

SYMPOSIUM ON

EDUCATION IN
VETERINARY PUBLIC
HEALTH
AND
PREVENTIVE MEDICINE



PAN AMERICAN HEALTH ORGANIZATION
Pan American Sanitary Bureau, Regional Office of the
WORLD HEALTH ORGANIZATION

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**SYMPOSIUM ON EDUCATION IN
VETERINARY PUBLIC HEALTH AND
PREVENTIVE MEDICINE**

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PREFACE

While this Symposium on Education in Veterinary Public Health and Preventive Medicine was being planned, an expression on education in general was kept in mind: "If the learner hasn't learned, the teacher hasn't taught."

The instructor of public health and preventive medicine is first of all a teacher. The teacher speaks, but what he does speaks as strongly as what he says. To the students of veterinary public health, the teacher of that discipline is public health. The students respect the teacher who can see beyond his own image, who creates in each of them an awareness of their responsibility for the health of the people in their community. The teacher must provide knowledge of the most acceptable and recently developed principles and procedures for resolving the health problems of man that have a veterinary medical aspect.

But knowledge and experience are not enough in this discipline; it is vital that the skills learned be applicable to the mores, superstitions, and sociopolitical differences of any community. In today's borderless world, every person is our neighbor and every country is within our community. The health problems of the community today are poverty, disease, illiteracy, and ignorance. One of the paramount objectives of any future teaching program in veterinary public health and preventive medicine should be the development and implementation of a contemporary educational philosophy. From this first Symposium on Education in Veterinary Public Health and Preventive Medicine come recommendations outlining methods for instilling in students a contemporary educational philosophy aimed at achieving the optimum health of man.

HAROLD B. HUBBARD
Editor of the Proceedings

ORGANIZATION OF THE SYMPOSIUM

In October 1966 the University of Minnesota College of Veterinary Medicine extended an invitation to the Association of Teachers of Veterinary Public Health and Preventive Medicine to conduct a symposium on education in these subjects at the University. The Pan American Health Organization furnished financial support for the organization and conduct of the Symposium. Doctors Pedro N. Acha, Robert K. Anderson, and Harold B. Hubbard were designated program co-chairmen.

In January 1968 invitations were extended to the deans and professors of veterinary public health and preventive medicine of the colleges and schools of veterinary medicine in the United States of America and Canada to participate in the Symposium, and the Pan American Health Organization invited educators from medical schools, schools of public health, and schools of other health-related disciplines to prepare working documents.

Registration and a social hour were held on Sunday evening, 17 March 1968. Participants included representatives of twenty-one schools of veterinary medicine (twenty in the United States and Canada, one in Latin America), six medical schools, and three schools of public health. Federal and state agencies were represented by fourteen participants, and the United States Armed Forces by four.

The opening session was held in the Veterinary Science Building, at the University of Minnesota College of Veterinary Medicine in St. Paul, Minnesota. Dr. Donald K. Smith, Associate Vice-President, Academic Administration, University of Minnesota, who welcomed the participants, pointed out quite explicitly in his remarks the significance to the academic arena of a symposium on veterinary medical education, particularly in the fields of public health and preventive medicine.

Short presentations (twenty to forty-five minutes in duration), followed by long discussion periods open to all participants, provided a new approach to the conduct of symposia on veterinary medical education. Participants expressed favorable comments concerning this method of presentation. It was felt that more self-evaluation of each teacher's instructional program was accomplished in this manner.

The subjects for the daily sessions were selected and programmed to focus study on the constituents needed in the public health curriculum. The main topics of the public health curriculum were scheduled early in the program in order to develop discussion on *what* to teach before the several excellent sessions on biomedical communications, which engendered discussion on *how* to teach. Evaluation of the teaching-learning process was reserved until last to emphasize the fact that evaluation is equally as important as the subject matter and how it is to be presented.

The recommendations on subject content and methods for their implementation were considered during the final session. Chairmen of the various com-

mittees presented the recommendations as prepared by each committee. Suggestions for alterations, additions, and corrections were offered by the Symposium participants, and it was voted to adopt the recommendations.

A general recommendation was proposed and adopted: to develop a reference list of the recommendations formulated by the Symposium, which should be circulated to each college and school of veterinary medicine in the United States and Canada to verify implementation of the recommendations or to solicit a schedule of implementation.

To provide continuity to the efforts of the Symposium, another general recommendation was proposed and approved; to establish and support an Advisory Group of members of the Association of Teachers of Veterinary Public Health and Preventive Medicine to visit each college or school of veterinary medicine in the United States and Canada for the purpose of presenting the concepts, responsibilities, and requirements of veterinary public health and preventive medicine as expressed by the Symposium.

Dr. Pedro N. Acha, Chief of the Veterinary Medical Services of the Pan American Health Organization, expressed appreciation to the University of Minnesota for its contribution to the Symposium and stated that it was a pleasure for the Pan American Health Organization to cooperate with the Association of Teachers of Veterinary Public Health and Preventive Medicine by providing financial support for the Symposium.

Dr. Daniel Cohen, Chief of the Section of Epidemiology and Public Health of the University of Pennsylvania School of Veterinary Medicine, expressed on behalf of the Association gratitude to the Pan American Health Organization for their leadership and financial support, and to the University of Minnesota College of Veterinary Medicine for their hospitality in providing facilities conducive to intellectual concentration and expression of opinion.

An evaluation of the Symposium by the participants revealed unanimous praise for the agenda, the speakers, the method of presentation, and the conduct of the Symposium in general. It was suggested that the next such conference be held as a cooperative effort with the teachers of veterinary public health and preventive medicine in Latin America in order to promote a unified educational philosophy in the Western Hemisphere in instruction in this discipline.

In conclusion, the participants suggested that the deans, other administrative officers, and curriculum revision committees of the veterinary medical colleges and schools give serious and favorable consideration to the implementation of the recommendations of this Symposium.

During the banquet held on the evening of 18 March, the Association of Teachers of Veterinary Public Health and Preventive Medicine presented an Award of Recognition to Dr. Gaylord W. Anderson for his outstanding leadership and contribution to the education of veterinarians in public health. Dr. Anderson is Mayo Professor and Director of the School of Public Health, University of Minnesota.

OBJECTIVES OF THE SYMPOSIUM

PEDRO N. ACHA, D.V.M., M.P.H.,* AND HAROLD B. HUBBARD, D.V.M., M.P.H.†

In recent years, three Seminars on the Teaching of Preventive Medicine and Public Health in Schools of Veterinary Medicine in the Americas have been sponsored by the Pan American Health Organization: in August 1959 at Kansas City, Missouri; in August 1963 at Mexico City, Mexico; and in March 1967 at Lima, Peru.

In a sense, the 1968 meeting in St. Paul complements the meeting held in 1967 in Lima. During that meeting, at which representation was limited to the teachers of public health in veterinary medical schools in Latin America, a series of recommendations were adopted which should be of considerable interest to participants in the present Symposium. We shall mention a few of the most important recommendations. Before doing so, however, we should mention the fact that some essential differences exist regarding the importance of public health as a subject in the veterinary curriculum in Latin America. First and foremost, it must be borne in mind that the countries of the Americas are in a state of accelerated development. This is especially true of the livestock industry, which is an industry basic to the economic development of these countries. This fact in itself underscores the growing need for more veterinarians. From 1957 to 1967, a total of 25 new veterinary schools were opened in Latin America, and the number continues to increase. Secondly, a great deal more than simple attention to veterinary medical activities is being expected of, and demanded from, the graduating veterinarian. He is expected to suddenly be prepared to deal with a whole host of disease problems which in some instances have a specific relationship to the gravity of economic problems. Many times he is the only qualified professional in the public health field who not only understands the major zoonoses and other disease complexes but can interpret their significance and formulate, execute, and evaluate a program designed for their control.

In the United States the veterinary profession has had the benefit of years of experience, advanced thinking, resources, and assistance in the development of programs of veterinary public health significance. Federal and state veterinary medical services have been developing at a high level as part of a complex watchdog structure, designed to afford a quick response to the appearance of zoonoses which threaten the safety of the public or which constitute a hazard to the economic well-being of the livestock industry. Guidance has been supplied for the enactment of Federal, state, and local legislation in such

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areas as inspection of food, meat hygiene, storage, and transportation. With few exceptions (and those are in very special situations) such trusteeship over public health from the veterinary medical point of view is absent from the Latin American scene, though we must point out that this is changing. Today, as never before, the demand is for both quantity and quality, as regards the knowledge of veterinary public health expected of the veterinary medical student.

The extent to which the recommendations which came from the 1967 meeting in Lima should be borne in mind by the participants of this meeting is a matter of degree. It will be found that, to a great extent, the recommendations are entirely applicable to the North American scene. Therefore, we present for consideration the following summary of viewpoints expressed by our Latin American colleagues:

1. The teaching of biostatistics, epidemiology, and administration constitutes a basic prerequisite in the preparation of a fully trained veterinarian.

2. The health departments and livestock units of departments of agriculture at various levels of government should establish departments of epidemiology and biostatistics; furthermore, all officers of such departments who are carrying out work related to either of these fields should be adequately trained in their specialty.

3. Postgraduate courses in the subject of teaching of public health should be held from time to time.

4. Courses in public health held in schools other than veterinary medical schools should be so designed as to afford special usefulness to the participating veterinary medical graduate; and the usefulness of having a suitably qualified veterinarian in the school of public health as part of the teaching staff should be recognized.

5. The graduate veterinarian, with his adequate knowledge of public health implications of veterinary medical interest, should be utilized to the full in the team approach to solutions of problems in environmental health, zoonoses control, food hygiene, etc.

For the participants in the present Symposium, perhaps, the subject is not *what* but *how*, as it is for our colleagues in Latin America. The papers presented are intended to provoke discussion as to how best we can achieve our goals. As more and more demands are made by society and by our times, it behooves us always to anticipate the needs of the future and to define the responsibilities which fall to us. We should remember, too, that our response to such provocation is necessarily a delayed reaction. Even if we begin at once to implement recommendations, it is usually not until two to three years after (or even later) that the first results can be perceived, and it is much longer before the fledgling veterinarian can contribute significantly.

The Pan American Health Organization has continued to support efforts to meet this challenge. Now, as never before, we are conscious of the need to maintain close liaison with our colleagues in Latin America and with our sister profession of human medicine, if full use is to be made of resources for the attainment of the economic and health goals of the countries of the Hemisphere.

If a survey were to be conducted among recent graduates of schools of veterinary medicine concerning their opinions regarding public health training,

there would be a considerable variation in responses. Some would suggest that more time be spent in teaching public health; others would want to eliminate the teaching of the subject altogether. We would guess that some would agree that certain teaching programs are poorly organized and lack imagination in presentation. Departmentalization of public health activities in various schools presents almost the same state of disorganization. The public health teaching program is incorporated into the teaching of microbiology, pathology, parasitology, or almost any other subject embraced by "public health." In contrast, many schools have complete departments devoted to comprehensive public health instruction.

Hand in hand with diversity in instruction go differences in the quality of the student's background. Each of you knows the basic knowledge implanted into the students of your region. You alone are aware of the metal or steel with which you must work. Ofttimes, the tempering of this steel presents the greatest difficulty. The purpose of this Symposium is to help find newer and better ways to perform this tempering process.

To provide a protocol of instruction for every school would be a pretentious and obviously inadequate effort. Each format of instruction *must* be geared to the local philosophy and facilities. However, certain fundamental concepts and commonly accepted practices can be utilized by all.

We need to strive for a *realistic* approach to veterinary public health instruction applicable to today's needs and challenges. Concurrently, each teacher must be dedicated to a program of unified effort if we are to achieve our goals.

A unified group of dedicated teachers can present programs and resolutions calling for action that will be listened to more attentively and judged far sooner than can a few teachers individually. The implication here is not necessarily securing more curriculum time but seeking support in depth for the philosophy of the public health teaching program. At the same time far-reaching instructional resources should be provided. By attaching some slight human health significance to their research programs, some schools of veterinary medicine are able to operate vast research programs with monies obtained from the Federal health agencies. But the true purpose of some of these programs is to provide the means for research in the researchers' own discipline, some of which is quite removed from public health. While soaking up the benefits of these resources, some researchers and administrators pay only lip service to their teaching programs in veterinary public health. When observant students begin to ask why this is so, the need for administrators to correct this imbalance becomes all the more necessary.

The responsibility of public health instruction in schools of veterinary medicine should not be delegated to teachers whose foremost interests are in microbiology, pathology, or some other discipline. Public health is a discipline in itself like parasitology, medicine, or surgery. The true public health teacher who conducts research in microbiology, pathology, or immunology is to be admired, since the new knowledge he gains will be fed back into his teaching program in public health.

It is time we subjected our public health teaching to a re-evaluation. Is it a sideline activity or our primary endeavor? If it is not just a job to be accomplished with token enthusiasm, then we should request the administration to secure the services of a full-time instructor formally trained in public health.

This Symposium offers the opportunity not only for self-analysis by the individual but for an external analysis of the entire teachers' group by highly skilled teachers of medicine, public health, education, and other disciplines. Our present teaching programs should be re-evaluated in the light of the curricula and methods presented here. Some sound, realistic recommendations will be proposed by this Symposium, in line with today's needs. If we implement these recommendations when we return to our classrooms, we will have taken great strides in the direction of the optimum health of man.

**RECOMMENDATIONS
OF THE SYMPOSIUM**

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THE PROMOTION OF HEALTH

Although progress has been made since the 1963 Seminar on the Teaching of Preventive Medicine and Public Health in Schools of Veterinary Medicine, not all of the recommendations of that meeting have been implemented.

The critical shortage of personnel in the health professions has increased the demands on both veterinary medicine and public health. As a member of this "health team," the veterinarian has been asked to assume an ever-increasing number of responsibilities in the field of public health at local, state, national, and international levels. These increased demands have occurred because of both existing environmental and public health problems and increased awareness on the part of the public as to the veterinarian's ability to contribute to the solving of community health problems (e.g., serving on local boards of health).

Because of these trends and further improvements in the teaching of veterinary public health and preventive medicine, more graduating veterinarians are entering directly into full- or part-time positions with various health agencies.

If the schools of veterinary medicine are to provide the necessary leadership in these areas, then it is imperative that basic material on veterinary public health and preventive medicine be taught by faculty trained specifically in public health. It is recognized that other areas of the curriculum incorporate public health philosophy. However, it is recommended that schools of veterinary medicine establish teaching and research departments, sections, or units for the purpose of organizing and coordinating the teaching of this subject and for developing the student's knowledge and understanding of the objectives and principles of public health.

Subject matter in the veterinary medical curriculum must reflect trends in society that affect the health of man, animals, and plants. Promotion of health is as important as prevention of disease and disability.

The deans of the schools and colleges of veterinary medicine must accept the responsibility for seeing that all veterinary medical students are not only *trained* but *educated* to assess the importance and consequences of future technological changes that affect the "wellness" and "illness" of the total animal kingdom of which man is a part.

EPIDEMIOLOGY

It is vital that all students of veterinary medicine be taught the principles and practices of epidemiology, since this science is basic to all problems of disease and veterinary community medicine.

To begin with, there should be a separate course in the veterinary curriculum

on the principles of epidemiology, comprising a minimum of 30 contact hours. Preferably, this basic epidemiology course should be presented early in the student's experience.

Opportunities for formal reinforcement of epidemiological principles should be provided late in the curriculum, perhaps in connection with the teaching of preventive medicine, infectious diseases, and/or public health. This formal epidemiological training should include problem-solving experience. Opportunities for this experience should be created both in the field and in the laboratory.

Experimental epidemiological models should be developed for teaching purposes. The general availability of closed laboratory animal and poultry populations on all veterinary medical campuses, and the practical importance to veterinary medicine of studies on these populations, suggest their use for this purpose.

These courses require for their instruction the participation of veterinarians who have had postdoctoral-level training and experience in epidemiology.

Prompt, adequate attention should be given to effective correlation of epidemiological and biostatistical instruction in the curriculum.

Teachers of veterinary public health and preventive medicine should actively encourage the exchange of teaching materials, particularly those relevant to epidemiological problems. The Association of Teachers of Veterinary Public Health and Preventive Medicine should designate from its membership a teacher of epidemiology to assume the functions of collection, duplication, and distribution of these materials.

Serious consideration should be given to the possible utilization of existing extramural programs, both at home and abroad, in the training of veterinary medical students in epidemiology and related fields. The Association should make an effort to expand such training opportunities for veterinary medical students and to keep its membership adequately informed.

BIostatISTICS

The Second Seminar on the Teaching of Preventive Medicine and Public Health in Schools of Veterinary Medicine, held in Mexico City in August 1963, expressed in general terms the need for education in statistical methods. Because of the delay in implementation of the Seminar's recommendations, it is appropriate at this time to provide more specific guidelines for effecting such a program.

The impact of a resident statistical unit on the progressive development of quantitative thinking makes it essential that all schools aim for the establishment of a fully trained statistical unit in residence at the veterinary medical school. Its functions should include (1) assistance to students and faculty in the design and analysis of experiments and (2) the training of students and faculty in statistical techniques. This unit should be located within the department or section of public health, epidemiology, or preventive medicine, since these areas are the prime users of biostatistical procedures.

There are three areas in which all students should be instructed:

I. *Basic Biostatistics*

1. Population distributions
 - Binomial, Poisson, and normal distributions
 - Central tendencies (means, medians, and modes)
 - Dispersion (range, standard deviation, standard error)
2. Probability theory
3. Methods of testing hypotheses—null and alternate
 - t* tests for numbers
 - t* tests for proportions
 - chi-square
 - Analysis of variance
4. Experimental design
 - Randomized individuals or blocks
 - Greco-Latin squares
 - Incomplete balanced blocks
 - Principles of scientific methods
5. Regression analysis

II. *Vital Statistics* (Population characteristics in health and disease)

1. Natality, growth, and mortality of normal and abnormal populations; age, sex, breed, etc.
2. Rates and ratios
 - Incidence and prevalence rates
 - Case fatality, attack rates—apparent and inapparent
3. Adjustment of rates and standardization of rates
4. Comparison of rates
5. Life tables and life table methods—life expectancy
6. Sampling and sampling surveys and bias
 - Random sampling
 - Systematic
 - Stratified
 - Clustered
 - Two-stage sampling
 - Sequential analysis
 - Double blind studies
7. Validity and reliability of testing
 - Agreement
 - Specificity
 - Sensitivity
8. Data processing
 - Principles of collection of data
 - Construction of tables and graphs
 - Review of methods used in data processing
 - Hand methods (tally sheets, cards, etc.)
 - Machine methods (IBM, etc.)

III. *Statistical Applications in Other Disciplines* (such as pharmacology, physiology, microbiology, and clinical medicine; e.g., Reed-Muench, geometric means, etc.)

The first area (basic biostatistics) should have a minimum of 30 contact hours to be presented in the preveterinary medical curriculum or within the first two years of the veterinary medical curriculum.

The second area (vital statistics) should have a minimum of 16 contact hours plus an appropriate amount of time for work sessions or homework. It should be given as part of the course in epidemiology.

The third area (statistical applications) can best be left to the individual departments concerned. These departments could utilize the basic biostatistics unit as a teaching resource.

Laboratory space and equipment (calculating machines and data processing equipment) should be provided for the teaching of biostatistics. Furthermore, appropriate space, faculty positions, personnel, and equipment should be allocated for the purpose of establishing a statistical unit as soon as possible within the veterinary medical school.

It has been said that statistics is the language of modern science. Through statistics, students and graduate veterinarians alike are able to communicate with each other and with other scientists in their professional pursuits. Accordingly, statistics is an essential component of professional preparation and must receive its appropriate share of faculty positions, facilities, and curriculum time.

FOOD HYGIENE

The current era is one of great change, both in legal aspects of inspection and in food production, transportation, and processing technology. These changes are necessary to meet the demands of the consumer and to protect his health and welfare. Rapid movement of livestock, people, and goods increases hazards from exotic diseases of both man and animals.

The Wholesome Meat Act of 1967, the pending Wholesome Poultry Products Act, and the act pertaining to the inspection of fish and marine products place a greatly increased demand on inspection personnel (both veterinarians and subprofessional food inspection technicians) and on the competency of the individuals involved.

It has long been recognized that one of the major responsibilities of the veterinary profession is to assure the wholesomeness of human food products of animal origin. To meet the requirements of the increasingly complex situation it is essential that the veterinary profession assume leadership in establishing, expanding, and improving both the scope and the quality of general food hygiene and the hygiene of foods of animal origin in particular.

To fulfill the responsibilities of the profession and achieve our objectives, the following recommendations should be implemented: that the Association of American State Boards of Examiners in Veterinary Medicine and the National Board of Veterinary Medical Examiners re-evaluate coverage of food hygiene in their examinations; and that questions related to food hygiene emphasize scientific knowledge of principles or concepts rather than the ability to perform techniques of food inspection. The Association of Teachers of Veterinary Public Health and Preventive Medicine should be requested to provide the examination questions. Currently, there is a great lack of uniformity among states in the scope of coverage of food hygiene in the examinations. Further, in examinations both by the states and the National Board emphasis is frequently placed on minutiae of techniques of inspection rather than on a knowledge of principles and concepts.

The curricula of the veterinary medical colleges and schools must include fish hygiene in the food hygiene program. The role of fish as a protein source is increasing tremendously, in part because fish farming is coming more into

use. Fish raising, fish harvesting, and diseases of fish are subjects which are receiving close scrutiny by marine biologists and wildlife scientists. The wholesomeness of fish and marine products should be the concern of the veterinary food hygienists.

The veterinary medical profession has to assume its role of leadership in the proper use of chemicals and other substances which may affect the wholesomeness of foods of animal origin and also influence human and animal ecological factors. Drugs, biologics, herbicides, insecticides, rodenticides, antimicrobials, and other chemicals and biological substances are being used in ever-increasing frequency for diverse purposes, requiring a constant revision of acceptable tolerances. Many new compounds are being developed and used. The full impact on man and animals, on the ecology of both human and animal diseases, and on the environment has not been accurately and fully assessed. Residues in foods of animal origin and the solution of problems associated with them are logically veterinary medical public health responsibilities.

Schools and colleges of veterinary medicine should begin to provide intensified, in-depth training in principles and practices of food hygiene at the Master's and Ph.D. degree levels for those veterinarians who will be required to assume positions of responsibility in teaching, administration, and supervision of food hygiene activities. Schools and colleges of veterinary medicine are the logical educational institutions to assume leadership in providing such graduate training for developing the necessary expertise for veterinarians engaged in this area of veterinary medicine, so vital to the health and welfare of man and to the control, prevention, and eradication of diseases of animals.

