the larynx, in the presence of only local and minimal inflammation. (*Handforth, C.: Sudden Unexpected Death in Infants, Canad. M. A. J. 80: 872 (June 1) 1959.*)

FETAL HEART RATE Application of pressure to the fetal skull is associated with the transitory bradycardia that frequently is preceded and occasionally followed by momentary tachycardia. This was seen during vaginal examination, application of pessaries, uterine contractions, application of forceps, etc. Administration of spinal or caudal anesthesia did not seem to have any effect on the results obtained. (*Chung, F., and Hon, E. H.: Electronic Evaluation of Fetal Heart Rate; With Pressure on Fetal Skull, Obst. & Gynec. 13: 633 (June) 1959.*)