Continuing education courses in food hygiene should be made available to veterinarians engaged in food hygiene. These courses are necessary to properly inform interested persons of new developments concerning diseases, toxicology, emergencies, and disasters, and other topics. This training will provide expertise to help safeguard the health of man and animals.

Course offerings in all aspects of veterinary food hygiene in the colleges of veterinary medicine should be formulated with more uniformity. They should be strengthened, improved in quality, and modernized and their subject content scientifically oriented with less emphasis on mechanical techniques. Current and pending legislation demands uniformity of competence of graduates of all veterinary medicine schools and colleges throughout the United States and Canada. Since the shortage of veterinarians will require them to participate in an appropriately comprehensive professional capacity, the training must of necessity provide the veterinarian with a higher level of professional competence in the area of food hygiene.

Microbiological examination should be properly applied in monitoring sanitation procedures and food processing activities in food plants. Eventually this may lead to the establishment of ranges of microbial content as one of the criteria for judging the wholesomeness of foods. Organoleptic examination is no longer sufficient owing to the complexity of food processing. Furthermore, the effectiveness of sanitizers in food processing plants can be evaluated only by microbiological examination.

Techniques of inspection must be subjected to a continuing evaluation and re-evaluation to ensure the most effective utilization of personnel and the application of new techniques and concepts in control systems. Techniques of inspection as currently applied are essentially the same as when veterinary

medical inspection was first instituted. However, profound changes in disease patterns of man and animals and in food processing techniques have taken place. Under certain conditions, meat and poultry inspection could be based on a continuing survey of the health conditions in the production unit as a supplement to ante-mortem and post-mortem inspection in the slaughtering plant. This would not only protect the consumer but would also contribute to the prevention of diseases in food animals. It should also be pointed out that principles of statistical quality control have not yet been generally applied in the inspection of foods of animal origin and should be given serious consideration.

Job specifications for inspectors of red meat and poultry need to be changed in order to establish as a prerequisite certification of completion of an approved two-year course in food inspection or its equivalent. The curriculum for a two-year food hygiene course for the training of subprofessional technicians should be developed by a committee appointed by the Council on Education of the American Veterinary Medical Association. The curriculum for such a two-year course should be under the supervision of a veterinary food hygienist, and uniformity of curriculum content for these courses should be assured.

Certification of veterinary food hygienists by the American Board of Veterinary Public Health is essential to ensure the quality of training. The Board should study the matter of the certification of subprofessional food technologists with a view to the development of this specialty. The more sophisticated techniques of inspection require a better-trained, more capable inspector. If veterinary food hygienists are to assume a totally professional role in the food hygiene program, the inspector of meat products must have increased competence and ability.

ENVIRONMENTAL HEALTH

The initial objective in teaching veterinary medical students the practice of environmental health is to make them aware that the health of animals, plants, and man are significantly related to the quality of the environment. The ultimate objective is to improve the quality of the environment for the well-being of mankind.

Environmental influences on health include physical, chemical, biological, and sociological agents. Technologists in agriculture and industry are causing shifts in host-agent relationships which in many instances are detrimental to health. The student should be trained to assess the consequences of new technologies as they affect society generally and the practice of veterinary medicine specifically. Pollutants, as related to the population explosion, are increasing in the environment at an alarming rate. Control of these agents has become a responsibility of all informed persons, particularly members of the medical professions. The understanding of the concept of environmental hazards should be established early in the veterinary curriculum, or even in the preprofessional years. Training in environmental health practices should be integrated in all of the veterinary medical curricula, but should be specifically covered in a department of veterinary public health or community medicine.

We recommend that the teaching of environmental health practices include consideration of the following: animal and human wastes; air and water pollutants; ionizing radiation; environmental stresses from overcrowding, inadequate housing, and high noise levels; occupational and institutional hazards; accidents; food and residues in foods; drugs; recreation-created hazards; disasters (natural and man-made); and vectors.

Plans for the study of these factors should encompass: research; legislation; inspection standards; enforcement; incentives; systems analysis and evaluation; demography and land usage; sociological and aesthetic considerations; and forensic medicine.

Teaching methods and techniques for presenting this material should include: lectures; field and laboratory exercises; demonstrations; visual aids; externship programs; visits to environmental health agencies; performance testing, and problem-solving situations.

A curriculum including the above considerations would not only make each veterinarian aware of his increased responsibility as a citizen but would help him to successfully carry out his role in society by providing him with an understanding of:

- The fundamentals of ecology;
- The fact that good and bad changes of our ecologic equilibrium are often very subtle and difficult to measure;
- The "natural" and "man-made" factors affecting health and disease;
- The effect of man's technological impact on man-animal relationships;
- The socioeconomic-political implications of controlling and preventing environmental hazards to optimum health;
- The fact that multiple causes are involved in environmental health problems;
- The interdisciplinary approach to problem-solving;
- The use of the scientific method in assessing the effect of the environment on host-agent relationships; and
- Iatrogenic disease conditions.

VETERINARY COMMUNITY MEDICINE

In view of the rapid changes in society in the last 50 years—including modifications in scientific knowledge, migrations of the general population from rural to urban areas, diversities in the aspirations of the people for better health care, alterations in the functions of veterinary medical practitioners, and transpositions in educational aims—it is suggested that the administrative officers and executive faculties of colleges and schools of veterinary medicine recognize these changes by giving serious consideration to the following recommendations.

The role of the veterinarian in society and the health care field should receive more emphasis in the veterinary medical school curriculum.

Specific departments of veterinary public health and preventive medicine should be created in colleges and schools of veterinary medicine. It is assumed that such departments will be given administrative, faculty, secretarial, and budgetary support.

"Joint academic appointments" should be given to qualified and interested public health professionals in schools of medicine, schools of public health,

and schools of allied sciences, particularly engineering. Ordinarily, this joint appointment does not require an additional salary or partial salary commitment.

Trained and interested public health professionals in local, state, and national health agencies should be given "clinical faculty appointments" in the department of veterinary public health and preventive medicine. These clinical appointments do not ordinarily require salary funds.

Such departments are to be responsible for presenting either alone or in cooperation with other departments in the veterinary medicine school or college, such course content as biostatistics, epidemiology, community and veterinary public health, food hygiene, regulatory or preventive animal medicine, and environmental health.

These departments, in addition to undergraduate instruction, should sponsor a "total educational program" of graduate and resident study in veterinary public health and preventive medicine, with emphasis on continuing education for practitioners of veterinary medicine. This instructional program should contribute to the preparation for certification by the American Board of Veterinary Public Health.

A large part of the teaching of veterinary public health and preventive medicine can best be done by using the community as a laboratory. Therefore, such departments should establish for undergraduate veterinary medical students practical field training in health departments and in regulatory agencies, and with the utilization of owned herds. These field training assignments may be on a local, national, or international level.

The department of veterinary public health and preventive medicine should emphasize the concept of disaster preparedness to the undergraduate student. It is important that the student recognize the responsibility of the veterinary medical profession in the multidisciplinary effort of a post-disaster period.

FIELD TRAINING

The responsibility for teaching and research in the disciplines of preventive medicine and public health should be delegated to a section in the departmental or curricular structure of a college or school of veterinary medicine. In these areas, programs of field training in which the student is actively involved should be developed. Participation should be supervised and directed by a qualified instructor with faculty rank assigned to the preventive medicine curriculum. The college administration should give consideration to faculty assignments in order that an adequate faculty-student ratio will allow development of such field training.

The following types of facilities are suggested as appropriate for utilization in field training: available university facilities (food, health, and animal); cooperating local, state, Federal, and international health agencies and laboratories (for example, public health and animal health diagnostic laboratories should be utilized in the teaching processes to familiarize the student with the available services, diagnostic tests, specimen processing, and data gathering; also, laboratory personnel will help promote the philosophy of value gained by cooperation between them and the private and public veterinary medical

practitioner in reporting both human and animal diseases); animal health agencies and laboratories; all types of food establishments and food processing plants; animal holding and handling facilities (zoos, dog pounds, laboratory animal facilities); and animal production units (farms, feedlots, etc.).

An appropriate amount of time from the total college curriculum should be devoted to the increasingly important area of preventive medicine and public health. Considering the utilization and application of the professional capabilities of a graduate veterinarian, whether in private or public practice, an adequate amount of time for this specific area of teaching would be one-third of the total curriculum time available in the third and fourth years. An appropriate portion of this time should be devoted to field training.

BIOMEDICAL COMMUNICATIONS

The Symposium endorses the following report by Dr. Robert Getty, which was published in *The Proceedings of the 104th Annual Meeting of the American Veterinary Medical Association, 9-13 July 1967*:

The 14th annual meeting of the Audiovisual Conference of Medical and Allied Sciences was held on July 18-19, 1966, at the Washington Hilton Hotel, Washington, D.C. This conference meets annually under the auspices of the National Audiovisual Association at its annual convention.

The Conference membership includes the Council, made up of representatives from nonprofit medical and allied science organizations, and associate and individual organizational members. A total of 96 registrants, in addition to Council members, attended the 1966 meeting.

The first day of the meeting was devoted to reviews of the audiovisual programs of the respective professional associations represented. Each attending member of the Council gave an oral report and submitted a written report to the Secretary of the Conference. The reports of the respective professions represented emphasized, as in past years, the sophisticated programming and the tremendous amount of time, energy, and money being expended in the general area of audiovisual education by the health-related professions.

The remaining one and one-half days of the Conference were devoted to papers and discussions of the following topics, all presented by nationally recognized authorities in their respective fields: the multimedia approach; designing educational facilities for best use of audiovisuals; television, versatile servant of the health sciences; curriculum courses on educational television; the 8-mm cartridge film for programmed instruction; the potential for research in biomedical A/V education; mental health film forums; communicating to world's medical scientists; medical tapes; remote dial selection of video and audiotape.

Recommendations for the future. In view of the information explosion and the limited time available to impart this information, the shortage of faculty and trained personnel, the increased student enrollment, and the fact that the veterinary profession is playing a more and more important role in world health and agricultural and economic welfare, a more effective means of presenting information seems imperative. The effectiveness of audiovisual methods in biomedical communication has been well documented and proved over the years by our sister health professions.

Some national central agency or council of the AVMA, or both, consisting of several full-time professional personnel, should be delegated responsibility in the general area of biomedical communication. These individuals, committee, or council could ascertain

the status of audiovisual material, not only in the veterinary profession but in all allied health-related professions as well, and advise the AVMA and its constituent state associations and educational institutions relative to the many facets of audiovisual education. The activities could be coordinated with those of the Council on Education, Council of Research, and the American Association of Veterinary Medical Colleges.

Their duties would encompass serving in a liaison capacity between medical communicators at the college and university levels in all matters pertaining to audiovisual education and research; ascertaining the ideal objectives of postgraduate veterinary medical programs at a national level, and coordinating such activities at a state and local level through audiovisual methods; indexing, summarizing, and codifying all available audiovisual material as it pertains to the veterinary profession; circulating an annual report and questionnaire to institutions throughout the United States; keeping all abreast of new films contemplated or in production, the availability of videotapes, kinescopes, 5-minute concept films, programmed material, and other audiovisual aids and tools; working at a national and local level, using audiovisual methods and media in the continuing education of our profession; coordinating the audiovisual activities of the AVMA central office at local, state, and national levels as well as with the audiovisual activities of our sister health-related sciences.

It should be noted that similar recommendations had been presented to the deans of schools and colleges of veterinary medicine as early as 1956 (Getty, this volume, Ref. 3).

To help achieve these goals in biomedical communications in the schools and colleges of veterinary medicine, the following recommendations should be given serious consideration.

The dean of each school or college of veterinary medicine should include, as part of the duties of an assistant or associate dean (or a director appointed for the purpose), the development of biomedical communications for the college. This person should be assisted by a committee of interested faculty members. He should be provided with a budget and empowered to seek additional funds to support this work.

This committee should include as a part of its responsibility the development of competency in areas such as educational technology (including methodology and objectives), photography, the graphic arts, information retrieval (including retrieval of literature and demographic information) and medical illustration. The committee should obtain full-time personnel as soon as possible to expedite the development of these special areas.

It is further recommended that this committee develop channels through which members of the faculty and the profession (via continuing education or other methods) will be informed of the newer concepts of teaching and instructed in the use and operation of equipment and procedures related to the biomedical communications field.

The Symposium recommends the exchange of biomedical communications teaching materials among schools and colleges of veterinary medicine, and advocates the concepts of EDUCOM, CIC, and WICHE as examples of the spirit of exchange of information with other institutions.

The Symposium recommends that each college make an immediate and serious effort to develop biomedical communications teaching materials and that any future Symposium on Education in Veterinary Public Health and Preventive Medicine devote a portion of the program to the review of recently developed materials.

GENERAL RECOMMENDATIONS

Establishment of An Advisory Group

In consideration of the sincere efforts of the Symposium participants and the complex problems faced by the individual schools and colleges of veterinary medicine, a specific method of actively supplementing the publication and implementation of the recommendations formulated at this Symposium should be initiated. It is recommended that an Advisory Group of members of the Association of Teachers of Veterinary Public Health and Preventive Medicine be established and supported financially so that this group may schedule visits to each school and college of veterinary medicine for the purpose of presenting, by the most direct method possible, the concepts, requirements, and obligations of veterinary public health and preventive medicine as expressed during this Symposium.

Development of a Reference List of Recommendations

In order to focus emphasis on the efforts of the teachers of veterinary public health and preventive medicine in their endeavor to implement the recommendations formulated by the Symposium, a reference list shall be prepared that incorporates every recommendation. Each school and college of veterinary medicine in the United States and Canada shall receive this reference list so as to determine which of the recommendations have been adopted in the curriculum and to what degree.

The replies from the various schools and colleges will be consolidated into a master reference list, which will be reproduced and made available to editors of journals in the field of veterinary medicine, to the Council on Education of the American Veterinary Medical Association, the Association of American State Boards of Examiners in Veterinary Medicine, and the American Board of Veterinary Public Health.

As an additional aid to the teachers of veterinary public health and preventive medicine in implementing the recommendations and in improving their teaching programs, instructional resource material will be compiled and registered. A registration or catalog list of all this material will be printed and circulated to each school or college of veterinary medicine in the United States and Canada.

Part I

THE VETERINARY PUBLIC HEALTH CURRICULUM

TEACHING PROGRAMS TO MEET PRESENT AND FUTURE NEEDS

THE PUBLIC SERVICE VETERINARIAN

ERNEST E. SAULMON, D.V.M.*

Economists stress that the heart of their problems lies in trying to plan for the most effective use of resources that are never adequate to the demand. It seems to me that this is the type of situation confronting us in this Symposium.

We all know that the explosion of knowledge in recent years has affected veterinary medicine as well as the other sciences. From the standpoint of teaching programs, the problem is one of deciding which is the most important information to present, rather than how to cover all that a professional student should really have.

Given the variety of specialties that a veterinarian may elect, the basic professional curriculum obviously cannot fully prepare a graduate for a lifetime career in all of these fields. It would appear, therefore, that the preparation must lay a strong basic foundation from which to advance, with the concurrent aim of giving the student an understanding of other fields within the profession so that he can relate his chosen activity to those of the specialists he must work with, in our current era of interdependence.

My professional life has been spent in

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the Animal Health Division of the U.S. Department of Agriculture, an organization devoted to large-scale public programs of animal disease prevention, control, and eradication. There are at present in the neighborhood of 800 veterinarians in our organization; a comparable number comprise the state organizations with which we work cooperatively. Approximately 13,000 veterinarians in the United States are accredited to perform professional services in connection with our activities, so this field of effort is one that has a direct relationship to most members of our profession in this country.

One important factor in basic foundation training for this field is presenting the concept of disease prevention. This is important in many fields of veterinary medicine. In our field it is vital.

To be effective, the public service veterinarian in the animal health field must understand how his work relates to a total population. Though he may work in some programs with the individual animal, he must have the perspective to see beyond the animal or the herd—or the county or even the state. We are increasingly convinced that the real professional, in our work, must be able to visualize how his activities fit into the very large and very complicated

network that makes up our modern livestock industry.

The public service veterinarian needs to go further. He needs to recognize that he is in an action situation and that his technical ability, even in terms of this total population awareness, must be translated into a program that produces measurable and beneficial results—and that he will be judged on these results.

This is a stimulating and challenging demand and one not easy to learn; therefore, it is important that it be an early and significant part of professional preparation.

This does not mean that the basic medical disciplines have decreased in importance in our work. The need for these is even greater than before, and this need will grow. Our veterinarians, as those in other fields represented in this Symposium, use more of their basic veterinary education than ever before. To these we now must add as broad an appreciation of epidemiology as can be packed into the already crowded curricula.

Given an understanding of the concept of preventive medicine, the tools of our trade are closely allied with what we call epidemiology—although I suppose epizootiology would be more precise terminology for most of our work. For this reason, we applaud the great progress made in adding an appreciation of epidemiology to undergraduate instruction. We hope there can be more. Here again, we recognize that there are limits to what can be covered in a four-year period, but epidemiology is so closely related to preventive medicine, which is so much a part of either public or private veterinary practice, that it is an area of great value to most graduates.

The importance of epidemiology to our work is illustrated by the fact that in the last six or seven years we have conducted basic epidemiological orientation courses for more than 800 state and Federal veterinarians. We have depended heavily, in

these cases, upon faculties from several universities; our demands upon the University of Minnesota have been as great as, if not greater than, for any other institution.

We know that basic orientation is not enough—which is why we have sent, and will continue to send, selected veterinarians back to the university for graduate training. But the stronger the emphasis placed on epidemiology at the undergraduate level, the better the foundation for professional life.

There is another area of increasing importance, and that is an understanding of disease conditions exotic to our livestock population. In our work in the Animal Health Division we are of necessity becoming internationally minded. It is a cliché to say that the world is getting smaller, but in relation to foreign animal diseases it is nonetheless true. We no longer have a lengthy built-in quarantine period aboard ship for animals coming to this country, and we are no longer reasonably self-sufficient in terms of animals and animal products. We imported in excess of 900,000 live animals and over a billion pounds of animal products last year.

So these foreign animal diseases are not something to be mentioned in passing during a pathology course—as was the case when I was in school. They are knocking on our doors every day, and there is no way to put a guard on every door to ensure against their entry. While our system of safeguards at points of entry has been to date quite effective as a first line of defense, the pressure grows and will continue to grow.

Our livestock industry depends on the veterinary profession as a second line of defense to rapidly detect any exotic agent that may enter. Our division maintains about 80 specially trained veterinary diagnosticians at strategic points throughout the country with a primary mission of

immediate investigation of suspected exotic disease conditions. In a normal year, we conduct several hundred such investigations, but the heart of a successful effort in this direction is not these few trained men but the alertness of the thousands of veterinarians on farms and their awareness of every case that looks "different."

So it is important that veterinary students learn the nature of foreign animal diseases and develop an awareness of the danger they pose here. It is important that they carry such knowledge away with them upon graduation.

One of the strong unifying factors in any profession is a common basic educational background. This rules out excessive spe-

cialization in early academic training, and properly so. In our field, as in others, we want a man with a broad basic foundation in veterinary medicine. We are not interested in technicians. Recognizing the absolute necessity of continuing education throughout a working lifetime, we want men who are capable of continued growth.

In recognizing the primary need for training in the basic sciences, I have mentioned three areas that appear worthy of consideration: preventive medicine, epidemiology, and, especially, exotic diseases. All three are important as preparation for the public service veterinarian and also, I believe, for the majority of graduates, no matter what field they elect to enter.

TEACHING PROGRAMS TO MEET PRESENT AND FUTURE NEEDS

A VETERINARY MEDICAL SCIENTIST TRAINING PROGRAM*

JAMES H. STEELE, D.V.M., M.P.H.†

Veterinary medicine is capable of fulfilling a more significant role in the future. In order to attain this role, a clearly identifiable program should be developed which is aimed (1) at the attraction of a few excellent scholars from each participating veterinary school into the veterinary medical sciences, and (2) at the establishment of well-demarcated but flexible pathways by which the developing young scientist can obtain appropriate combinations of scientific, medical, and veterinary training needed for a research and/or academic career. For the first five years the program should be clearly experimental in nature since, of necessity, this is an undertaking that not all veterinary schools would be in a position to undertake at this stage in their development.

An important aspect of the proposal would be the development of a veterinary associate program through which the research training of the veterinary medical scientist could be continued while he is in the government service.

The veterinarian, like the physician, is subject to a rather rigid curriculum during his didactic training. The physician's train-

ing has two directions: the first in the basic science disciplines, and the second in the clinical specialties. Veterinary medicine, on the other hand, has a third dimension in the application of scientific and medical knowledge to a variety of animal species. Because of this third dimension, the veterinary curriculum is perhaps even more crowded than the medical curriculum and more difficult to compress. However, as a result of this dimension, veterinarians are in a position to introduce a comparative approach into medical research which is of definite value.

Veterinary medical scientists can contribute to medical research in a number of ways:

1. *In basic research*, in which veterinary medical scientists can utilize their scientific training for research in the area of comparative medicine, utilizing a wide variety of animal species with which they are familiar.

2. *In veterinary pathology*, because of their common interest with pathologists in animal diseases as models for human disease.

3. *In clinical investigation* in many areas of clinical medicine, in experimental surgery, and in other clinical subspecialties.

4. *In medical research and public health administration*, as the result of their broad knowledge of medicine and disease and

* Reprinted from Appendix C of "Career Development for Veterinarians," Career Service Board for Veterinarians (James H. Steele, Chairman), Department of Health, Education, and Welfare, 21 June 1968.

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their depth of training in a given scientific area.

In considering the development of a veterinary medical scientist training program, one must be aware of the differing state of the evolution of veterinary medicine as compared with human medicine. Whereas human medicine has reached a high degree of specialization during the past half-century, veterinary medical practice is still in a relatively unspecialized state, with far greater involvement of most veterinarians with general practice. Because of this difference it may not be feasible at this time for veterinary schools to attempt the same types of revisions in their curricula that medical schools are undertaking today.

Program Plan

The goal of the veterinary medical scientist program would be the development of a flexible program which provides the trainee access to the appropriate basic scientific and clinical training that he will need to develop his career along a clearly defined path. The breadth of his veterinary training will provide considerable latitude in this effort and will enable him to cross discipline lines in ways that are not readily achieved by basic scientists. His veterinary experience will provide a depth and richness of experience to clinical investigation that is different from that commonly available on the medical scene.

Students should be able to enter the program at various stages in their career: after the first two basic science years of the veterinary curriculum; immediately after D.V.M. training; after military service training; or during midcareer training.

The veterinary medical scientist program should concentrate primarily on freeing as much time as possible for the individual

trainee through his veterinary medical years, enabling him to initiate his scientific training and to begin to define his career goals within the biomedical sciences. Training initially should focus on the development of research competence in the basic sciences, with later training provided as needed in appropriate clinical areas. An additional period of thorough and rigorous research training should be provided during the postdoctoral years. In any case, the total training period should be approximately four to six years to assure adequate maturation of the trainee as a well-trained scientist. Training grants should be reviewed by a committee composed of veterinary medical scientists and scientists from appropriate basic science and clinical disciplines.

In-Service Training

With regard to in-service training, the following points merit particular consideration:

1. A certain number of positions should be specifically assigned to this program for in-service scientific and research training.

2. The in-service aspect of the program should be operated under the guidance of a committee or board composed of representatives from the Career Service Board for Veterinarians of the Department of Health, Education, and Welfare and an equal number of carefully selected representatives from veterinary and medical schools who can assist in the definition and development of the program.

3. The period of obligated service in return for in-service training should be carefully considered and kept as short as reasonably possible so as to enhance the attraction of outstanding veterinarians to the program.

4. An important in-service aspect of the

program would be the development of a veterinary associate program, which would enable veterinary officers to continue their research training at the National Institutes of Health, the National Communicable Disease Center, or at other appropriate loci within the Department of Health, Education, and Welfare. The identity of a special program for veterinarians within the service would help attract outstanding young

veterinarians—if its quality is kept very high.

5. The need for quality within the veterinary medical scientist program is paramount, and the primary goal of the program should be to attract outstanding students into the program and to give them superb training for a scientific career within government, within veterinary schools, or in other biomedical research settings.

TEACHING PROGRAMS TO MEET PRESENT AND FUTURE NEEDS

AN AIR FORCE VIEW

EDWARD L. MENNING, LT. COL. USAF, VC *

There are several recommendations that I should like to make concerning teaching programs to meet the current and future needs of veterinary public health.

First, several basic tenets must be accepted:

1. The *raison d'être* of the veterinary profession is the over-all well-being of man—not animals.

2. Disease is a unit. In our borderless world, subject to foot-and-mouth disease pollution as well as to air pollution, when one species is affected, others will be also.

3. Veterinary education, by omission or commission, is building "cash technicians" rather than professionals who are truly interested in animal disease as it relates in the broadest sense to public health.

4. We are members of a team of health professionals.

What educational programs or philosophies are required to meet the needs which logically flow from these tenets?

Aside from our reason for existing, let us look at a few figures:

- One-third of our profession in the United States is engaged in other than private practice; the majority of veterinarians are in health specialties aimed di-

rectly at maintaining or promoting human health.

- At any one time there are more than 1,000 veterinarians in military service.

- Of the approximately 900 veterinary graduates each year the military utilizes several hundred for at least a two-year period.

What can veterinary colleges do to better prepare these individuals to meet the needs of society whether in the Air Force, private practice, or other direct health support endeavors? From my point of view (in the Air Force) a change of emphasis in various subject areas is needed.

Rather than instill a philosophy in students that the animal patient is an individual entity, we should stress that the animal is protein nourishment for man (this fits in with our civic action programs in the Air Force). It should also be stressed that foreign animal diseases could cripple parts of our society (the Air Force is concerned because of the many military aircraft that enter the United States from other countries). Pet owners must be made aware of the disease potential when a zoonosis is encountered (Air Force clinics are based solely on zoonoses). There is a psychological need for pet owners to have a better understanding of their pets' health in general. Most laymen are aware of the

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danger of rabies, but their knowledge of animal diseases stops there.

The reporting of morbidity and mortality information should be encouraged. Involvement in epizootiological investigations should also be encouraged, as should liaison with other members of health service teams. Veterinarians have been individualists and isolationists by tradition. We have dug our own professional rut. In the counties where I and two other members of our staff have been stationed, the only monthly morbidity and mortality totals for the state have been our totals. (Evidently none of the other 6 to 12 practitioners in the counties diagnosed any reportable conditions.) We should be very willing to advertise and educate by speaking to any group in our community and by privately discussing mutual areas of concern with members of other professions.

Additional enlightenment in the areas of environmental health principles in food hygiene and sanitation, sanitizers and disinfectants, and water and air pollution would be invaluable for veterinarians in private practice, for part-time public health veterinarians, and for members of boards of health. I am constantly amazed that new students know little if anything about the principles of chemical or heat disinfection, yet this is basic to modern clinical practice, not to mention public health sanitation.

Laboratory animal medicine is vital to progress in medicine, yet what is taught today?

Better teaching methods are needed. These can be effected if public health teachers will:

- *Deemphasize the tradition of spilling*

out repetitious facts and encourage thought by discussing principles. Albert Schweitzer once said, "Our age has discovered how to divorce knowledge from thought." The student should be able to *correlate* facts so they can effectively solve new and unfamiliar problems. Memorization courses—such as anatomy, embryology, learning which lymph nodes to incise on post-mortem inspection—should be re-evaluated as to time spent for value gained.

- *Exemplify professionalism in public health.* Our students feel that public health is beneath them, yet the "giving of shots," which consumes a good percentage of their time in practice, is a professional public health procedure.

- *Discourage isolationism.*

- *Form dynamic teaching programs.* The typical veterinarian fights with vigor against unqualified persons diagnosing, treating, or even "giving shots"; nevertheless he usually considers himself qualified, without any preparation, to teach and test students. It should be obvious that there is more to teaching and learning than listening to a 50-minute lecture of facts delivered in a monotone. We in public health cannot change school policy but we can personally avail ourselves of all types of courses which could teach us to teach better. We must learn to:

Motivate

Profitably use training aids

Exude interest

All of which requires teaching plans that are focused more on student learning and less on lecturing and grading. Colleges should *educate* the student.

TEACHING PROGRAMS TO MEET PRESENT AND FUTURE NEEDS

AN EPIDEMIOLOGICAL APPROACH

PAUL R. SCHNURRENBERGER, D.V.M., M.P.H.*

One method of analyzing the problem of programs in teaching to meet present and future needs entails the epidemiological approach—visualizing the agent as the instructor, the host as the student, and the environment as the school or curriculum.

The Agent

We have long been concerned with establishing qualifications of the teacher as an expert in the field of preventive medicine or public health. Unfortunately, this has on occasion resulted in neglecting the fact that he is primarily a teacher and only secondarily a preventive medicine expert. We must recognize that in today's society it is vital for each person to be truly competent in his specialty. Further we must realize that, with the present overloading of curricula, there will be less and less time available to present more and more material. It then becomes obvious that the teacher must make maximum utilization of the teaching opportunities available. It is vital that the time spent with the students be a genuine learning process and not a mere exposure to facts.

It is further important that the agent, or teacher, realize the importance of, and

accept, his responsibility in motivating the student to learn. The teacher is the initial contact which most students have with the field of preventive medicine and public health. If this exposure leaves him with a sense that the field is exciting and important, we will have progressed a great distance toward changing the image of public health and preventive medicine from that of a professional area which collects only the dregs of veterinary medicine to one which requires vision, foresight, and a degree of competence unsurpassed within the profession. Then it will no longer be considered merely as a last resort for those who have failed at all other phases of veterinary medicine.

Further, one of the most effective ways of recruiting individuals into a specialty is to provide them with an attractive image. The teachers must be such that they will encourage students to follow their example. An interested student automatically enters the high-risk group for future enlistment. This in itself is the greatest opportunity for recruiting available to us.

The Host

Every day there are more graduate veterinarians entering the field of preventive medicine or public health as a full-time specialty; however, it is important for us

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to remember that the majority of these individuals enter and leave veterinary college with the sole intent of entering private practice. Therefore, it is far better to instill in the student a sense of responsibility to society and an awareness of his role in the community aspects of preventive medicine than to try to convert him to a public health specialist. Regardless of his area of specialization after graduation, there will be countless opportunities to practice preventive medicine, since it is one of the important foundations of the total veterinary education process. It is much better that we have an entire class of practitioners leaving the college with a full awareness of their responsibilities in this area and a complete understanding of the principles of preventive medicine than it is to have one specialist in a class while the other members have only a small understanding of, or worse yet, an active distaste for the field.

The Environment

This approach requires that we avoid an environment, or curriculum, full of regulatory details aimed at producing a specialist in public health. Rather, we must first provide the student with broad principles of preventive medicine that he can use after graduation, regardless of whether he enters preventive medicine, commercial medicine, or private practice, and becomes a zoo veterinarian, a laboratory animal specialist, or what have you. After this has been accomplished, specific, detailed information can be filled in as time permits.

Since these principles are to apply to every phase of veterinary practice, private or otherwise, they should be taught throughout the curriculum and not restricted to courses labeled "preventive medicine." Preventive medicine and public health must be taught as principles rather

than courses. This necessitates close coordination with other faculty members and a total awareness of the contents of courses.

Again, we must keep in mind that each area cannot be covered in equal detail. There is little logic to teaching detailed local or state regulations which will vary with the students' location. With the proliferation of information which we are encountering in this age, we must realize that what is being taught today will be discarded as obsolete or, in many instances, untrue in the near future. We are farther ahead when we teach broad principles rather than present specific detailed facts which are subject to rapid obsolescence.

Therefore, we must know now what these men will be doing in the next five years and present them with that information which will be most useful to the majority of the class. This decision must be based on projected roles to be filled by the profession, not the specific interests of a teacher. Further, it must not be guided by the availability of teaching aids but rather should be based on the needs of the students in the period immediately following graduation.

In Summary

1. We must teach efficiently to teach effectively.
2. In the eye of the student, the teacher of public health is "public health."
3. Preventive medicine is a set of concepts, not a dated collection of details.
4. Regardless of his specialty, every veterinarian utilizes preventive medicine principles daily in his work.

It is an established fact that veterinary medicine has an important role to play in the future of public health; how well we fulfill that role will be determined by what we ourselves do.

THE TEACHING OF EPIDEMIOLOGY

TEACHING THE BASIC PRINCIPLES

LEONARD M. SCHUMAN, M.D.*

For more than a decade now, I have maintained the conviction that the science of epidemiology may readily be taught to veterinary medical students, for much of their curriculum is dedicated to the concept of the herd, which in a real sense is one of the types of population that epidemiology is concerned with. The experience of the past 14 years in teaching both veterinary and medical students has led me to believe that the early teaching of the basic principles of epidemiology is highly desirable in order that the student quickly recognize that he must live and work in an ecosystem in which the magnitude of occurrence of a given disease is the resultant of a multifactorial display of causes and modifying factors—of a dynamic interaction of the characteristics of the agent (or agents), the host, and the environment. It is desirable that this be done before he falls into the rut of believing that disease is invariably the result of a single necessary and sufficient agent acting on a host—an approach which is all too often, if unconsciously, the outgrowth of our microbiological regimen.

It is also important that the student realize quite early in his career that, whereas the cure of disease may have a

trace of glamour, a more realistic approach is the control of spread or continued production of disease in a population or herd, and only the epidemiologic approach can provide him with the necessary expertise for such control. Even for the practitioner who insists on the individualistic approach to diagnosis and treatment of a single member of the species, the principles of epidemiology will enrich his approach in terms of the contribution which this single case makes to the health status of the herd or species population. Without a basic understanding of these principles the practitioner cannot appreciate the relative hazard which his case represents to the rest of the population, the milieu in which the disease developed, the risk of more cases developing, and the feasibility of controlling the relevant factors contributing to the development of the disease.

It is not necessary early in the curriculum to belabor the details of the epidemiology of blocks of representative diseases. These could much more meaningfully be integrated later with other subject areas in individual disease study. What is more important is that the student very early in his career *conceptualize* the epidemiologic principles—learn early the grand overview, lest he become a slave to rote learning of a flood of details which are all too frequently meaningless to him and remain

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isolated facts rather than illustrations or examples of an integrated, dynamically interacting whole. With basic concepts clearly understood, the facts which the student *must* master become easier to handle and, more important, the student has developed the ability to understand the mechanisms in epidemiologically related diseases, through transfer and application of these concepts. With experience he can add the concentric layers of sophisticated details to the core. Disease occurrence then takes on the characteristics of a dynamic process rather than a collection of boring details and only hopefully related facts.

To accomplish these ends the principles of epidemiology must be presented for their own sake, as common-denominator truths for all diseases, or at least for groups of epidemiologically related diseases. Emphasis should be on concepts. Examples and illustrations are to be used not as facts for facts' sake but to communicate the essence of the concept. Analogies and models prove also to be quite helpful in this regard.

Although many of the principles are intentionally derived from communicable disease experience (not only because we have at this stage of our development more information in this area, but also because their meanings are conventionally easier to grasp in the infectious disease frame, examples, analogics, and models in the chronic degenerative disease area are nevertheless interwoven—at every opportunity and wherever applicable—in order to strengthen the concept and illustrate its universality.

We begin with a definition of epidemiology based on etymologic derivation. Then a sophisticated definition involving the factors influencing the occurrence of disease is presented as an elaboration on the skeletal definition; the concept of epidemiology as the science of the mass phenomena of disease is also presented by analogy. The community, the population, the herd itself

is conceived of as a living organism and the manifestation of disease in the population as akin to disease in the individual. The students are told that the epidemiologist approaches disease in a population in much the same way that a physician probes for the meaning of a presenting symptom. He is warned that the symptoms and signs of disease in a population are qualitatively different from, though analogous to, symptoms and signs in a patient. The quantity of cases is likened to the intensity of pain, for example; the geographic distribution of the disease, its differential occurrence in age, sex, racial, occupational, or socio-economic subgroups is likened to the anatomical location of the pain; and the temporal distribution of the cases is likened to the relationship, in time, of the symptom to other events in the life of the individual. The student thus comes to appreciate the epidemiologic approach as a diagnostic approach to disease in the community, population, or herd, with community control of the disease as its objective—just as the physician seeks a diagnosis in the individual in order that he may apply the proper therapy.

The agent-host-environment complex or interaction is also presented as a concept of multifactorial causation of disease by generalizing with examples rather than by monotonous, repetitive recitals of its components, disease by disease. It is at this point that the student begins to understand the reasons for the rise and fall of disease incidence. It is only when he has been shown that the magnitude of occurrence of disease in the population is dependent not only on the presence of the agent or agents, their quantity or dose, their virulence, pathogenicity or toxicity, and their infectivity, invasiveness, or penetrability, but also on the presence and influence of environmental factors such as temperature, humidity, and moisture on

the agents, vehicles, vectors, and even hosts (as well as on variables within the host, such as the competency of the reticulo-endothelial system, its prior challenges by antigens, genetic makeup, age, sex and hormonal status and race)—it is only then that the student can fully understand their interaction and disease production is a multifactorial phenomenon. In man cultural and behavioral patterns (and in animals, behavioral patterns) may, in turn, be determinants of disease and these are also shown to act via environmental factors such as socioeconomic status and personal hygiene, for example. Once this concept has been grasped and its relevancy to any disease demonstrated, the student can accept the fact that control need not be dependent solely on our ability to manipulate the causal agent but can be accomplished by manipulating modifying factors in the environment or in the host. A linear equation, deliberately simplified by noting only a few representative variables in the agent, the host, and the environment—and equating a quantity of disease—assists in presenting the logic of this multifactorial concept. It is through such an equation that the principle of eradication may be expressed, that the meaning of a necessary but not sufficient cause becomes clear. It also becomes clear how control of disease can still be achieved even when the cause of the disease is unknown. Such an equation enables the student to grasp the notion of multiple causes of the same disease as well and the principles involved in decision-making for control, including the variations possible and the manipulability and feasibility of approach.

After a cursory sketch of the agent-host-environment complex, utilizing familiar examples, the complex is dissected in more detail, still utilizing examples for illustrative purposes. The epidemiologic—as opposed to microbiologic—meanings of the

several characteristics of the agent that influences the magnitude of occurrence of disease in the population are clarified. The yields of cases with agents of high as opposed to low infectivity are demonstrated. The relationship of virulence to severity of disease and of levels of pathogenicity to the yield of cases and the proportion of transient carriers produced is presented. The phenomenon of the transient carrier becomes readily understandable by this approach via the pathogenicity of the parasite.

The student is not left with the impression at this point that, given an agent in large numbers with high infectivity and high pathogenicity, the population will be overwhelmed by disease. Although susceptibility will more logically be dealt with in detail in terms of host variables, it is at this time that the student is warned that the susceptibility of the host is a strong determinant and that disease, in the final analysis, is the resultant of a number of vectorial forces in both the agent and the host.

Although the chain of infection is the structural model upon which the discussion is based, and although I do draw upon microbiologic and clinical data as an aid in understanding, the basic approach is via the conceptualization of epidemiologic principles as they derive from the links in this chain. Thus, for example, the approach to the reservoir of disease is not through an enumeration of sources or habitats of the agents, but rather through the magnitude of the risk to the rest of the population as posed by each kind of source; and this magnitude is considered in the frame of relative risk as based upon the dose, the intensity, the number of sources, and the relative mobility of that class or source. Thus the student can be taught to disabuse himself of the preconceived notion that the severity of a case spells greater hazard to

the rest of the population or herd. It can be shown that the greater number of transient carriers and their normally great mobility provide a product of risk far greater than the relatively smaller number of severe cases with relative immobility and even self-induced isolation. In this way the reservoirs of disease, as represented by the clinical types of cases of illness and by the incubationary, convalescent, chronic, and transient carriers, are evaluated as a spectrum of risk to the rest of the population. The concept of the dependence of the size of the reservoir on seasonal and secular patterns of prevalence of cases and carriers is also introduced at this point.

Then the efficiency of the several portals of exit (in terms of organ systems and physiologic mechanics) is discussed and evaluated. Emphasis is placed here on the epidemiologic principle of the effective fraction of the reservoir, i.e., that portion of the reservoir from which the agent can escape. Multiple portals of exit for the same disease and their significance as risks to the potentially exposed population are discussed. It is here that the concept of the secondary attack rate as a relative measure of infectiousness or communicability is introduced. The student almost spontaneously recognizes the portal of exit as the first link in the chain of infection where control methods may be applied.

The study of the several modes of transmission yields a wealth of concepts with epidemiologic significance. Students are informed that the modes of transmission practical for a parasite are dependent on the ability of the parasite to survive outside the body of the host—outside the reservoir. They are told that the danger of spread and hence the size of the caseload produced is in great part dependent upon the mode of transmission available for that agent in that place and at that time. It is here that the characteristics of vehicles

and vectors are brought into the picture, and their availability and utilization by classes of agents are discussed. Also discussed at this point is the epidemiologic principle of geographic limitations of disease due to climatic, geologic, and physiographic restrictions and vector mobility (or lack of it).

In discussing portals of entry, it is emphasized that, where more than one portal of entry is possible, the form of the disease may be an expression of the portal utilized. Particularly important for epidemiologic investigation is the fact that, in a given disease, the involved part is not necessarily an indicator of the portal of entry. Even in hitherto unknown diseases, making their appearance in an area for the first time, the mode of transmission may be inferred from considerations of age, sex, race, occupational attack rates, and secondary attack rates, as opposed to the assumption of a portal of entry based on the clinical designation of the involved anatomical part.

Our next consideration in the agent-host-environment complex is the host. After some preliminary considerations of primary factors of host resistance (which include such nonspecific autarceologic factors of inherent resistance as the first and second lines of defense and the protective influence of hormonal activity—and such specific factors as humoral and tissue immunity and the antigenicity of the agents), these phenomena are blended into a synthesis of the patterns of development of immunity via natural and artificial means. The secondary factors of resistance, which include the *extrinsic* or environmental factors such as diet, fatigue from overcoming gravity or inertia, temperature, humidity, and ionizing radiation, and the *intrinsic* factors such as age, sex, and race are then discussed. From these considerations, age selection or distribution of disease emerges as one of the most dynamic of the epidemiologic princi-

ples. By discussing the roles and interactions of such factors as passive transplacental antibody transfer, relative resistance of the skin, pulmonary tree, and gastrointestinal tract, the state of the reticulo-endothelial system over age, the influence of selected pathologic states, and the concept of increasing exposure potential with age—as well as the imprint on the population or herd of previous disease or exposure experience—students realize that age patterns of disease are the resultants of systematic combinations of these factors and not some mystical maturation process.

With this background, the age distribution patterns of disease are synthetically evolved, utilizing various combinations of agent and host factors. There is presented the classic situation of a childhood disease, where the agent is endemically present, its infectivity, pathogenicity, and antigenicity are high, and there is maternal antibody transmission in utero. Variations of this theme are presented where the agent characteristics are varied to the opposite extreme but taken one at a time, with or without passive transfer of antibody. The role of occupation as modifying exposure potential is also interjected at this point, as is the effect of postponing exposure potential, with physiologic maturity a prerequisite to sexual exposure as an example. In addition to the patterns which may be evolved utilizing agents of high or low antigenicity, the students are asked to develop the age distribution pattern of diseases reintroduced into isolated island communities after years of disease absence, or introduced for the first time into any community. The reverse procedure is then utilized. Curves are drawn, and the students are asked to discuss the possibilities in terms of antigenicity and exposure experience. All in all, this provides a good experience in epidemiologic inference.

An overlay of sex differences in attack

rates on an age basis is then introduced, and the roles of both hormonal differences and differences in exposure potential between the sexes are discussed. Disparities of attack rates by race may provide further epidemiologic clues as to the mechanisms of disease production in the population; these are then discussed generally. To the veterinary medical student this would have more meaning in terms of animal breeds in a species. Breed differences in resistance or susceptibility to disease may readily be explained on genetic grounds, but in man the overlay of socioeconomic difference leading to qualitative and quantitative differences in exposure very frequently overwhelms pure considerations of race as a genetic factor. Nevertheless, such insight into racial patterns becomes important in the teaching of principles of epidemiology, for they are prerequisites to an understanding of shifting patterns of disease in time. An illustrative experience, such as the shift from higher attack rates of poliomyelitis in whites than in Negroes to the reverse (and that in even younger age groups) following immunization programs, becomes quite helpful.

These considerations then lead normally to a discussion of the influence exerted on patterns of disease occurrence in populations by programs of active immunization, particularly such innovations as the replacement of a wild virus in a population with an attenuated transmissible virus through an orally administered live virus vaccine.

Crowding, or aggregation of populations, and its influence on the occurrence of disease would certainly be easy enough to understand much earlier in a course on basic principles, but the dynamics which involve the ratio of susceptibles to immunes in a population, which in turn is dependent upon the ease of spread, rate of exhaustion of susceptibles, and their replacement by new births or by immigration to urban from rural communities (or dense as

opposed to sparse populations) must await the considerations of the phenomena of immunity and age distribution of disease for a more solid conceptualization. Only now, in my opinion, will the student understand why urban or dense populations develop immunity earlier to an endemic disease produced by an agent of high antigenicity than do rural or sparse populations—and why the urban community, though having a greater absolute number of cases, usually has lower attack rates and fewer explosions of disease.

At this time the additional overlay of socioeconomic differences in the same population can be brought before the student. The emphasis is on the epidemiologic meaning of such socioeconomic differences in terms of earlier and greater exposure to the disease agent via poorer environmental sanitation and personal hygiene. If the disease in question increases in severity and in number of overt cases with increasing age, the student with this background now understands why the upper socioeconomic groups would have higher attack rates. If, on the other hand, the disease decreases in severity with age then, under identical conditions of socioeconomic differences, the attack rate will be higher and occur earlier in the lower socioeconomic groups. Illustrations of disease examples are here supplied.

This background leads to a consideration of changes in the age distribution patterns of disease over time, particularly in developing nations, which demonstrate the emergence of man-made disease patterns in a very compressed period of time. The student is presented with the example of poliomyelitis, which is clinically rare in underdeveloped, poorly sanitized countries, where immunity is virtually universal and is acquired very early in life. The student understands that this is the result of a combination of extremely early infection because of poor personal hygiene at a time

when maternal antibody is still present in the child and when the disease is in an extremely mild clinical form in the very young. With improvement in the standard of living and improvement in hygiene, including protection of the young against indiscriminate exposure, infection is postponed to a time when passive antibody is gone and the disease tends to be more severe clinically and hence more overt.

Finally, students are presented with the phenomena of seasonal and secular cyclicality as epidemiologic principles.

To round out the students' experience with these principles of epidemiology, an outbreak problem is posed for class discussion and solution. The disease is not identified, and the clinical diagnosis and all clinical and laboratory features are deliberately withheld until the very end of the discussion in order that the student may appreciate the fact that the particular dynamics of production of this disease and its mode of transmission may be derived by sequential logic and inference from the epidemiologic data alone, including the distribution of cases in time, the extent of multiple cases in households, and the age and sex distributions. Thus the students are prevented from following false leads based on *a priori* notions of the reason for the outbreak, just because they are familiar with the disease in question.

In summary, it is my conviction that the basic principles of epidemiology can be taught conceptually, utilizing specific facets of specific disease epidemiology only as examples or illustrations to clarify and augment the concepts, not as an accumulation of facts to be memorized without any feeling for their meaning. This conceptualization in the hands of reasonably intelligent students should help them to elicit the specifics in epidemiology without much further guidance and to engage in problem solving with confidence.

THE TEACHING OF EPIDEMIOLOGY

THE KENTUCKY PROGRAM

HUGH S. FULMER, M.D. *

This paper is presented from the vantage point of teaching epidemiology in a medical school. Whether the objectives and principles are appropriate for teaching in a school of veterinary medicine I leave for your judgment.

I should first present my biases, because the evolution of this particular teaching program in epidemiology has been affected by the guiding philosophy of our own Department of Community Medicine at the University of Kentucky, which represents a unique departure in medical education. Hence, the teaching of epidemiology is to be viewed in the larger context of what we call community medicine. Our teaching approach in Kentucky is, however, only one example of what can undoubtedly be accomplished in many different ways.

My own experience had some influence on how we designed our program at the new University of Kentucky Medical School in 1960. I myself had received virtually no training in epidemiology in medical school. Throughout my internship and residency training in internal medicine, there was no exposure to the concepts and principles of epidemiology. After training, I had the opportunity of participating in a field health research program on the Navaho Indian reservation. For the first time I

was involved in epidemiological research without, however, having had any formal training in the discipline. It became my lot to learn the hard way—by my own mistakes. After two years of this I obtained didactic instruction in epidemiology during an M.P.H. year—what might be termed a “remedial” year. We thought that it was the fault of medical educators for having slighted so important a discipline and that we ought to be able to do better.

Formulation of our own program, therefore, capitalized on a review of my own checkered career in painfully learning how it could be done differently and optimally. I was not alone. The original members of our Department had had similar experiences. We were sure that undergraduate medical students should have a good firm base in the discipline. Our concept of medical education had evolved to the point where we viewed it conceptually as needing to be based on three interdependent parts: laboratory, clinical, and community medicine. Community medicine had to have a scientific foundation. One major aspect of that scientific base could be designated epidemiology.

In order to teach epidemiology successfully, we believed strongly that it had to have both a didactic and a field phase. The formal classroom exposure would occur during the preclinical years, the application in the clinical years.

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Second-Year Course (Didactic Teaching)

The preclinical teaching occurs in an extensive second-year course in epidemiology. It consists of 72 hours of classroom time, covering the second half of the second year. By this time, the students have had microbiology and a good share of pathology, and they are beginning to examine patients.

Once a week for three hours we teach epidemiology. We think that for the subject to be most palatable it should be both oriented toward the clinical and rich with illustrations of local and national significance.

Our teaching is founded on MacMahon's comprehensive yet succinct definition of epidemiology as the science of "the distribution and determinants of disease prevalence in man." Whether the etymologic definition (the science of "upon the people") might be improved with the insertion of a root meaning "disease" (so that the word might be modified to epidemiopathology) is an academic question. The veterinarian term "epizootiology," the study of epizootic disease, similarly suffers from the lack of "disease" as one of its roots.

At any rate, our second-year teaching stresses the MacMahon definition, thus leading to the strategy implied in that definition. This strategy is that the epidemiologic approach to the study of disease has, conceptually, four phases. These are (1) descriptive epidemiology, a study of rates of disease in subgroupings of the population, leading to (2) hypothesis formulation, based on asking *why* rates of disease are as they are; the testing of these hypotheses of causation is the task of (3) analytic epidemiology, which by itself, either through prospective or retrospective methodology, only establishes associations between proposed cause and effect variables by controlled observation; the last

phase is (4) experimental epidemiology, which has the capacity for rigorously confirming or denying causal hypotheses in the arena of the real world.

Our course is divided into segments. The first series of three-hour sessions consists of "epidemiologic methods," outlining the role of descriptive, analytic, and experimental epidemiology. The balance of the course is divided into two parts and is oriented to specific disease or health problems. The first of these two parts discusses the problems of infectious diseases such as influenza, tuberculosis, hepatitis, polio, zoonoses, and venereal disease; the latter part of the course covers the chronic disease area: coronary heart disease, smoking and atmospheric pollution, cancer, the population problem, mental health, etc.

We have a flexible formula for this didactic course. Each session is initiated by a lecture period one-half to one hour in length. A clinical case is presented at the start of the lecture to whet the students' interest through the demonstration of a live patient with the problem of the day. The entire class of 75 attends the lecture; the class is then divided into small groups of 7-8 students each for a seminar session lasting two hours or so. Each group is led by a faculty member. This allows discussion of the topic of the day in some depth, favors a certain degree of individual instruction, and makes possible a close faculty-student relationship.

The format of the seminar period is to some degree structured, but it may be liberalized by the individual faculty seminar leader. Each student is assigned a *specific* epidemiologic article from the medical literature, pertinent to the subject of the day, and is required to report upon it orally during the seminar period. He is instructed to analyze the article critically, using his knowledge of epidemiologic methods. There may be three or four such

readings assigned, with two students in a group having the same reading assignment, neither knowing who will be called upon to report; the one not reporting acts as a critic of the other. The article may or may not be scientifically sound. In addition, all students are assigned a *general* reading for which all are responsible. This may be from a text, or it may be an article from the medical literature, but in either case it treats of the subject in a comprehensive fashion. Also, all students are assigned a homework problem on the day's topic which emphasizes epidemiologic methods and principles in relation to the categorical disease entity. Solution of the problem is discussed during the seminar. To round out the materials, all students receive the weekly morbidity and mortality reports issued by the National Communicable Disease Center; these are grist for the mill of discussion. All seminar groups are assigned the same mix of ingredients, lending uniformity to the teaching of the entire class. In sum, the seminar period may be used to discuss the patient of the day, the lecture, the general or specific reading, the problem, or the morbidity and mortality report, so as to re-emphasize those easily recallable principles that we hope the student will carry away from the course in his memory.

The seminar leader may vary the amount of time that he devotes to any of these teaching devices. We have found some teachers who are problem-oriented, some who regard dissection of literature as their particular joy, some who dwell on "the big picture," or the patient, and some who favor a free-wheeling, pot-boiling discussion around the over-all theme. To say that all seminar leaders should do their teaching in a predetermined manner is to say there is only one road to Mecca. It prevents leaders from playing to their own strengths. On the other hand, the willingness of the

faculty to accept critical evaluations of teaching ability and of attempts at change and improvement is to be favored and nurtured.

The development of group dynamics among the students and between the student and his faculty leader is interesting to observe and may be used to promote learning. To know who the better students are, who the peer leaders are, who responds well to whom, who are the better teachers among the students themselves, is of great advantage in improving the entire teaching process. We ought to make more of this; the behavioral scientist could help us here.

Fourth-Year Course (Field Teaching)

The medical students spend the third year in the hospital wards and clinics learning clinical skills. We are involved with them only indirectly during the third year by virtue of serving as clinical faculty. In community medicine-epidemiology instruction per se we are not involved at all.

In the fourth (senior) year all students spend a full six weeks under our aegis. It is during this period that we believe the "payoff" occurs in the learning of epidemiology. Again, this is to be viewed in the larger context of community medicine.

The student is assigned to study a community and its health problems. He moves to that community and lives in it for five and a half weeks. He is told to make the analogy to the patient in the hospital bed. We tell him, "You have learned the clinical approach to the patient by working with individual patients in the ward and the clinics. Now learn the approach to the 'sick community' by being at its 'bedside.' Just as you learn diagnosis and management, the science and art of clinical medicine, at the bedside of the patient, now learn the identification and solution of community health problems in the community." We empha-

COMMUNITY EPIDEMIOLOGIC PROJECTS

(Categorized by main emphasis and methodology)

- A. *Population Description: General and Specific Health Status and Health Indices Follow-Up*
 - Perinatal mortality and prenatal care
 - School children heights and weights
 - Vision testing of school children
 - Current status of mentally retarded children
 - Immunization levels in infants
 - Domestic water supply evaluation
- B. *Population Descriptions: Health Attitudes, Knowledge, and Behavior*
 - Family planning, knowledge and practices
 - Adolescent prisoners' attitudes
 - Alcoholics Anonymous population study
 - Epileptics' social problems
 - Over-65 population needs for knowledge of health services
 - Consumers' attitudes about University of Kentucky Medical Center
- C. *Health Service Description, Evaluation and/or Utilization Review*
 - Vacation area health services availability
 - Cholecystectomies in a community hospital
 - Coroner's office services
 - Regional pediatric clinic operation
 - Rabies vaccination clinic operation
 - Rural doctor's office and hospital utilization
 - Mental health service for children
 - Post-partum complication of office deliveries
 - Medical record data retrieval in general practice
 - Prenatal care utilization by a minority group
 - College health service evaluation
 - EKG screening test evaluation
 - Medical history questionnaire development
 - Medical care resources for a factory population
 - Carcinoma of cervix detection in welfare recipients
- D. *Disease Detection, Early Diagnosis, and Control*
 - Diabetes detection in school and factory
 - Cervical cancer detection in office practice
 - Tuberculosis detection and follow-up
 - Alcoholism detection in a large factory
- E. *Infectious Disease Prevalence, Incidence, and Care Studies*
 - Group A beta streptococcus prevalence in general practice
 - Tuberculosis and histoplasmosis skin test positivity in students
 - Toxoplasmosis in retarded children
 - Intestinal helminths in school children
- F. *Noninfectious Disease Prevalence, Incidence, and Care Studies*
 - Highway accidents
 - Accident patients at a community hospital
 - Chronic respiratory disease and smoking
 - Glaucoma in a nursing home population
 - Mental illness in doctor's practice and community
 - Glaucoma in family practice
 - Aluminum dust and chronic lung disease
 - Familial disease genetic work-up

size that the science he is now going to have the opportunity to apply is epidemiology. This is what the second-year course

was all about, and the preparation obtained in the didactic phase is now going to be applied in the field.

Therefore, in addition to studying individual patients and families in the community setting and making a comprehensive descriptive study of the medical needs and resources of the community, the student is required to complete an epidemiologic project.

This latter task involves several elements. He selects a disease or health problem in which he has a certain amount of interest—one that has significance in the community. He reviews the pertinent literature. He designs the study, selecting a proper sample and detailing the research protocol. He presents the study design to faculty and colleagues at the end of the first week of the clerkship. He then carries it out; the study is modest in scope and is planned to consume no more than three weeks in data collection. During the fifth week he analyzes, interprets, and writes up the study. At the conclusion of the six-week period he presents the results to a faculty-student seminar group.

The particulars of such studies are itemized in the accompanying table.

Evaluation

What is the over-all impact of this program? We really do not know as yet. We do not aim to create specialists in this field but rather to widen the horizons of all. We do not know whether or not our graduates will practice medicine with a finer sense of

community medicine than other medical graduates. Thus far, we have only graduated four classes.

We would like to see every practitioner apply the epidemiologic approach as he practices medicine. If not that, we would hope that practitioners would recognize its significance and know whom they should call upon when problems of epidemiologic dimensions arise in the community and they have need of such expertise.

An evaluation ought to be made of our graduates; even though we have no control group, we plan to do so. Evaluation for the long term will have the most meaning.

Conclusions

We are constantly being surprised and even amazed at how our students have developed sophistication in epidemiology. This reflects our own impoverished undergraduate background in this discipline. Epidemiology, as the diagnostic arm of public health-community medicine, has been sadly neglected in our curricula. Yet its importance cannot be overstated. If we are to make our physicians and health professionals aware of the magnitude of the health problems we face in the coming years, we have to instill in them the concept that the scientific approach is as important and meaningful, if not more so, to the study of population pathology as it is to individual patients.

THE TEACHING OF BIOSTATISTICS

OBJECTIVES AND PRINCIPLES

PAUL LEAVERTON, PH.D. *

Statistical methods and concepts are used today in every field of science. This naturally follows if we accept the fact that science is defined on the basis of whether or not relevant entities can be measured. Statistics is most often defined as the collection of methods for summarizing and analyzing data. Those methods most applicable in the biological sciences are called biostatistics, and they have long been a part of the curricula in public health and preventive medicine.

Obviously, it would be presumptuous for anyone to offer a set of principles on a subject as though they were universal, and these comments should not be so construed. What follows, therefore, represents some of my personal views on the objectives and principles in teaching biostatistics. I will briefly outline what I consider to be the essentials of the subject and will point out a few topics, which, from my experience, seem to need more teaching emphasis than they generally have enjoyed.

The basic subject matter of a first course in biostatistics may be divided into two areas:

1. Descriptive methods.
2. Statistical inference (analysis).

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There is some overlap between the two but this division will prove to be useful.

Descriptive Methods

The idea of a relative frequency distribution is basic to any attempt to describe data or to perform a "statistical analysis." The histogram, or bar graph of a frequency distribution, is still the best way to describe a set of measurements and it deserves primary emphasis. Of course the familiar, concise, summary measures of central tendency and variation are also necessary. One of these, the standard deviation, is very frequently misused. For some reason people tend to forget that the standard deviation gives you a useful description of variation only when the frequency distribution is approximately symmetric. As an alternative, more attention should be given to the use of percentiles, which do not depend on the shape of the underlying distribution.

Statistical methods are based on an abstraction—a model—which is an approximation to real-world phenomena. If the approximation is a good one, we have a useful, sometimes even powerful, tool. If the approximation is poor, ridiculous conclusions can easily result. This critical point can be illustrated even with a simple descriptive measure such as the average, or mean. When the number of observations is

small and includes one or two extreme values, the mean gives a figure which simply does not describe the "center" of the frequency distribution very well. For example, the average of the four numbers 0, 1, 2, and 97 is 25. The descriptive usefulness of the mean requires that we deal with an approximately symmetric distribution. Obviously the underlying assumptions such as this one must be kept in mind, even when we use such an elementary technique, if misleading conclusions are to be avoided. This deceptively simple axiom applies to all of statistics.

Descriptive methods involve easy concepts, which can be covered briefly in a course. However, it has become apparent that more emphasis on the specific purpose and limitations of each method is needed.

Statistical Inference

The use of statistical methods for making decisions on a "probability basis" has been a recent development in the history of science. In fact, it was only in this century that the methods and concepts of statistical inference, principally under the influence of R. A. Fisher, became widely accepted. These ideas, used to quantitate the decision process in estimation problems and in testing hypotheses, are the main substance of statistics today. These methods of statistical analysis may be grouped under the label "statistical inference" to differentiate them from purely descriptive methods.

Even more attention must be given to our assumptions in this area. This requirement should not be considered a disadvantage of the statistical approach, for whenever inferences are drawn from observations—whether a formal statistical analysis is used or not—some assumptions about the nature of the data are necessary for valid

conclusions. Not stating an assumption does not affect its requirement, of course. As Hooke (1) puts it, "We do not subscribe to the common fallacy that he who does not mention his assumptions is not restricted by their limitations."

Statistics is sometimes generally described as "the science and art dealing with variation in such a way as to obtain reliable results" (2). Obviously situations do exist where variation is not a problem and no formal statistical analysis is needed. It seems reasonable, in fact, to require the presence of variation as a prerequisite for a statistical analysis. If there is no variability, then a sample size of one is sufficient. As Bradford Hill has pointed out:

If we were to use a new drug upon one proven case of acute leukaemia and the patient made an immediate and undisputable recovery should we not have a result of the most profound importance. The reason underlying our acceptance of merely one patient as illustrating a remarkable event—not necessarily of cause and effect—is that long and wide experience has shown that in respect of acute human leukaemia human beings are not variable. They one and all fail to make immediate and indisputable recovery. They one and all die (3).

Of course this is an extreme example. When dealing with almost any biological phenomenon, remarkable variability usually exists between elements in a group or between observers. This fact can hardly be overemphasized. And there certainly is no shortage of examples.

The relative frequency (Neyman-Pearson) concept of probability is the basis for statistical inference, and its principles are a necessity in any statistics course. A concept of probability (subjective Bayesian) based on quantitating one's "degree of belief" in hypotheses has recently gained some support among statisticians. However, this approach to probability has been mainly of theoretical interest and its even-

tual usefulness in helping to solve real-world biomedical problems is doubtful.

Since the main objective of a statistical analysis is to make inferences about populations, it is essential that the idea of a population (in the statistical sense) be grasped. Selecting random samples and considering the variation among them is basic. In fact, the concept that data from a study may be considered a sample result—from among many possible such samples taken from a population—is the basis of statistical inference and the inductive reasoning process (from the particular to the general).

This "population-sample" concept and the rationale for random sampling are prerequisites for all of the methods of statistical analysis. There are two major reasons for selecting samples at random:

1. Chances for bias are minimized.
2. The laws of probability may be employed in evaluation of results.

These are strong advantages which may be illustrated many ways. Perhaps the point is made most dramatically to students by considering examples of inferential difficulties encountered when nonrandom samples are chosen.

The use of randomization is not limited to sampling, of course. In comparative experiments random allocation of subjects to treatments has come to be regarded as a fundamental scientific principle for the two reasons given above.

Randomization allows a judgment to be made about the compatibility of observed group or "treatment" differences with the hypothesis that all groups effects are alike. Making this judgment on a probabilistic basis is the essence of hypothesis testing. This broad subject may be illustrated by some of the simpler, but very useful statistical tests. Although their calculation is

straightforward, it is the proper interpretation of the resulting statements concerning statistical significance (p -values) that seems to elude most persons. It seems obvious, therefore, that more time should be spent on interpretation than has been the case.

A related problem is the failure to differentiate between "statistical significance" and "practical significance." This semantic difficulty has been caused by the statisticians' unfortunate choice of the term "significant difference." What is meant by this is that differences as large as that observed or larger, could be expected to have occurred by randomization alone only a small percentage of the time. Conversely, a difference judged to be not statistically significant is one which might well have occurred by chance alone. Being specific about the expressions "small percentage of the time" and "might well have occurred" is what the p -values are all about. But these expressions pertain to the *reality* of a difference, not the magnitude. It is easy to cite examples of real and statistically significant differences between two treatments where the actual magnitude is biologically unimportant.

The fact that the subject of test "power" is sometimes omitted from statistics courses and textbooks no doubt contributes to the confusion about statistical significance. But an understanding of power is absolutely necessary for proper understanding of all statistical tests. It needs to be pointed out more often that mistakes in judgment about hypotheses can go either way. We may "reject" them when they are true or "accept" them when they are false. A statistical test does not prove or disprove a hypothesis but merely establishes the probability of a judgment error about the reality of a difference.

Experiments and Nonexperimental Studies

The term "experiment" has been best defined by Donald Mainland (4) as "an investigation in which randomization is performed and in which throughout the experiment nothing is allowed to interfere with the effects of randomization except the treatments, if they can do so." In this case the investigator has control over the independent variables and assigns them himself to the subjects. In nonexperimental studies no such control exists over the relevant variables. Such investigations are sometimes called "observational studies" or simply "surveys." Students often fail to appreciate the fundamental difference between the two with regard to the inferences which may be drawn from each.

Part of the difficulty lies in the fact that, in many instances, the same computational methods of statistical analysis are appropriate in each of the two types of studies. For example, differences between two groups may be tested for statistical significance in either case, but a cause-and-effect relationship may appropriately be inferred only in experiments.

Nonexperimental studies of both a retrospective and prospective nature are useful for suggesting *possible* cause and effect relationships. Such investigations are, of course, the heart of epidemiologic research. However, it needs to be stressed that, when the criteria for an experiment are not fulfilled, all we can ever "prove" are associations.

Computers and Biostatistics

The increasing availability of high-speed computers enables many statistical analyses to be easily and inexpensively calculated. In fact, there are numerous packaged programs which will perform all the necessary

calculations for standard analyses of variance, bioassays, regression problems, and many others. As a result, the production of routine statistical computations is going up.

One particular area of statistics that owes its recent rapid development to the computer is multivariate analysis, in which methods are studied for simultaneously handling many correlated variables. Although most of the ideas are not new, their application has been limited by the complexity of the required calculations. The development of computers has removed this constraint, and many applications are now being found for these techniques.

Multivariate statistical methods are naturally of particular relevance to epidemiology, where measurements of multiple dependent variables is usually the case. Many of these methods are techniques which enable a search for "patterns" in large quantities of data. This is sometimes called "data analysis" as opposed to testing hypotheses. There is nothing wrong with such procedures; interesting possibilities are often uncovered in this manner. (Unfortunately a lot of nonsense is also spawned.) However, it is inappropriate to formulate hypotheses and "test" them on the same set of data.

Although the computer is a powerful tool for the analysis of data, it enjoys an undeserved reputation as a data purifier. The easy accessibility of statistical computer programs allows researchers to produce myriads of impressive statistics, *p*-values, etc., regardless of how casually a program may have been selected. Mistakes of great magnitude can now be calculated with greater precision. And somehow the words "analyzed on a computer" seem to lend an aura of dignity and authority to any result, no matter how fallacious it might be. Such statements as "the standard deviations were thus developed on the computer" or "the

data were analyzed by computer" are common annotations.

Teaching Biostatistics

This attitude toward computers is actually only a step beyond that of a fairly prevalent blind faith in "statistical analyses." If Hogben's (5) 1950 statement that "less than one percent of research workers clearly apprehend the rationale of statistical techniques they commonly invoke" was correct almost two decades ago, then the computerized simplicity by which statistical techniques may now be used has certainly not made it less so.

One of the best ways to counteract this situation in biostatistics courses is to point out and discuss examples of redundant and erroneous use of statistical methods whether or not the crime was aided by computers.

The basic statistical flaws in most studies are not complicated but have to do with some of the ideas already mentioned here, such as randomization, probability, and experimental inference. Proper understanding of these basic concepts would do much to alleviate the problem.

Probably the most important single guideline for teachers of biostatistics to keep in mind is that nature is under no obligation to provide data which fit our mathematical assumptions. Therefore, we must question the suitability of these assumptions in every instance where a statistical method is contemplated. No other general principle can contribute more toward giving students the correct perspective of statistics in biology. They will see these methods and concepts not as a panacea—not as ritualistic nonsense—but as a very reasonable approach to formulating and solving many real-world problems.

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THE TEACHING OF BIOSTATISTICS

MINIMUM GOALS FOR VETERINARY STUDENTS

JACOB BEARMAN, PH.D.*

I should like to make but a few brief remarks on this subject.

It is clear that, in the time available to teach biostatistics to veterinary students, the goals must of necessity be rather modest. That is to say, we cannot expect to make statisticians out of these students. However, we can expect to accomplish certain valuable objectives:

a) Veterinarians should be expected to learn to read their own technical and scientific literature critically and with understanding.

b) They should understand the nature of biological variation and the formation of judgments in the face of variation.

c) They should understand the uses of rates and their importance to the interpretation of public health problems.

d) Those who will do at least some scientific work should do so with some confidence of understanding the jargon of statistics and

of being able to make use of the help offered by statisticians.

In order to accomplish these objectives, it is intended that certain principles involved in statistical reasoning be clarified:

a) Since chance and chance fluctuations are at the foundation of biostatistics, the student should be presented the elements of probability calculations.

b) On such a basis, the principles of sampling and sample surveys can be developed, and some applications in veterinary public health can be used to illustrate the principles.

c) In this context, some basic distributions, e.g., the binomial and normal distributions, and their uses should be introduced.

d) Estimation of parameters should be emphasized; the student should distinguish between precision and accuracy.

e) Methods for averting bias should also be included, and the central role of appropriate random processes should be given major attention.

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THE TEACHING OF FOOD HYGIENE

MEAT AND POULTRY HYGIENE

JAMES D. LANE, D.V.M.*

In December 1967 the U.S. Congress passed—and the President of the United States signed into law—the Wholesome Meat Act. This dramatically focused attention on the quality of meat being served in the American home.

The states have been given two years in which to bring their standards of meat inspection to the point where they are at least equal to Federal requirements. If at the end of this period the states are making progress toward this standard, they can petition the Secretary of Agriculture for a one-year extension so that they can meet the requirements. At the end of this one-year extension the state inspection programs must either meet the Federal standards or the Federal Government will operate the inspection program within the states concerned. What this means is that by 1971 virtually 100 per cent of the meat being offered for sale in the United States will be regulated to the extent that it will meet the standards of the Federal Government. At the same time, the Federal Meat Inspection Program will be expanding its review of foreign inspection programs to ensure that the meat imported into the United States is equivalent in every respect to the product produced in this country.

Just recently, the Administration has in-

troduced a bill in Congress to provide for a poultry inspection act that in substance will be equal to the Wholesome Meat Act. Should this bill pass, and there is reason to believe that it will, all poultry slaughter and processing will also have to meet or exceed Federal standards within a given period of time.

I believe that the impact of these two pieces of legislation on the veterinary profession is just beginning to be felt, and within the next two or three years the demand for veterinarians in meat and poultry inspection activities, both state and Federal, will be almost more than the profession can meet. The Federal meat and poultry inspection programs now utilize nearly 1,500 veterinarians, and the states hire about 200-300 additional men. But the Wholesome Meat Act and the poultry legislation, if adopted, will, within the next two to three years, require at least a 40 per cent increase in this number. And that is a healthy segment of the veterinary profession by anyone's standards. I want to point out, however, that not all of these men need be engaged full-time in inspection work. There will be many positions open requiring only part-time inspection duties. Presumably, these jobs could coincide with large or small animal practice or with animal health regulatory work at the state or Federal level. And let us not forget that during the coming years our meat- and

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poultry-consuming public will grow ever larger, the demand for these commodities will increase, and the need for veterinary food inspectors will continue to increase.

The critical question, as I see it, is how the profession can best meet this rapidly expanding demand for veterinarians in food inspection work. It is a serious problem and we as leaders and advisers in the field of veterinary education have to provide the leadership for change in the veterinary curriculum. I think it is generally recognized and agreed that many forces are at work today changing the focus of veterinary medicine. Large animal practice is changing to the herd or preventive medicine concept. Small animal practice is slowly but surely growing. More graduates each year are going into biomedical research, and the number of veterinarians in one or another aspect of public health work is steadily increasing. Change seems to be the order of the day, and frankly I do not envy the curriculum committees of the various schools in their efforts to make veterinary education relevant to the needs of tomorrow.

A Program for Food Hygiene

To meet the problems I have outlined, I would like to point out a few objectives that I believe must be substantially met by the schools if they are to provide the manpower for food hygiene programs of the future.

As a broad objective I propose that it is high time to accept food hygiene as an integral part and responsibility of the profession as a whole. For too many years food hygiene has been the poor country cousin who ends up with the neck of the chicken or the cheapest cuts of the cow. Food hygiene is becoming a science requiring special skills and talents just as any other segment of the profession. Our job in the Consumer and

Marketing Service is to identify and woo the brightest students of veterinary medicine that we can find. We need men who not only have a well-developed knowledge of anatomy, pathology, and microbiology but who have the quality of leadership and the brightness and alertness to come up with creative answers to problems of control systems and statistical analysis and the ability to meet and deal with all types of plant management at the state, local, or foreign government level. We cannot find these people—and will not be able to—until the veterinary faculties as a whole bring food hygiene concepts into the daily lectures and discussions carried on in the classrooms and laboratories during the four years of school life. This is a large order and I fully realize that years may pass before it becomes a fact, but a start must be made.

More specifically, I am looking for a veterinarian who can walk into a meat or poultry plant and know what to do without going through a long training period by a state or Federal agency. In the Federal Government we now find it necessary to train our veterinarians a minimum of 12 weeks before they can be allowed to act on their own in making an inspection and disposition of an animal. This, it seems to me, reflects the underemphasis on food hygiene in the veterinary schools. Very basic sanitation principles and practices must be taught to our newly hired veterinarians. True, they have a good background in the sanitation requirements of surgery, but at the present time they all too frequently lack the ability to relate these sanitary principles to food-handling practices. In pointing to this as one example of deficiency in the total veterinary curriculum, I do not intend to criticize the food hygiene teacher. What I am saying is that food hygiene is too often taught as an isolated segment of the curriculum, and the segment is all too brief considering the

major role food hygiene will be playing in the future.

I would like to see the man who enters a meat or poultry plant for the first time have a better understanding of how ante-mortem symptoms relate to the wholesomeness of the meat as a food, or a better understanding of how and why the meat from the animal may be objectionable from an esthetic viewpoint. There are many lesions of animals and birds, as well as meat-handling practices during the dressing or processing operation, that would make the meat repugnant to the consumer if the latter knew what he was being asked to accept as food for himself and his family. The veterinarian must see that such meat does not enter food channels.

This man should also know the techniques of providing a full post-mortem inspection of at least one species of animal and one class of poultry. With this ability he can very quickly learn the techniques of inspecting other species of livestock or of poultry. Without such a capability by each graduating veterinarian, we can expect to continue to see the only too familiar cursory inspection of animals being dressed for food by the veterinarian who did not have an opportunity for postgraduate training in meat hygiene and who may be inspecting meat or poultry on a part-time basis.

He should also know the more common causes of condemnation and why these parts or carcasses should be condemned. And he must be able to recognize this pathology when he sees it. Again, I ask you to keep in mind that meat in its various forms is a prime responsibility of the profession. Not all state agencies, for example, can provide an extensive training program for veterinarians starting work in meat hygiene. In these cases, the Federal Government will assist the states whenever possible, but certainly a man leaving veterinary college should already know and recognize the more

common conditions calling for rejection of meat as a food.

When the meat is rejected, he must know what to do with it to ensure that it is not and cannot find its way into food channels after he has left the plant. All else is of little use unless the meat is effectively destroyed as a food and he knows that this has taken place.

These, it seems to me, are the basic objectives of any meat hygiene program, and such capability must be obtained by the student during his undergraduate years. Meat and poultry inspection will be the livelihood, at least partially, of a large proportion of our graduates during the coming years. Consequently, it is the responsibility of the schools to adequately prepare their students for this work to the same extent, for example, as they do in the case of small animal medicine. It would seem to me that our national board of veterinary examiners should examine license applicants in the various aspects of food hygiene.

Curriculum Objectives

What principles to follow in order to gain these objectives is a more complex problem and I hesitate to suggest changes that may seem radical or "far out." But change is long overdue so I will make some suggestions that, though not unique or original, will, if followed, go a long way toward meeting the stated objectives.

First, I suggest that the history of veterinary medicine become an integral part of each curriculum. Veterinary medicine, as a biological and medical science, has a rich and diverse history, and our students from the onset of their training should be oriented to their profession's over-all role in human society and alerted to the great variety of career opportunities open to them. As Dr.

Calvin Schwabe of the University of California points out, later in this volume, many American medical schools support departments of medical history while, so far as is known, not a single chair of veterinary history exists on an American veterinary faculty. The effect of emphasizing the study of veterinary history would be to broaden the outlook of the student, provide him with better tools to chart his future, and tend to guide him away from the concept of veterinary medicine as a narrow technical specialty. It certainly is anything but a narrow profession, and the student body should be able to draw its own conclusions on this if they are provided with a wealth of information on past and present achievements and the opportunities that exist in veterinary medicine.

To further introduce the student to basic meat hygiene, I propose that each student spend a minimum of four weeks in a meat and in a poultry packing plant learning the techniques of inspection and the principles of determining when and why meat is suitable or not for use as food for human consumption. The U.S. Department of Agriculture has attained an exceptional record of protecting the public from unwholesome meat and poultry for many years and is continuing to evaluate newly recognized diseases and pathology and the effect of such conditions on the flesh of the affected animals. Learning how to conduct inspection and to recognize the more common lesions is a time-consuming process, and actual participation by the student in a real situation has proven to be the most effective experience from the learning viewpoint.

The subject of basic statistics is not always considered to be a vital part of a veterinarian's education. Yet research design as well as food inspection techniques depend more and more on the utilization of this mathematical tool. Both the military and the civilian food control programs now

heavily rely on sampling plans established according to statistically sound principles. I predict that a veterinarian lacking knowledge of this subject will, within a very few years, be just as handicapped as a graduate of my era was in entering his professional life with no knowledge of the powerful effect of antibiotics on disease entities. Statistical analysis provides a means to control large volumes of meat and poultry production that simply cannot be adequately controlled by a casual and random examination by a man who looks in now and then on the manufacture of frankfurters or hams.

Within the past few years, ever since the publication of the book *Silent Spring*, both the public and the profession have become more aware of the long-range chronic effects of consuming foods containing potentially dangerous insecticides, grubicides, herbicides, and veterinary pharmaceuticals. Ecology is a rapidly growing science today, and man, as a mammal, is not exempt from the toxicity produced by consuming contaminated foods. The extent and effects of the resultant toxicity is a serious consideration of the Consumer and Marketing Service, and the Service's meat and poultry inspection programs have inaugurated broad survey programs of fresh meat and poultry—as well as sausage and other items—in order to identify and condemn, if necessary, foods containing excessive amounts of such chemicals. I believe that the veterinary profession as a whole has a responsibility to ensure that such chemicals are utilized only according to instructions dictated by the U.S. Department of Agriculture and the Food and Drug Administration. Perhaps someday these toxic chemicals will be even more stringently controlled than today. But in any event the schools must strongly impress on the student body the hazards of such potent chemicals and the need for our meat supply

to be as free as possible from traces of these dangerous, but also beneficial, drugs and chemicals. Where the public health and our meat supply are concerned, the veterinarian must be concerned.

In all honesty, food poisoning seems of little concern in many veterinary schools today. Yet the veterinarian is striving to become the primary source of concern with poisoning arising from the mishandling of food of animal origin. This assumption of authority, however, is based not on the title of doctor or veterinarian but on the familiarity of the individual man with the source, course, and syndrome of food poisoning cases. The veterinarian can be an invaluable aid in the field of public health if he is knowledgeable regarding the causes and effects of consuming toxic meat or poultry products and knows how to avoid conditions leading to such illness. We all recall the fatal cases of botulism poisoning of a few years ago brought on by eating canned tuna fish and smoked whitefish. Although cases like these are extremely rare, this is small consolation to the families of the victims.

Why, we can ask, has the veterinary profession in America consistently ignored marine life as a source of rich protein for the public? Fish, too, suffer from pathology and disease. In future years, fish farming will become an important agricultural enterprise in the United States simply because fish are an inexpensive source of protein and our population is growing ever larger. In Japan this is already the case. The veterinarian has the responsibility from the standpoint of both agriculture and public health to protect this small but growing industry and the people who include fish as a portion of their diet. When the profession recognizes this, then and then only will the veterinarian become a vital link in this segment of the food chain.

I have been talking a good deal about food and how to see that it meets our high

standards. Now let me turn briefly to the art or science of turning meat and poultry into the tremendous variety of food products seen in our supermarkets today. Fresh meat and poultry are becoming almost old-fashioned compared to the exotic combinations in plain and fancy wrappers available to us. Millions of dollars are spent on food research, testing, and marketing programs in an attempt to grab the magic formula that will tickle the palate of the American with a new meat, cereal, or other combination of ingredients that is tasty, attractive, and low-priced—and the merchandisers are succeeding in a remarkably high number of cases. Meat technology or food technology graduates are swept up by large corporations almost before the ink is dry on their diplomas. But if we are really interested in emphasizing our ability to feed the modern American, we had better wake up and start producing veterinarians with some knowledge of meat technology. In my own organization, we finally realized that the veterinarian is quite deficient in his knowledge of how new products are prepared, why certain chemicals are added to these foods, and what, if any, effect the additives may have on the long-term health of the consumer. Also, there are many ways to degrade the quality of food, even though we know the ingredients are perfectly safe to eat. Meat technology is becoming a highly complex field and, as it continues to develop, the regulation of these foods becomes even more difficult. The veterinarian planning to enter meat hygiene work could well use a core of basic information on the principles and practices of meat technology. Unless we understand the field we cannot realistically expect to evaluate and regulate the flood of new products entering the market place each year. As a rule these products are wholesome, but we in the Consumer and Marketing Service are concerned with quality, and we must be able to assure the

buyer that the product he eats is accurately described on the package so that he is not deceived into paying meat prices for a lower-grade product.

Finally, I suggest that the veterinary schools and the profession are well advised to be concerned with the development of subprofessional meat technicians. Manpower is critical in the veterinary profession, and the graduate veterinarian is best utilized in work that is a challenge to him and draws on his reservoir of professional talents. Many of the jobs in meat and poultry inspection work, however, do not meet these criteria. In these cases, subprofessional people should obviously be used. Our problem in the Federal Government (and I am sure it is a problem in the state inspection programs as well) is to find and attract competent employees who can perform the tasks of the noncritical aspects of inspection. By noncritical, I mean those jobs that are not directly related to health considerations, such as evaluating disease conditions in the animals presented for slaughter or during slaughter. There is a need each year for about 500 new employees of this type in the meat and poultry inspection programs throughout the country. During the next year or two the demand will rise sharply. I would suggest that a one- to

two-year curriculum be designed by the veterinary profession to properly train such people and that the implementation of these recommendations in junior colleges or agricultural institutes be pushed with vigor before state boards of higher education. It is conceivable that schools of this type might even be attached to veterinary schools in the same way that classes for medical technicians are sometimes allied with medical schools.

In summary, the needs of our profession are changing rapidly. What was of primary importance yesterday quite obviously is not quite so important today. Values in a profession are relative in many respects, so long as the ethical character of our livelihood remains strong. We are first of all people, but let us remember that we are a people with a strong vested interest in our profession. As such, each hopes to pass this interest on to the next generation in the form that they can use best to serve the society they are entering. The importance of food hygiene is growing by leaps and bounds, and we have the responsibility to so alter our profession that graduates in the years to come can enter this field with the confidence that their role within the profession will be played with competence and satisfaction.

THE TEACHING OF FOOD HYGIENE

CURRICULUM OBJECTIVES

MORRIS A. SHIFFMAN, D.V.M., M.P.H., PH.D.*

Proposing objectives for the teaching of food hygiene is difficult for two reasons: (1) food hygiene is not a separate discipline but borrows its subject matter from a number of scientific disciplines and technologies, and (2) the establishment of objectives is a difficult exercise in itself. Recent developments in systems analysis, cost-benefit analysis, and program-planning-budgeting systems point to the formidable problems of determining objectives that allow for the systematic assessment of accomplishment in terms of criteria for these objectives. It is necessary to deal with objectives in terms of:

1. *Relevance*: Do the objectives reflect the present problems, conditions, and developments, or do they relate to conditions which no longer prevail?

2. *Realism*: Are the objectives designed to impart a warm and noble feeling or do they express the operational realities and the limitations and constraints that beset all objectives?

3. *Focus*: To what extent are the objectives an expression of disciplinary background, experience, and individual values rather than a wider expression of societal requirements?

The predominant teaching objective is the preparation of a student who is factually and intellectually equipped to adapt to change. Therefore, it is important to have some knowledge of the history of a field of study. Knowledge of the past and present state of the discipline is necessary to planning for future teaching objectives.

Historical Perspective

An account of the highlights of food hygiene practice over the last 100 years could be structured around three phases, beginning with the sanitary reform movement of the latter part of the nineteenth century and leading to the scientific uncertainty of the present day. Dubos (1) has described the sanitary reform period in terms of a reaction to the destruction of human values that accompanied the first phase of the Industrial Revolution. The sanitarians of that time observed that disease coexisted with poverty, dirt, and pollution. They had faith that health could be restored to the people by bringing back pure food, air, and water and more pleasant surroundings. This assumption was indeed based on social reform rather than scientific findings. The era of the sanitary reform movement lasted till the rise of scientific medicine and was supplanted by advances in disinfection and vaccines and

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by the development of the environmental barriers of pasteurization and water treatment.

The second phase in food hygiene practice was the era of the microbiological causation of food-borne illness. We have hardly passed out of this era; however, the third phase requires that microbiology share the stage with physical and chemical contaminants. The rapid social and technological changes of the post-World War II years resulted in the introduction of new chemical and physical contaminants—pesticides, additives, and radiation. The nature of the pollution problem has changed drastically. The philosophies and strategies for the containment of pollution must also change, since the control strategies of a previous era may not be applicable to changed conditions. The point at issue is that many programs and some teaching in food hygiene are based on a past historical and developmental phase. Students may be learning (and practitioners may be doing) things which are inappropriate to the present problem.

Some of the significant changes may be summarized as follows:

1. The change in epidemiological patterns of food-borne disease from patterns in which cause and effect could be readily related to more complex multifactorial etiologies, which require prospective epidemiological investigations in addition to the retrospective approaches.

2. The mechanisms of microbiological contamination are sufficiently complex, but the newer chemical contaminants add further dimensions of complexity. These mechanisms include the effects of cofactors and accelerators as well as problems of synergism, potentiation, and antagonism.

3. Changes in the patterns of food production and distribution to large-scale, centralized food production facilities and in-

creased international exchange in food products.

4. Changing consumer patterns which result in the creation of new food products, new food technologies, processes, and food-handling methods.

5. Although there is a greater need for food protection programs, food hygiene must now compete with other programs of environmental pollution control. Therefore, issues arise which relate to the allocation of resources among competing objectives in food hygiene programs and in competition with other programs. The student should be familiar with some of the methodologies for measuring efficiency and effectiveness of program design.

6. Food protection programs have been based on the untenable assumption that control should be complete and all-inclusive. The reality of the control situation is uncertainty, limitation of resources, and the necessity of making choices among competing objectives. The all-inclusive food protection program is usually not feasible. Control strategies will depend on sampling procedures, selective methodologies for sensing the environment, and surveillance. The student should be familiar with these approaches and with the need for dealing with probabilities rather than certainties.

In summary, a rapidly evolving society and an expanding technology have diminished some of the risks that were connected with food adulteration and microbiological contamination in earlier times. However, these same changes have added factors of complexity to the solving of food hygiene problems and factors of uncertainty to both etiology and the solution of these problems. A peculiar aspect of the nature of these newer risks is that they have dual, built-in values of benefit and disability. The choices for control are therefore less clear-cut than ever before. With pesticides, for instance,

there is a legitimate choice as between benefits to society and costs in health and destruction of natural systems. Food and food hygiene are so closely tied to the fabric of society that students must be introduced to the study of social and technological changes that determine food production and utilization if they are to be at all prepared to make decisions for society.

Objectives of a Food Hygiene Program

The defining of objectives is of little use unless these definitions express the prevailing values of a society in a realistic manner. The importance of multiple and conflicting objectives have been ignored by public health practitioners. Attempts were made to compress the rationale for food protection programs within the rigid framework of a single objective called "public health reason." In fact, there are a number of objectives that must be considered:

1. Maintenance of a food supply. The objective in this case is the provision of an acceptable level of food to support a population at a specified nutritional level.
2. Prolongation of the shelf life and keeping quality of food. The prevention of food deterioration and wastage is the primary objective of food protection programs in a major part of the world.
3. The maintenance of a food supply that meets the cultural and esthetic expectations of the consumer.
4. The maintenance of a safe food supply. It is only at this point that the "public health reason" becomes the predominant objective.

Approaches to Teaching Food Hygiene

There are a number of alternatives in organizing a curriculum in food hygiene. The straightforward approach is to teach on the basis of a food or class of food, e.g.,

milk hygiene or meat hygiene. Or the presentation may be related to the nature of the contaminant, e.g., microbiological or chemical. These are manageable approaches. However, food hygiene should be considered within the framework of the food system rather than from the standpoint of an isolated food commodity waiting to be contaminated by an isolated microorganism. Ackoff (2) notes that "we must stop acting as though nature was organized into disciplines in the same way that universities are." The inadequacies of treating food hygiene within the conventional disciplinary framework becomes apparent in the planning of a suggested curriculum for a course in food hygiene.

We may insist that the foci of study can be limited to the food commodity and the pertinent microbiological, chemical, and physical agents. Food control officials educated within these disciplinary frameworks, however, would have missed a number of important elements of food protection. The essence of food protection is a knowledge of the operation of the food system. In the broadest sense, a system is any set of inter-related components. What are some of the components of the food system which relate to food hygiene? The primary link between food and contaminant is the mechanism of contamination. The probabilities the contaminant will gain entrance to the food depends on a number of interrelated factors, including:

- Food handling methods, and human factors of care or carelessness
- Consumer food habits and food cultural practices
- Food technology
- Patterns of distribution and transportation
- Microbial ecology

The immediate food-contaminant system is surrounded by a larger system for the

control strategy and the public response. A knowledge of the food-contaminant system permits the choice of the point in the chain of pollution where the control strategy may be optimal. There are usually a number of alternate approaches to control procedures; these include inspection, technological fixes, laboratory testing, and sampling (as opposed to total inspection procedures).

The system is extended further, since control strategies and methods cannot be isolated from the agencies and organizations responsible for the program. There are, therefore, additional subsystems that must be considered. The control may be through one or all of a number of Federal, state, or local agencies. The food industry is another organization involved in the control program. The mechanism of control is determined by the objectives, which in turn depend on political and social factors. These factors are intimately related to considerations of law, economics, and administration. Food hygiene should be taught from the viewpoint of human ecology rather than as a subdiscipline under chemistry of microbiology or a similar subject.

It would be self-deluding, however, to expect any teaching program to deal with all these factors in depth. The objective of a teaching program may be geared to the preparation of specialists and generalists. Differing programs are required for: (1) research scientists, who require a rigorous and specialized education within a basic discipline; (2) technologists, who are educated for the translation and application of research findings into current practice; and (3) technologist-managers, who will follow career patterns in government or industry in the operation and management of food protection programs.

It may be useful to differentiate the educational needs of these groups. Kranzberg

points to the differences between science and technology by noting that the technologist must deal with problems that are invariably complex:

He must consider problems of materials, energy, information and control. He must have some idea of the scientific and technical knowledge necessary to his project. He must consider matters concerned with utility such as costs, markets, state of other arts and legal restrictions. The questions he deals with spill over into the social sciences, law, health and medicine and even into history, literature and philosophy.

Scientists have a preference for small, manageable problems. René Dubos notes that the biologist who decides on a student to study man, soon narrows to the study of an organ, then to a single cell, then to the cellular fragments, then to the molecular groupings, individual molecules and atoms. Though he is losing sight of man in the process, he is looking for some fundamental understanding of nature's building blocks (3).

The School of Public Health at the University of North Carolina cooperates with the Department of Food Science at the North Carolina State University in preparing students with backgrounds in science for careers in the public health aspects of food science and food product safety. The required course work in food processing, food chemistry, and microbiology is given at the Department of Food Science, and the School of Public Health provides the instruction in food protection, environmental control, epidemiology, statistics, and administration. The graduate of this program should have the basic skills for the understanding of scientific findings and for the translation of these facts into current food hygiene practice. In sum, he should have the skills and attitude of the "technologist" described by Kranzberg.

There is a third level of preparation which has been suggested: that for the technologist-manager. This educational pattern is intended for those who have achieved the skills of the technologist and are preparing for managerial functions with government

or industry. There is increasing recognition that scientists and technologists do become managers and that there is a separate and additional set of skills that must be learned in this progression. The School of Public Health at the University of North Carolina offers courses in environmental health services management for persons concerned with the direction or supervision of professional and technical programs in environmental protection. The curriculum includes program planning, administration and management, systematic approaches to decision-making, public policy development, and an appreciation of the significant factors that are involved in the implementation of technical solutions to environmental and food protection problems.

The foregoing discussion has evaded the real purpose of this part of the Symposium, which is concerned with the teaching of food hygiene to veterinary students. The organization of a course or curriculum in food hygiene for veterinary students is more difficult than that for the preparation of the graduate student in food protection. There is limited time as well as limited interest. There are conflicting educational objectives,

such as those for example, between the relative content of conceptual instruction and practical instruction, and between coverage in depth of limited subject matter as against a more superficial coverage of a wider content. I would favor conceptual instruction over practical and breadth over depth. For instance, practical instruction in meat hygiene inspection methods could be given in continued education courses to those veterinarians who will actually follow this career.

I believe that it would be useful to introduce the student to the concept of the food system, its components, and their interrelationships. Food hygiene has reached a stage of complexity and specialization that requires graduate education. Courses in the veterinary school cannot prepare the student for effective comprehensive food hygiene practice. In emphasizing the food system, the few students interested may choose to pursue graduate study and then participate in the total approach to problems of food protection. The other students will have gained some appreciation of the scope and complexity of modern food hygiene practice.

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THE TEACHING OF ENVIRONMENTAL HEALTH

OVER-ALL OBJECTIVES AND RESPONSIBILITIES

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No socially aware professional would deny today that the environment is changing. What we need to understand is *how* it is changing, *why* it is changing, and *what* are the emerging problems. Although these questions may never be completely answered, we as educators must prepare ourselves and our students to cope with this changing environment, both now and in the future. "The future," as Blakely states, "belongs to prepared intelligence" (1). This obviously means that we must have a plan (2). As teachers of preventive medicine and environmental health, we must not fall into the rut of believing that all motion is necessarily progress. As one physician puts it, let it not be said of us that "having lost sight of our objectives, we redoubled our effort." Conferring together, pooling expertise, and sharing experiences are steps toward reassessing present objectives and principles in teaching veterinary public health and preventive medicine.

What, then, is the objective of environmental health? Logan (3) states that it is "the improvement of the quality and character of the total environment for the well-being of mankind . . . and implies the conservation and utilization of natural re-

sources in such a way as to prevent disease and debility, and to assure an environment which is esthetically satisfying and developed in conformity with the highest aspirations of the human spirit." According to Weisburd (4), environmental health is an *approach* to medicine and public health rather than a major scientific field in itself. The American Public Health Association Committee Report on the Environment (5) states that "comprehensive health planning must consider the major role that environment plays in health." The report includes the following checklist of program areas, together with plans and methods to be used as guidelines:

I. *Environmental Program Area*

- Wastes
 - Air
 - Sewage and liquid
 - Solid
- Water supply
- Housing and residential environment
- Food and drugs
- Radiation
- Noise
- Accidents
- Occupational and institutional hazards
- Vectors
- Recreation

II. *Planning Considerations*

- Health
- Economic
- Demographic and land use
- Social

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Esthetic
Resource conservation

III. *Methods and Techniques*

Research
Demonstration
Education
Standards
Legislation
Inspection
Enforcement
Planning
Evaluation
Incentives
Systems analysis

The Committee emphasizes the importance of other resources, among them, manpower, facilities, and services.

Those in veterinary medicine have a role to fill in every one of the categories listed. The student, therefore, must be taught the fundamental concepts of integrated planning in environmental health. To do this, he must know who the other participants are and what they can offer. This will allow him to understand how he can best serve on the team in solving environmental health problems.

Health care for man is presently one of the largest industries in the United States and Canada. Because of shortages of "health" professionals, all members of the health team will have increasing demands placed on their time. These trends will require more communication and cooperation among the health professions (6, 7). Veterinarians must do their part in reversing the daily pollution and deterioration of the air we breathe, the food we eat, and the water we drink.

Educators in veterinary public health must share responsibility for improving our rapidly deteriorating environment. To do this we must assess our own knowledge before we can hope to educate our students and fellow faculty members.

The student must be motivated to believe that the health of man and animals is re-

lated, directly or indirectly, to the quality of the environment. Of the three terms "host," "parasite," "environment," the last is probably the least understood. In reviewing motivation, Paul (8) states that "society's mandate to the individual is to achieve or accomplish 'something' which implies a goal or objective. . . . The job of education is to teach the individual to take care of himself in society and society's reciprocal obligation is to create an environment conducive to the achievement or attainment of these personal goals." Certainly, this is also true of the objectives and principles of the teaching of environmental health.

Environmental influences on health and safety include physical, biological, chemical, and social groupings. They have been discussed in detail by Dubos (9, 10), Top (11), and Gordon (12). The by-products of human living and advancing technology have polluted the air, water, and soil beyond the saturation point, especially in and near large cities, both by implosion and explosion. Sooner or later, we will have to pay the consequences, unless we work together to more fully understand what the environment is and what our role will be, individually and collectively, in solving present and future problems. Because of expanding human and animal populations, we will have to "pay" our way into a relatively healthy environment. Berry reviews the trends and organization of agricultural health and safety programs in this regard (13, 14).

As educators, we must read and listen to accounts of what society is doing around us. We must teach understanding. We must teach our students how to keep up, how to analyze the potential effects of changes and, hopefully, to take early, preventive steps. Unfortunately, it is difficult to sell prevention because it is difficult to measure the impact of what has been prevented.

The veterinary student must be taught

that to "get it done" he must often join an organized structure to effect major changes in which timing is an important factor. Good laws do not always pass. What with vested interests, economics, and politics, the role of the future veterinarian in these areas will become more complex. The student must be made aware of these basic facts of life. He must be taught that interagency local, state, and Federal communication is a necessity because of the complexity of many of the basic environmental health problems (15). He must be taught to understand public health administration, methods of problem-solving, and the role of local boards of health (at present 20 of the 99 counties in Iowa have veterinarians on their local boards of health).

Few environmental health problems have simple cause-and-effect relationships, and many defy description. Certainly, the concept of multiple causation must be impressed upon the student. New changes in technology have and are causing shifts in host-parasite relationships, many of them being detrimental to the health of both man and animals. Therefore, the student must be told of some of the "knowns" that result from society's changes so that he might be further educated to assess the importance and consequences of future technological changes as they affect the practice of veterinary medicine.

The human leptospirosis outbreak caused by swimming in an irrigation canal in the State of Washington typifies how changing the environment (in this case, reclaiming land by irrigation) alters disease patterns (16). Because of man's desire to use his leisure time for recreational activities, he often becomes exposed to zoonotic agents shed via urine or feces into farm ponds and streams by infected animals (17, 18). Often "new" host-agent relationships become apparent, as in the human cases of leptospirosis associated with squirrel hunting, reported by Diesch *et al.* (19).

A man-made problem, not necessarily of man's "external" environment, but one of medical progress, has been the use of immunosuppressive drugs on human patients prior to organ transplants and also in the treatment of Hodgkin's disease (20). Because of the reduction of host resistance, a kidney transplant patient died of generalized toxoplasmosis following such treatment (21). This is an example of an iatrogenic effect, a result of medical progress (22). Do this and the afore-mentioned examples have implications for veterinary-medical progress?

A syndrome characterized by acute abdominal pain and signs of peritoneal irritation was seen with increasing frequency beginning in 1955 in the Netherlands. Studies of the involved segment of the small intestine revealed penetration of the intestinal wall by a nematode. This infection was contracted by eating raw or improperly cured herring containing larval stages of the nematode that normally mature in the stomach of aquatic animals such as porpoises and seals. The increasing prevalence of the disease was attributed not only to the increased consumption of herring as part of the diet, but also to a change in the economics within the fishing industry that led to delayed processing of the fish (23). Heinemann has studied the effects of sonic booms on the hatchability of chicken eggs and on mink breeding and whelping (24, 25). He raises the question: What will be the long-range effects of the supersonic transport on man and animals?

Dr. William Buek and colleagues at the Iowa State University College of Veterinary Medicine observed an unusual environmental problem recently. Although fluorosis in animals had not been a problem in Iowa, changes in the industrial patterns and the establishment of a chemical plant manu-

facturing defluorinated phosphate near the Mississippi River led to considerable problems in the area where farmers began reporting a reduction in corn and other crop yields. Livestock began to show reduced weight gains and many animals in milk and calf production became emaciated—a good example of livestock and crop production losses associated with industrial air pollution—one more case in which industrial technology has changed some of the specific geographic patterns of certain disease syndromes (26).

Types of farm accidents have also changed because of technological development in farm-machinery design. Knapp (27, 28) states that the power-take-off (PTO) replaced the auxiliary engine on farm equipment and therefore reduced fires and cranking accidents. However, the PTO produced entangling accidents such as emasculations, fractures, and amputations, which required the development of new shielding. Further changes have developed with the use of hydraulic lines to motors to replace the mechanical PTO drive. Although this has helped to reduce accidents of the former type, they have been replaced by such consequences as dermatitis, injections of oil into the body, and burns. According to Knapp, the lesions are not initially visible, and the physician must eventually operate to remove "invisible" oil droplets.

Extensive mining and farming of the oceans will take place by the year 2000. It is predicted that approximately one-fifth of the world's food will come from the oceans. What, then, will be the contribution of veterinarians toward understanding potential environmental health problems associated with farming the oceans? Again, a problem of advanced technology.

We must critically observe trends in society and assess their impact on the health of man and animals. We must teach stu-

dents how to critically evaluate these trends, how to be aware of potential new associations in man-made relationships, and how to keep open minds through the use of scientific methods of observation.

The veterinary student must be told of the interrelationships, responsibilities, and roles of other disciplines and professions with which he will work in solving environmental health problems, both present and future. He must be taught the principles and objectives of teamwork. He must be taught that, as a "giver" of advice and information, he must understand the "user." He must understand that the environment influences the relationship between giver and user and that political, social, and economic trends affect these communications. He must be told of the importance of client education and motivation and have an understanding of issues and problems that affect man (the owner) and his animals.

The veterinary public health curriculum must reflect the trends in environmental health and develop in the student a desire for contributing to the solution of local health problems. The curriculum must do more than just impress him with the economic value of the services he can provide to the community (29). There are only so many hours available for teaching, and with the increasing amount of technical information available daily, the teacher must continually reassess his teaching program. The student need not know all the facts, because many will change, but he must certainly understand the concepts which remain fairly constant. More importantly, the student must be taught how to keep up with the changes by taking advantage of continuing education programs and the printed word. He must continue his education after graduation.

As Osler has stated:

In addition to the various senses, the student

needs to have a sense of "responsibility" and more important, a sense of "proportion." . . . Thoroughness is the most difficult habit to acquire, but it is the pearl of great price, worthy of all the worry and trouble of the search. . . . What we need is the man who knows the records, who, with a broad outlook and drilled in what may be called the embryology of history, has yet a powerful vision for the minutiae of life. . . . The scholar can never feel initiated into the company of the elect until he can approach all of life's problems from the cosmopolitan standpoint . . . and it is not only book knowledge and journal knowledge, but a knowledge of men that is needed (30).

We must also realize that what students are taught and what they learn may not necessarily be the same thing. Teachers must understand the background and motivations of students if they are to be realistic in their approach to educating them about the impact of environmental health problems and their importance in the practice of veterinary medicine. Both training and education are important in veterinary medicine, but "educated" is the key word for the total professional life of the veterinarian.

There is a need for coordination of environmental health areas in the present veterinary curriculum. The teachers of preventive medicine and veterinary public health can play an important role in the over-all education of the total faculty in this regard, and, hopefully, will prevent duplication of teaching material in an already too crowded curriculum.

Teachers of veterinary public health might also influence information given in lectures in the preveterinary curriculum. The "users" of veterinary services need to be educated as to the value of veterinary medical professional talents. While I have not taught formally in a college of veterinary medicine, I feel there is a need to pursue an expansion of the environmental health or ecology courses that are offered and/or required.

The student should be made to read basic information in environmental health (31-41), including the basic areas (air, food, water, soil) and pollution, whether natural or man-made (ionizing radiation, chemicals, agricultural waste). Such reading should be assigned as background information, and lecture time should be spent discussing the why, where, future applicability, and importance of environmental health in its broadest concept.

The student, of necessity, will have to be tested on subject matter and will have to "regurgitate" certain fundamental facts to pass exams; however, it is hoped that "spoon-feeding" will be kept at a minimum and that we, as teachers, will have the courage, conviction, and ability to stimulate the student to utilize the scientific-method approach in educating himself while in school—so that he may continue to educate himself after graduation.

It is also important that we know and consider the human factor in teaching. We must understand students' motives for entering the school of veterinary medicine. Therefore, the challenge of teachers of preventive medicine and veterinary public health will be to continually instill and motivate the student to believe in the value of preventive medicine. Top emphasizes that "wellness" is an attribute that has to be sought and preserved in addition to the after-the-fact treating of illness (42). It must be realized that the environment has been a great friend. Nature's air, water, and soil have provided natural benefits for man's survival. However, concentration of animal and human populations and technological developments in industry and agriculture have undermined nature's own method of disinfection.

Some students may wish to pursue environmental health training within the undergraduate curriculum, and it is possible that a part-time or summer externship

program could be made available for them in environmental health programs in medical centers, health departments, or veterinary colleges. In 1967 a Comparative Medicine Externship was initiated at the University of Iowa College of Medicine, and two freshmen veterinary students spent the summer working in various areas of our field and laboratory studies, primarily on leptospirosis and toxoplasmosis. They were allowed to participate in and see the various aspects of a total environmental health center and to confer with the people working in these areas. Such an interchange of ideas not only helps the students directly involved, but is of value in educating their classmates in the veterinary school. The externship program was continued through the summer of 1968. I am sure that there are many other potential externships throughout the United States and Canada under private, state, or Federal sponsorship. Vacation time is limited, but the more students become involved in active programs of environmental health, the broader will be their concepts and the more effective will be their contribution to society and their future profession.

I personally feel that if we are to develop a curriculum which will enable future veterinarians to successfully carry out their role in society, then *we must*:

- Understand the fundamentals of ecology.
- Accept the fact that change is inevitable and that these changes will have both good and bad effects on our ecologic equilibrium, effects which are often very subtle and difficult to measure.
- Understand natural and man-made factors affecting health and disease.
- Understand the effect of man the "invader," his technology, and his impact upon man-animal relationships.
- Understand the socioeconomic-political implications in controlling and preventing environmental hazards to health.
- Understand that multiple causation or a combination of factors is involved in environmental health problems.
- Understand the team approach to problem-solving.
- Use the scientific method in assessing the effect of the environment on host-agent relationships.
- Understand and cope with the "diseases" of medical and veterinary medical progress.
- Influence the teaching of the various concepts of environmental health in the total veterinary medical curriculum, not just in the veterinary public health area.
- Educate our students on how to be objective and instill in them a heightened sense of awareness.
- Keep current with the literature, both inside and outside of veterinary medicine.
- Volunteer our talents to the solution of environmental health problems and encourage interprofessional communication.
- Practice what we preach.

Representative John C. Culver of Iowa best summarizes my thoughts when he states that "more than anything else, our society needs today the man who can be the skilled professional, yet is not imprisoned by his subject or calling" (43).

The great challenge then, is to develop an individual who has the confidence and courage to actively and intelligently involve himself in solving the problems of tomorrow.

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THE TEACHING OF ENVIRONMENTAL HEALTH

EXPANDING THE CURRICULUM

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Unfortunately, veterinary public health has been used synonymously with meat inspection over the years. It is extremely difficult to correct this impression, not only in the eyes of the public but, even more important, in the minds of our fellow veterinarians. Such a misconception is primarily the fault of our veterinary colleges, our several professional organizations, and veterinarians themselves. Our colleagues have been guilty of not looking at the full range of health activities and determining where the veterinarian can fit into the picture. It should be one of the major goals of veterinary public health education to correct this professionally damaging image. Meat inspection services are an important consumer protection function. However, it is only one part of the over-all public health activity involving the veterinarian. Traditionally the veterinarian has been associated only with inspection of the foods of animal origin, whereas he should be concerned with the processing of all foods. His training gives him an excellent background for dealing with the problems associated with canned, frozen, cooked, dried, and other processed foods. We should not exclude ourselves from this area of food protection responsibility.

There is no member of a profession more

adequately trained and equipped to deal in health matters than the veterinarian, with the possible exception, of course, of the medical physician. Our basic training in microbiology, parasitology, immunology, chemistry, and many other sciences is unsurpassed by the education of any other professional entity and is particularly of value in matters dealing with the health of the public. The average veterinarian, however, is not aware of this, as he has had little opportunity to compare his training with that of his fellow professionals and usually does not come into close enough contact with an organized public health department to become knowledgeable in this respect. It is therefore the responsibility of the teacher of veterinary public health to make these facts known. The increased utilization of the governmentally employed public health veterinarian in the teaching program of veterinary colleges would contribute significantly to the improvement of this situation.

In certain health matters the veterinarian is the only one that has the professional knowledge to answer technical health questions and should take a definite stand in resolving such problems. He should not consider himself inadequate and "pass the buck" to a physician or other health professional. If the problem is within the scope of his health competence, he should exert his influence and knowledge in a posi-

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tive manner. I have observed many times the reluctance of the practicing veterinarian to commit himself on a technical question of a veterinary public health nature.

Public health departments, be they local, state, or Federal, are beginning to realize the multiple values of a veterinarian's training and are more and more utilizing his skills and expertise in a variety of health programs. In my own case, for example, I was recently made chairman of the Hospital Infections Committee at Denver General Hospital. Being the only veterinarian on the medical staff of this city hospital pleases me very much, not only because of the personal recognition, but because it shows that the medical administration of the hospital recognizes the knowledge, training, and capability of the veterinarian. This assignment has been particularly challenging and of considerable professional interest, but the assignment of a veterinarian to such a responsibility should not be too surprising, as the microorganisms found in the hospital are not unknown to the veterinarian. Furthermore, the equipment and unique environment of the hospital are not totally unfamiliar to us, particularly if we have had any public health training and experience. The hospital and institutional environment should be an area of environmental health interest to the veterinarian.

When considering a topic such as environmental health and what the veterinary student should be taught about such a subject, we should first recognize that most public health problems require a team approach. Many health disciplines are a part of the environmental health team. Health professionals—physician, sanitarian, engineer, nurse, laboratory technician, and others, as well as the veterinarian—make up this health team. A good example of environmental health and the team approach would be our country's space program, where a great many health special-

ists, including the veterinarian, work in a highly integrated and complex program with a common objective.

In planning a course in the environmental aspects of veterinary public health, one must first consider the administrative framework of the governmental agencies with which we deal. Veterinary students should be exposed to training in basic governmental administration. Such training should include public health law, governmental organization, relationship of one level of government to another, and relationship of organized health organizations to the governmental body. Today we frequently see local practicing veterinarians appointed to boards of health and other governmental bodies, both at the city and state level. Very often they are elected to state legislatures, city councils, and boards of county commissioners or become mayors of municipalities. Too often they find themselves lost for the first few months because of their lack of familiarity with governmental organization and administration. This can lead to their embarrassment, frustration, and frequently to dissatisfaction and withdrawal from governmental participation. I realize that the present-day veterinary curriculum limits the amount of time that can be devoted to such a subject. However, some time should be spent on this worthwhile topic, which is a part of the over-all program of veterinary public health. Veterinarians should know how laws are developed and enacted. They should know the basic responsibilities of boards of health, state legislatures, city councils, and the like. Furthermore, the duties and responsibilities of the state health officer and the administrative framework of the health department should be covered for the veterinary student. This would be valuable information, even if he were never to become intimately involved with government. It appears that we have always had

a relationship to departments of agriculture and have been given some exposure to the administrative organization of those agencies. Should not organized public health be given equal time?

Webster's dictionary defines environment, as it pertains to biology, as "the aggregate of all the external conditions and influences affecting the life and development of an organism." We can accordingly define environmental health as the external conditions and forces which affect man's health and well-being. These are tremendous and complex factors, as you can well understand. When orienting new personnel at the Denver Department of Health and Hospitals to the environmental health program, I usually illustrate my subject by utilizing a rough sketch of a man with arrows coming at him from all directions. Each arrow is labeled with one type of environmental influence or force exerted upon him: the air he breathes, the water he drinks, the food he consumes, his animal associates, his occupation, recreation, and housing or shelter. I then run several arrows back from the figure of the man, indicating his contaminating influence on the environment in areas such as air, indicating man's pollutional influence on his air supply. The same example applies, of course, to man's waste, both solid and liquid, which influences his water supply and creates other environmental health problems. It is important to visualize man as an organism with various influences acting upon him, and with man influencing his environment in turn.

The principles of sewage disposal, including the large municipal treatment plant as well as the small private septic tank system and lagoons, should be covered in any course of public health. Proper and adequate treatment of human and animal waste is an extremely important matter and all veterinarians should have some familiarity

with the subject. Therefore, in the teaching of veterinary public health, considerable emphasis should be placed upon treatment of water supplies and proper waste disposal, as these two processes are vital to the health and well-being of all our citizens. In addition, these two environmental considerations are extremely important nationally at this time. Even though veterinarians are usually not going to be actively involved in water treatment or in waste disposal, the principles of such treatment and processing are important. The complex water filtration and chlorination treatment principles should be understood by the veterinarian and he should be able to talk with some authority on this subject because of the relationship to disease prevention and health. For example, most health professionals are aware today that normal water treatment does not free the water supply of viruses. The general public feels, I am sure, that it does. The veterinarian should also know of the water-borne diseases of man and animals. Veterinarians, particularly those engaged in public health, should be able to speak with detailed knowledge on this subject. The problem of cross-connections with relationship to the water supply piping system should also be stressed, as veterinarians can and do create these problems in veterinary hospitals, in laboratories, and in meat processing establishments. They should know how to prevent this dangerous back siphonage problem into potable water supplies. It is surprising the lack of knowledge that veterinarians have on this subject of cross-connections. Many of these cross-connections have been noted in establishments inspected by the U.S. Department of Agriculture. The principles of well construction should also be given attention in our courses of veterinary public health, as the veterinarian can serve as a valuable consultant to

the farmer and his community in the problems of water supply.

The problem of solid waste disposal has become a matter of concern to the entire country. The tons of waste that are created each year is a growing problem with no easy solution. New and better packaging methods are multiplying the amount and types of wastes requiring proper disposal. Veterinarians must know of the health hazards created and should be able to contribute to the solution of the problem. When attending veterinary school, many of us had no thought that we would be engaged in any pursuit other than the practice of veterinary medicine after receiving our degrees. I was one of those persons and I could have used such health information, which I had to gain later through practical experience.

The relationship of man to his animal associates is a close environmental influence. I am certain that you spend considerable time with veterinary students on zoonotic and epizootic diseases. Today, because of the ease and speed of modern transportation, we must further consider the exotic diseases of foreign origin, both microbiological and parasitic, which affect man's health. For example, the large numbers of monkeys and other animals imported into this country have contributed to the growing zoonotic disease lists. Two weeks ago I attended a hospital infections course at the National Communicable Disease Center in Atlanta. One of the speakers, a medical doctor whose practice is in Southern California, was called to examine a patient who had been injured by a gorilla and subsequently developed a fever and enlarged axillary lymph nodes. Upon further investigation it was learned that the patient had been scratched earlier by a leopard and that, through consultation with a public health veterinarian, had learned that leopards can carry the disease known as cat-

scratch fever. He concluded, therefore, that the patient's infection was from the leopard and not the gorilla, as first thought. (I do not know whether this should be called an exotic disease or a disease of an exotic pet animal.)

Look at the problem of pet turtles in the home and the increasing problem of salmonellosis. What closer environmental health relationship could we have than this? In many cases man's relationship to his animals is occupational rather than recreational or for his own personal enjoyment. The danger of brucellosis to the farmer, veterinarian, and packinghouse worker are well documented. Here again, man can contribute to health problems in his environment by not providing proper care and attention to his occupational relationship. Another example might be the problems created by fly production on the farm from poor environmental sanitation practices in the handling and disposal of organic wastes. There is a tremendous problem today in the disposing of cow manure, as inorganic chemicals have many advantages as a source of fertilizer over the natural product. The veterinarian should assume the responsibility of advising his client as to proper waste disposal methods which do not create a hazard to himself and to his family. He should be knowledgeable of the life cycle of the fly and know the methods for controlling this health threat. He should stress the value of good environmental sanitation and convince the farmer that fly control does not rest with the use of insecticides alone. The veterinary student should also be taught mosquito control and the management of other insect vectors of disease. The hazard to animals should not be the only consideration in dealing with pesticides used in vector control; information on modern insecticides should be current and should include types, application, and specific uses for distinct problems. Safety

factors involving these agents and their use should be stressed.

The same consideration should be given to the subject of rodent control. Today we often forget that rats and other rodents provide serious problems and are a threat to man's health. In addition, the rat consumes tons of food of both man and animals each year. This dangerous pest, which lives in close association with man, contaminates our food supply and destroys our material goods. This problem has become so serious in our large urban centers that Congress has shown concern and has provided funds, through the U.S. Public Health Service, for grants to cities to conduct comprehensive rat control programs. Our veterinary graduates should be knowledgeable about this problem and its control—but are they?

Today the veterinary student is exposed to considerable training in the use of X-ray and other gamma radiation sources. He should and does, I assume, receive training in radiation safety and radiological health. In numerous states and in the U.S. Public Health Service, veterinarians have been employed as radiological health officers after supplemental training. The effects of radiation are a very important environmental health consideration, and the veterinarian can play an important role in this field. Our teachers of veterinary public health should provide some additional background in this subject area.

Although the subject of civil defense is commonly an unpopular one, the possible civil defense participation of the veterinarian as it relates to environmental health problems should be provided for. This could be done in a highly palatable manner by interjecting these topics while covering waste disposal, water supplies, food protection, radiation hazards, and other health problems of the environment. At a time of disaster the veterinarian might be called

upon to perform a wide range of health tasks and would be consulted for answers to a multitude of environmental health questions.

I fully realize that the competition for the course time of veterinary students in educational subject matter is tremendous. Each department head feels his subject area to be the most important and in need of substantial time increase. In any event, additional time should be provided to cover some of the basic principles of environmental health. Veterinary education should take into account that the activities of veterinary medicine have an environmental health influence and that the environment affects the practice of veterinary medicine and the health of our citizens as well as our animal associates.

With the observed population shift leading to greater numbers of our nation's citizens moving into the urban areas of our country, environment plays an increased role in the health of man. The veterinarian is also becoming more prominent in the urban scene than was the case 15 or 25 years ago. The practicing veterinarian will be confronted with an increasing number of questions pertaining to diseases of animals and their relationship to the health of their owners and the public. With this more congested living situation, the veterinarian must assume his proper place in the urban scene.

In summary, teachers of veterinary public health must assume the important responsibility of making known to their students the numerous problems of the environment as it affects the health of man. After all, man too is an animal and should not be excluded from our consideration just because he is of a higher order. No other area of the veterinary curriculum can provide this important health training. Environmental health encompasses a broad

range of complex problems, the list of which grows longer each day. The veterinarian cannot escape participation in the development of solutions to these problems. It is therefore the responsibility of colleges of veterinary medicine, through the veteri-

nary public health divisions, to make these problems known to the student and to define his part in the over-all picture. Let us make the veterinarian and the public aware of our professional credentials and broaden our participation on the public health team.

THE TEACHING OF VETERINARY COMMUNITY MEDICINE

CHANGES IN EMPHASIS AND METHODS

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Change is inevitable in society. Professions supported by society must change to meet social needs. The past 50 to 100 years have been characterized by accelerated changes in scientific knowledge, in the number and distribution of people and their aspirations for better health, in the functions of health practitioners, and in educational aims and pedagogies. Lane (1) has stated that "a profession, to remain viable, must serve the society in which it lives and breathes." Anderson (2) believes that veterinary medicine "must respond to change by acquiring new knowledge and by adapting our services to the needs of the times if we are to be useful and productive, not only as citizens but professionally." According to Burney (3), "the university is an instrument of society, an instrument for social change." One must keep in mind that the students being trained today must function in society 10 to 25 years from now. Are we

providing those students with the training they need to function effectively and efficiently?

There are innumerable similarities between human medicine and animal medicine. Likewise the aims and methods of teaching students in these two health professions are similar. During the past 10 years there has been tremendous improvement in and expansion of the teaching of preventive medicine and public health in American medical schools. Almost all new medical schools are planning large departments of community medicine. The Shepard-Roney report (4) describes the status of the teaching of preventive medicine in schools of medicine prior to these recent developments. Historically, preventive medicine was characterized by few separate departments, inadequate numbers of poorly trained staff members, lack of budgetary support, and unimaginative teaching programs. Coker and associates (5), in a study of medical students' attitudes, showed that public health ranked low as a career choice.

Knowledge of the teaching experiences and innovations in medical schools may prove useful to those teaching community medicine (public health) in schools of veterinary medicine. Therefore, the purposes

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of this paper are: (1) to review some of the important changes in society, medical sciences, and medical education; (2) to indicate why more emphasis should be placed on community medicine in schools of veterinary medicine; and (3) to suggest some methods that may prove useful in teaching veterinary community medicine.

Changes in Society

Perhaps the most dramatic change in society in the past 100 years has been the population explosion. Steele (6) in 1963 pointed out that the world population is estimated at 3 billion people and that this figure probably will double by the end of the century. Moreover, better than one-half of the world's population subsists on a substandard diet. Add to this the aspirations of developing nations and we face a critical public health and socioeconomic problem, to which birth control is only a partial answer. The veterinary profession and agriculture are faced with the immediate problem of increasing livestock and food production. Widespread animal diseases limit food production in many countries. Obviously, veterinary practitioners will never conquer these diseases by treating individual sick animals. A public health approach is needed in animal populations to prevent diseases before they occur. In the United States the population is increasing rapidly and moving from rural to urban areas. The number of people operating small farms is rapidly decreasing. Large farms and stock operations are the emerging pattern. These trends emphasize the need for veterinarians trained in herd medicine (public health) and international health.

During the past 10 years there has been increased social legislation in the United States to improve health care and health

protection. This legislation includes the regional medical programs (Heart, Cancer, and Stroke), Medicare, Medicaid, the Comprehensive Health Planning Act, and the Allied Health Professions Act. Government is becoming more interested in safer food and drugs, environmental health, and animal health. This trend in health legislation is likely to continue. The health industry now ranks as the third largest industry in the country and employs between 3 and 4 million people (7).

Increases in population and new health programs have resulted in a decline in the number of veterinarians, physicians, and dentists per 1,000 population. In addition, there is poor distribution and inappropriate use of available health personnel. How is veterinary medicine helping to meet this problem? According to *Health Resources Statistics* (8), 22.4 per cent of all veterinarians in this country are employed in veterinary public health and regulatory animal medicine. Because of inaccuracies in reporting there is reason to believe that between 25 and 30 per cent of veterinarians are employed by agencies directly or indirectly related to public health. Veterinarians are performing jobs today that were not even envisaged 50 years ago. These range from air pollution control and international health to medical care administration and the Air Force's new civic action programs in various countries (9).

Looking at the other side of the coin—what do practicing veterinarians do? Strangely enough, no one really knows. There have been no detailed time studies of veterinary practice, either small-animal or large-animal practice. For human medicine, a recent time study of 25 rural general practitioners' office hours (10) showed that the physician's time was apportioned as follows:

	<i>Per cent</i>
Personal activities	8.6
Preventive medicine	10.9
Administration	16.3
Health information and counseling	17.2
Treatment	20
Diagnosis	27

A surprising finding was that less than 50 per cent of the physician's time was spent on diagnosis and treatment. Most likely similar findings apply to the everyday practice of veterinary medicine. There may be a great disparity between what veterinary medical educators and students think veterinarians do and what they actually do!

Changes in Science

What are some of the changes in scientific knowledge and technology that should be taken into account when planning the training of future veterinarians? There has been an explosion of scientific information since 1900. The number of outstanding scientists currently living exceeds the total number of such individuals throughout history up to the present time. The number of scientific papers published has increased in a geometric fashion. Yet reviews of these publications in human medicine journals indicate that many of them are not based on sound experimental and statistical methods (11, 12). Similar findings probably are true for veterinary medicine journals. Students must have enough knowledge of biostatistics to be able to evaluate the articles appearing in their professional journals. Otherwise, true scientific discoveries may never be translated into effective veterinary medical practice in local communities. Computers have opened new vistas for research, medical diagnosis, and the handling of masses of scientific data. Pharmacology and therapeutics have emerged from the realm of empiricism to rather exact biological sciences. Over 75 per cent of the

drugs used to fill prescriptions today had not been discovered 100 years ago. Superficial diagnoses and symptomatic treatment of animals and tender loving care to clients are no longer acceptable in modern practice. Today many diseases can be prevented or controlled. Where these measures fail, potent methods of cure are available through the use of drugs and surgery. Professional school is but a brief interlude in the continuing education of a veterinarian. Are we motivating and preparing our students for a lifetime of learning?

The United States citizens have indicated through their Congressmen that they are willing to support health-related research on a large scale. This is reflected by the proliferation and growth of the National Institutes of Health. Universities have entered into partnership with government to produce this research. This has affected schools of veterinary medicine in several ways: (1) a sizable number of faculty members are being supported by grant funds; (2) more emphasis is being given to research by the faculty and administration; and (3) more students are becoming interested in research careers. Laboratory animal medicine has evolved as a specialty, owing in part to increased demands for animals for medical research. Veterinary public health is firmly established as a specialty. Comparative medicine has finally come of age. Multidisciplinary research is past the talking stage.

Changes in Medical Education

A university and its professional schools must meet the needs of society. They cannot operate effectively in an academic vacuum. They must extend their influence beyond their granite walls into the community. They must anticipate the needs of society and prepare their students to meet

these needs. Curricula and courses should be reviewed and revised periodically if they are to stay in the mainstream of social and scientific progress.

Some recent changes in the organization and educational aims of schools of medicine are pertinent to improving the teaching of community medicine (public health) in schools of veterinary medicine. These are:

Creating separate departments of community medicine.

Financing departments of community medicine on the same basis as other preclinical departments.

Providing adequate time in the curriculum for teaching community medicine.

Introducing subjects such as behavioral sciences, biostatistics, epidemiology, medical care organization, and clinical preventive medicine into the curriculum.

Establishing preceptorships with medical practitioners and/or preceptorships in community medicine which all students are required to take.

Providing more free time in the curriculum for electives of the student's choice.

Moreover, schools of medicine have become more and more active in the health affairs of the communities which surround them. Examples of this are the Regional Medical Programs (Heart, Cancer, and Stroke), Operation Headstart, and the community health centers financed by the Poverty Program.

Departmental Status

Schools of medicine have recognized for some time that community medicine cannot function successfully as the poor stepchild of a department of microbiology or a department of medicine. Thus, separate departments of community medicine were established. Owing to the broad, multidisciplinary nature of community medicine, one-man departments are grossly inadequate. A school should provide basic support for at least three full-time staff

members, a secretary, and a laboratory technician.

What categories of professionals might be found in a department of veterinary community medicine? A veterinary epidemiologist, a veterinarian specializing in regulatory animal medicine, a veterinarian with experience in veterinary public health practice, a biostatistician, an environmental health specialist, and a comparative medicine specialist—all might prove useful, depending on the teaching objectives of a particular department. Most members of a department of veterinary community medicine should have graduate training in public health leading to an M.P.H. or M.S.P.H. degree in addition to their basic professional training. It is highly desirable that the veterinarians on the staff be certified by the American Board of Veterinary Public Health or be working toward this goal. Adequate office and laboratory space should be provided for the professional and non-professional staffs and for resident physicians and/or graduate students.

Schools of veterinary medicine have not used the "clinical faculty appointment" as extensively as schools of medicine. For example, public health veterinarians in local or state health departments might be given clinical appointments in the department of veterinary community medicine. This academic appointment usually carries no salary commitment from the school. Another useful administrative procedure that we have used at the University of Missouri is the "joint faculty appointment." Selected members of the Department of Community Medicine in the School of Medicine are given joint appointments in the section on veterinary public health in the School of Veterinary Medicine. The reverse is also true. In most instances the school of the primary appointment pays the faculty member's total salary. In other cases the faculty member's salary is shared by both

schools. The joint appointment might be used even if both professional schools of a university are not located on the same campus. Similar joint appointments could be used with schools of public health and schools of engineering. In our experience doctors of medicine are very willing to teach in schools of veterinary medicine.

Teaching Program

What subjects should be taught by a department of veterinary community medicine, either within the department or in cooperation with other departments? There are certain subjects that are basic to community medicine and that would be applicable to both schools of veterinary medicine and schools of human medicine. Several authorities (13-17) agree that the following subjects are appropriate: biostatistics, epidemiology, medical (veterinary) care organization and administration, and clinical preventive medicine or clinical public health. Meat and food hygiene and certain aspects of environmental sanitation should be added to this list for veterinary schools. Zoonoses and comparative medicine could be taught within the framework of epidemiology. We believe that some aspect of veterinary community medicine should be offered during all four years of the curriculum. It is unrealistic to believe that a single lecture series presented to fourth-year veterinary students will ever meet their needs in community medicine. In our experience the sooner community medicine can be introduced to a student the more likely he is to become interested in this subject.

A suggestion of courses to be taught and the time they might be presented in the curriculum follows:

1. *Biostatistics*. This course should be introduced during the first year of the cur-

riculum. At least 20 contact hours are needed to introduce basic statistical concepts. The object of the course is not to make a statistician out of the student but to impress on him that measurement is essential in basic and clinical veterinary sciences.

2. *Epidemiology*. This course should occur during the second year of the curriculum. It is a basic science of community medicine and should be taught at the same time other basic sciences are taught. Thirty contact hours are needed for adequate coverage of this subject.

3. *Meat and food hygiene*. This course may be taught during the third year of the curriculum. At this time the student has completed his basic microbiology and pathology courses. Some environmental sanitation can be taught in this course which should consist of both lectures, practical demonstrations, and field trips. This subject might be taught jointly by the department of veterinary community medicine and pathology. About 40 to 50 hours are needed to present this material.

4. *Regulatory animal medicine*. This subject would be taught during the third or fourth year of the curriculum in a clinical setting. The department of veterinary community medicine could cooperate with the department of large animal medicine in teaching this subject.

5. *Veterinary community medicine*. This course is taught during the third year of the curriculum and emphasizes the role of the veterinarian in the community and the organization of community health services. Thirty hours are required for this course.

6. *Electives and free time*. These assignments are for students especially interested in veterinary community medicine. They are designed to get the student outside the four walls of the veterinary school and into the community. The elective should be at least four weeks in duration. It may be

taken during the summer months or during free-time or elective blocks in the curriculum. Helwig (18) has pioneered in training veterinary students in health departments, in abattoirs, in regulatory agencies, and with state-institution-owned herds and flocks. Other types of electives include community health surveys, epidemiological research, and preceptorships with practitioners. Elective assignments in developing nations is a very effective way to teach the international aspects of community medicine. Community medicine should be taught in the community as well as in the classroom (16, 17).

Other Activities

The Third National Conference on Public Health Training (19) recommended to the Surgeon General that training grant funds provided by Sections 306 and 309 of the Public Health Service Act be extended to schools other than schools of medicine, osteopathy, engineering, and public health. If this recommendation is approved by Congress, schools of veterinary medicine will become eligible for training grants to strengthen the teaching of public health. The project, apprenticeship, and residency training grants covered by the Public

Health Service Act and what they could provide schools of veterinary medicine were recently reviewed by Parrish and associates (20).

Departments of veterinary community medicine should organize residency training programs which would qualify graduate veterinarians for certification by the American Board of Veterinary Public Health. An experimental two-year residency program in veterinary public health recently was started at the University of Missouri (21). One year is for formal training leading to a Master of Science in Public Health degree. This training may be taken at a school of public health or another institution providing comparable training. One year of additional training is taken in a department of veterinary community medicine in a school of veterinary medicine. This training includes research, teaching, and field experience in an agency which practices some aspect of veterinary public health. The physical presence of residents and graduate students in veterinary community medicine is a powerful stimulus to interest undergraduate veterinary students in this speciality.

Research and participation in continuing education are two other functions of a department of veterinary community medicine.

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THE TEACHING OF VETERINARY COMMUNITY MEDICINE

ARE OUR VETERINARY SCHOOLS EQUAL TO THE TASK? *

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In a penetrating little book entitled *Science and Human Values*, Jacob Bronowski (1) espoused the view that a real understanding of *any* science "disputes the petty view which many scientists take of their own work." As a veterinarian, I have thought a great deal about this statement. For a long time I have wondered whether we veterinarians fully understand *our* work. Do we as a group clearly see our profession's role in society at this critical juncture in man's history? Or do many of us—perhaps even most of us—tend to take the "petty view" of our responsibilities and our obligations as a profession?

If, as I believe, we are not completely certain of our role, then should we not begin to engage in some frank introspection? Should we not begin to query ourselves about those influences which determine our horizons—the limits of our outlook—and our purposefulness as members of a learned profession? It seems clear that the problem of horizons in veterinary medicine lies chiefly in our schools. More than any other factor, I believe that it is the influence of our schools upon each of us, i.e., the impact

of our professional education, which shapes our future outlook and either restricts or enhances our vision as veterinarians. I am convinced personally that our schools of veterinary medicine do not today assume the leadership role in this regard which society has every right to expect of them. This is the utmost importance to us all.

For example, are our schools truly serving our profession as its germinal center? Are they opening up new horizons and new vistas of service for each new class of graduates? At the same time are they constantly re-examining, redefining, and revitalizing our old and established relationships? Are our schools truly innovative and visionary in their approach, or are our faculties content more often than not to bask in the deceptively secure warmth of an unbecoming professional smugness and uncritical self-conceit?

To be sure, we do occasionally ask ourselves whether our veterinary schools are fulfilling well the more traditional of their responsibilities to private practice? But how frequently do we inquire beyond this as to their alertness in identifying and responding to new and potentially exciting professional responsibilities? We might ask ourselves, do our veterinary schools often reflect a conservatism in this respect and an introversion which is uninspiring at best and certainly unbecoming to a learned and

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dynamic profession? In short, the question is simply this: Are our veterinary schools really equal to their task? Are they providing us with the leadership which we must have if we as a profession are to render our full measure of service to society?

In all honesty I do not personally believe that they are. I say this as no prognosticator of doom (far from it) but as one who is convinced that our schools can and must become what society and enlightened veterinarians everywhere have the right to expect them to be—and they must become this *soon*. But to bring this about will require nothing short of a revolution in veterinary education, a revolution certainly no less dramatic than that earlier one which forced the closing of the veterinary diploma mills and private profit schools in this country.

We in veterinary education are guilty—guilty not only of failing to lead our profession today but, in many respects, of failing even to keep pace with our profession. At times we do little better than “follow the crowd” and even then we sometimes do that ever so reluctantly.

As an example, let us consider just for a moment our uninspiring record with respect to laboratory animal medicine. Did the veterinary schools take the lead in identifying laboratory animal medicine as a veterinary specialty, or, once this need was demonstrated to us by others, did we pioneer in establishing programs of graduate study which would enable veterinarians to more effectively assume positions of responsibility in this area? Did we even take the lead in developing this increasingly important sphere of veterinary service by creating within our own schools model physical facilities or standards of care for laboratory animals? Did we develop research programs or research institutes whose aim was to identify, breed, domesticate, and define the characteristics and particular re-

search uses of new species, breeds, or strains of laboratory animals? We did none of these things! Where, for example, were our veterinary school centers for germ-free and specific pathogen-free animal research at the time when veterinarians in other institutions were pioneering in this field?

Is the record of our schools really any better in public health, in wildlife diseases, in primate biology and medicine, in experimental surgery, in food science, in animal reproduction, in nutrition, in fish diseases, in diseases of invertebrates, or in experimental aspects of the behavioral sciences? These are just a few important facets of the field in which veterinarians are working today and in which they individually or collectively have made their mark. Why is it that leadership in each of these new directions in veterinary service has come not from our veterinary schools but from veterinarians and others situated in other types of institutions? Have we in the schools even attempted to solve the acute yet long-standing problems associated with the performance of such routine veterinary tasks as meat inspection, artificial insemination, and mass testing, perhaps by setting up courses or qualifying standards for veterinary technicians on our own campuses?

If our schools are failing us professionally in providing leadership in these and many other areas, are we not forced to ask the question as to what role our schools *do* envision for themselves? I believe that the role which they recognize is very much a role which conceives of veterinary medicine almost exclusively in terms of its private practice and increasingly, I am afraid, of its more lucrative luxury practice. But is the private practice of veterinary medicine really the sum total of veterinary medicine? Is this the only, or even the most important, outlet for veterinary service? Of course not. Then why do our schools give every indication that they assume that it is?

It is certainly self-evident to many of us in and out of the profession that veterinary medicine represents, and historically has always represented, three overlapping spheres of activity and service—agriculture, public health, and the general biological sciences. This is our real source of professional strength and of our utility to society.

Our profession, unlike most others, derives its sustenance not from a single root but from deep roots in each of these three equally important areas. Herein lies our unique usefulness as a profession. It strikes me as absolute folly therefore to think, as some of us do, that we must deny one or another of these parental roots in order to personally identify with or to strengthen our ties to the second or the third. It ill becomes us and demeans us to do this. It shows that we do not really understand our own work.

All the administrative maneuvering and petty rationalization in the world cannot alter our profession's overriding responsibility to agriculture—for helping in a very significant way to ensure that mankind has an adequate supply of food. Verbal skull-duggery will not alter by one iota our role as a health profession, the character of our bonds to our sister health professions, our direct responsibilities to public health, or our even more important role in basic biomedical research. An individual obsession with any of these admittedly important aspects of veterinary service, agriculture, or public health, should never obscure for a moment the fact that veterinary medicine is synonymous with pathological zoology. Veterinary medicine is the field of study specifically concerned with problems of disease in all lower animals. While representatives of many different disciplines and professions contribute directly or indirectly to the solution of the disease problems of man and the disease problems of lower animals, it is the

physician and the veterinarian, respectively, who bear the major obligation in these areas. Are we assuming our broad responsibilities as biological scientists?

The tasks and the opportunities in veterinary medicine are, in fact, crystal clear. Why then are not the obligations and the responsibilities of our schools equally clear? I do not for a moment believe that there is a simple panacea to this dilemma which our veterinary schools now face, nor do I believe that there is any single solution. We can, however, begin here to consider some of the things which we *can* do about our situation.

What I believe is needed above all is for us to open up more effective channels of communication within our profession so that we as veterinarians may begin to share more effectively with each other our thoughts with respect to veterinary education and types of veterinary service. Some of our sister professions are doing this far better than we are. For instance, the World Health Organization has published a 391-page annotated bibliography of the literature on medical education (2). Its 2,600 entries represent the literature on medical education for only one 10-year period! Each year the Association of American Medical Colleges through its *Journal of Medical Education* and through the proceedings of countless conferences and seminars adds impressively to this literature. As a result of these attempts to communicate, many medical school faculties today are in the throes of self-criticism, experiment, and drastic reorientation. Are we?

Why is there so little literature on veterinary education? Our profession certainly does not lack ideas, nor do we lack potential sponsors for conferences or seminars on veterinary education. It seems that we members of veterinary faculties communicate our original thoughts far more effectively to our students than we do to each

other. It is ironic, but I am sure at the same time most fortunate, that each new crop of veterinary graduates finds itself very much in the vanguard of such new ideas as we individually generate. In our contacts with them they receive and accept from us individually our own half-formed hopes and aspirations for the profession and our most "far-out" thoughts. To the new graduate who hears them and *accepts* them, as our colleagues seldom have the opportunity to do, these points on the veterinary horizon at which we teachers have so laboriously arrived serve our students as their immediate points of departure. In truth they collectively begin at a point at which we collectively have yet to arrive.

In a recent graduating class at the University of California, for instance, there were at least 15 students who were deeply concerned about (and, from a career standpoint, seriously interested in) working abroad in an underdeveloped country in order to help face the critical problems of food production and livestock disease control. Four or five of them were as keenly interested in veterinary aspects of marine biology; several others were interested in disease of terrestrial wildlife. Having *individually* aroused their interests and convinced some of them of the needs and the opportunities, have we *collectively* provided new graduate programs and the like which are required to channel students along the road to these careers of service?

As we carry out our existing programs of education, I wonder whether we who run the schools understand at all that the private practice of veterinary medicine is a luxury most countries have never experienced—that almost the entire veterinary complement elsewhere in the world is engaged either in research, in governmental service, or in academic life. Even in Western Europe the pet hospital as we have come to experience it in this country in recent

years is a virtually unheard-of-commodity. Do we intend that the pet hospital is to be the ultimate product of our professional life in America—and that it is to be the principal reason our schools exist? If so, then we are certainly shortchanging the public as well as ourselves.

Let us examine a few of our profession's needs, such as the need, for example, to provide governmental services. The fact is that 25 years ago the U.S. Public Health Service was as unattractive to young physicians and as uncompetitive for their careers as the U.S. Department of Agriculture's veterinary divisions are to most young veterinary graduates today. Yet today the Public Health Service offers a great variety of attractive and exciting career opportunities not only to physicians but to veterinarians and others—in the National Institutes of Health, the National Communicable Disease Center, and many other branches of the agency.

Topnotch scientists are found in these organizations today. Their work is interesting and the positions they occupy are attractively competitive. Bright young students and graduates are being exposed to opportunities in the Public Health Service through two-year appointments in the NCDC's Epidemic Intelligence Service or through such imaginative devices as COSTEP—the Public Health Service's career development summer training program for professional students. It has not always been that way. We in veterinary medicine should not forget for one moment that outstanding veterinary scientists in the early decades of the U.S. Bureau of Animal Industry were making medical history in the United States at a time when the NIH and the NCDC were not even dreamed of! The accomplishments in fundamental research of the young Bureau of Animal Industry, more than those of any other U.S. institution, first attracted world attention to

American medicine. The pioneering efforts of Daniel Elmer Salmon and his colleagues in microbiology, immunology, parasitology, food hygiene, and disease control and eradication constitute one of the brightest chapters of our profession's history.

The greatest share of the blame for the fact that the governmental veterinary services today do not compete, as they once did, for the careers of our brightest graduates lies with our schools. If these governmental organizations have tended to become dull or unexciting it is because we in the veterinary schools have failed in our responsibilities to society. Today's generation of veterinary students, like all university students in America, is up to its ears in deeply felt concerns for society and for our fellowmen. Is it necessary that they shame us into action?

They come into my office—and I am sure into your office—every day asking us how they are going to bring their veterinary training to bear upon human needs, how they are going to really do something worthwhile. They do not necessarily have to go to Africa or Asia to do these things as so many of them believe. They can do them right here in the United States, and perhaps more effectively, by helping to revitalize the governmental veterinary services.

The problems and the challenges are at our very doorstep. What activities are inherently more exciting or more worthwhile than efforts to combat and eradicate diseases, to lift these tremendous burdens from society, and, in a concrete way, to contribute to a solution of the overwhelming food shortage and disease problems which face the people of the world today? In other words, the U.S. governmental veterinary services in agriculture must become again the pioneering organizations they once were, and for this to come about we in the veterinary schools must accept the fact that gov-

ernmental research and disease control careers constitute an extremely important avenue of veterinary service and one for which we must prepare our students.

What can we do? First of all I believe that our students must, from the very onset of their training, be better oriented to veterinary medicine's over-all role in human society and properly alerted to the great variety of career opportunities open to them. They must be exposed much more to the history of veterinary medicine than they are now so that they will have the cultural background upon which to truly become not only "citizens in their profession" but citizens in the world. This is not a frill; it is absolutely basic.

To me it is utterly fantastic that in a day when many American medical schools support *departments* of medical history there is not, to my knowledge, a single chair in veterinary history on an American veterinary faculty. Is this not a disgrace? Is not such an appointment really more important, for example than an eighth or ninth member of an already quite adequate physiology department? Are we proud of the fact that we veterinarians probably know less of the accomplishments of our profession—of its very sizable accomplishments—than the members of any other professional group of which I am aware?

We must completely overturn the fallacious and almost uniquely American notion that the teaching of clinical veterinary skills should be directed solely to the demands of private veterinary practice and increasingly, I am afraid, to the limited demands of a luxury type of pet practice. To do this the schools must in every way possible strengthen the natural herd basis of clinical veterinary medicine by engaging more actively in such things as feedlot practice, contractual herd health plans, and poultry practice, rather than in concentrating more and more—and to the exclusion

of all else—upon the intensive treatment of the valuable individual sick animal within the unnatural confines of a veterinary hospital.

Ours is *herd* medicine. Our goals as a profession are not a carbon copy of those of human medicine and they never will be. We should completely integrate a portion of each of our school's clinical staff into the cooperative Federal-state livestock disease control activities of our area. We should work with the U.S. Department of Agriculture and our state veterinary authorities to set up model disease control districts in which basic and operational research can be carried out as part of these activities, where new disease reporting and epidemiological surveillance techniques can be tried out, where the requisites for exciting and attractive careers can be established, and where our students can be exposed to a type of veterinary practice which has a more lasting and meaningful impact upon pressing problems of our society.

We can speed up the process of upgrading the governmental veterinary services by setting up imaginative graduate programs in preventive veterinary medicine for those promising young veterinarians who are already serving in these agencies, as well as for those whom we will help attract to these positions in the future. It is not that responsible veterinarians in government have not been asking for our interest and our assistance for many years, for they have. It is rather a question of when are *we* going to begin to respond?

Turning to another, and perhaps equally important, problem area, that of the veterinary role in the general biological sciences, provides us an opportunity to consider for a moment the rigidity of most of our existing academic programs and some of the ways in which we might begin perhaps to make them more flexible. Most of us are aware, for example, that veterinarians have

been concerned about diseases of fish at least from the time of the compilation of the Egyptian veterinary papyrus of Kahun some 4,000 years ago!

Many veterinary schools in Europe, in Japan, and elsewhere have had departments or organized research units concerned with the diseases and pathology of fish and other marine forms practically from the beginning, and they have had the same for diseases of economically important insects. Is this not precedent enough? Yet is there a single elective course in either of these important fields in an American veterinary school? If so, I am not aware of it. Does any American veterinary school other than that at Guelph, Ontario, in Canada even support a regular staff position in either of these fields? We know that there are several academic departments of invertebrate pathology already in existence in the United States—but not in veterinary schools—and we know that practically every marine biological or fisheries research institute in this country is engaged in disease-related studies of one kind or another.

Why are we not doing something to design graduate programs for veterinarians who wish to enter veterinary specialties such as these? Why are we not working out cooperative research and teaching arrangements with the departments of marine biology, entomology, and zoology in our universities and creating positions on our faculties for veterinarians who become trained in these fields? Who else should more logically do research or offer courses on diseases of wild vertebrate and invertebrate animals or on their important roles in the epidemiology of diseases of man and domestic animals? Such courses would not only serve as electives for our own students but could also meet the special needs of graduate students in the other branches of zoology. We say that veterinary medicine is comparative medicine. We say it often, and there is

good historical evidence for our claim, but so long as the veterinary schools in this country fail to see their real responsibilities as extending beyond concern for a few important domestic animal species, how true really can our claim be? Until at least some attention to disease and disease-related problems in the whole spectrum of the animal kingdom is evident on our veterinary campuses, the full benefits of our profession's traditionally comparative approach to disease will not be realized.

We must not let the limited demands of its private practice obscure the fact that veterinary medicine is a broad academic discipline in its own right and that our schools, at least through a wide variety of elective professional courses, specialized graduate training programs, and research activities, have the responsibility to develop and communicate the knowledge and skills which are required if veterinarians and others are really to raise the veil of ignorance in these areas and to help comparative medicine become something other than the undifferentiated monster it now is.

These then are a few of the serious questions with which we in academic veterinary medicine must, in all urgency, begin to more actively concern ourselves.

In concluding I would say that it has certainly not been my intent to detract in the slightest from private veterinary practice as an established and valuable type of veterinary service nor to imply that our schools are not now meeting the requirements of our future private practitioners of veterinary medicine quite effectively, for they are. What I would leave you with, however, is the thought that, if the veterinary profession is to serve mankind as it can and as I think it must, then we in the schools of veterinary medicine must grasp the reins of leadership and begin to guide our unique veterinary team not only down this well-trod pathway of private practice but simultaneously down the three principal avenues of veterinary service to mankind—agriculture, public health, and general biology. To do anything less than this, I believe, is to fail in our task.

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THE TEACHING OF VETERINARY COMMUNITY MEDICINE

AN APPLIED PROGRAM

JOHN H. HELWIG, D.V.M.*

The teaching of community medicine should be incorporated in the over-all public health training of veterinary students. An early understanding and introduction of students to community health problems will better orient and prepare them to appreciate the team effort in applied preventive medicine. The teaching result is more effective when the student is provided an opportunity to participate in solving actual community problems. Perhaps it would be an ideal situation to use a neighboring community for studying all aspects of applied community medicine. This approach would be effective in acquainting students with the good as well as the bad conditions and practices that prevail. The learning experience would very likely be an interesting one since a first-hand evaluation of the application of principles and objectives of community medicine could be made.

The applied preventive medicine training program of the College of Veterinary Medicine at the Ohio State University utilizes an adjoining community with a population of approximately 39,000. This community provides the laboratory for applying the principles and objectives of food hygiene. We have limited the student assignments to those areas that would be least likely to cause concern and resentment by officials

of the municipality. This latter point is important and should not be overlooked.

If we exercise care in selecting problems when cooperating with local communities in a teaching program, there is much to be gained by both students and the community. Restricting the problems also ensures continued cooperation and confidence on the part of officials. Selected community problems can be effectively supplemented in a teaching program by using data that pertain to hypothetical communities. An excellent example is the Dixon-Tiller County material that is available through the Community Service Training Section of the National Communicable Disease Center. The only request made by the Center is for information as to the application of the material.

The hypothetical community acts as a teaching reference for a population of about 170,000. The material incorporates all the necessary statistics, maps, slides, and data that are relative to an average community. The data are flexible and lend themselves to uni- or multidiscipline training in veterinary preventive medicine. Contents are readily adaptable to many problems and with minor modifications and supplements allow for data relative to the distribution of domestic animal populations, wildlife conservation practices and populations, the status of animal disease eradication pro-

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grams, and the like. The use of a hypothetical community as a substitute for the actual community is not ideal but is about as close to ideal as one might hope for.

The teacher will find that through deletion or rearrangement of data, he can convey a real community working feeling to the student. The course content should be specific and definite when possible and designed for flexible application to environment and circumstances that will differ from community to community. This learning experience should help the student to acquire an applied understanding of the following five levels of prevention:

- Health promotion
- Specific prevention

- Early diagnosis and treatment
- Disability limitations
- Rehabilitation and program appraisals

These represent the core of the course and are just as applicable today as they ever were. Objectives and principles have not changed but communities have. There is not a great need to influence adults to continue their education. We must exercise leadership and communicate to these persons our objectives and principles so that they will be incorporated into a philosophy that will become a part of the everyday life of the community.

"Continuing education" for adults of all ages is the present-day keynote to the successful teaching of community health.

FIELD TRAINING PROGRAMS

THE OHIO PREVENTIVE MEDICINE PROGRAM

JACK H. RUSSELL, D.V.M.*

At the Ohio State University College of Veterinary Medicine, instruction in preventive medicine is culminated by a full quarter (10 weeks) of study during each undergraduate student's senior year. The senior class is divided into three groups and one group each quarter rotates into this program from the autumn through the spring quarter. The remainder of the class is assigned to the veterinary clinics during any given quarter.

Prior to their senior year all students have already been exposed to the basic academic aspects of preventive medicine, including meat hygiene, epidemiology, biostatistics, and the control of specific infectious diseases, including the zoonoses.

The objective of this quarter of preventive medicine during the student's senior year is to apply the basic principles he has learned to real-life situations. Thus in a very real sense the world outside the confines of the university can be considered to be a laboratory to these students, whether they are being exposed to a public agency, a meat or food processing plant, or a state-owned dairy herd. To give an idea of the learning experience each group is exposed to each quarter, I have listed below the wide variety of field assignments that are given

to students during their senior year at the Ohio State College of Veterinary Medicine.

Preventive Medicine Program

Animal health and disease control—The entire group of approximately 24 students is given four days of instruction in state and Federal quarantine regulations by members of the Animal Health Division of the U.S. Department of Agriculture and the Bureau of Animal Industry of the Ohio Department of Agriculture. Lectures in the control of specific animal diseases and epidemiological techniques used in the tracing of animal disease sources are also given. Clinical demonstrations of testing and diagnostic procedures are included.

Meat hygiene—Four days of "in-plant" instruction in meat and poultry inspection procedures are given by Meat Inspection Division personnel of the Federal Department of Agriculture. At this time the instructional groups are broken down into units of five or six students.

Milk hygiene—One day is devoted to dairy farm inspection with regular sanitation workers who perform this duty for the Columbus, Ohio, Health Department. Another day of instruction is given by the Department of Dairy Technology at Ohio State University with respect to milk proc-

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essing and pasteurization. Factors affecting milk quality are discussed. Equipment used in milk processing is broken down, and the operational aspects are explained.

Organization and responsibilities of the local health department—A one-day visit to the Health Department of the city of Columbus (about 500,000 population) exposes the students to the organization, function, and philosophy of local health department structure in Ohio. This Department has well-organized programs utilizing veterinarians in many ways. The Deputy Health Commissioner and Chief of the Environmental Health Section is a veterinarian.

Military preventive medicine—A one-day visit to the nearby Lockbourne Air Force Base gives the student a chance to see military preventive medicine in action. The base veterinarian lectures on this subject at the University during the quarter.

Vector and rodent control—Pest control, its industrial and agricultural applications, and its economic importance are presented by the district agent representing the Predator and Rodent Control Branch of the U.S. Department of the Interior. Control methods and the use of poisons are covered, as well as the importance of rodents and predators as disease vectors.

Food hygiene—The basic principles of food hygiene are covered in two days. This includes food-borne disease, Ohio laws and regulations on food service, and inspection visits to restaurants, food stores, and bakeries in a nearby suburb of Upper Arlington. The students fill out inspection forms together with the instructor, who is Deputy Health Commissioner of the local health department. They are expected to explain and justify their inspection reports.

General sanitation—Students travel with Columbus Health Department sanitarians to see public water supply treatment, sewage disposal, landfill operations, and sub-

standard housing and its effects on public health. The veterinarian's role in general sanitation is discussed from the standpoint of veterinarians in both private and public practice.

Humane society animal shelter—The Franklin County Humane Society by contract serves as the official agency for the city of Columbus and Franklin County in enforcing stray dog control, licensing, and the confinement of biting animals. The shelter's operation is explained by the Humane Society staff and the students have an opportunity to see how a modern, well-equipped animal shelter operates.

Aerospace research—The entire group of 24 students tours the aerospace research facilities of the Wright-Patterson Air Force Base at Dayton, Ohio, about 50 miles from Columbus. In addition to the base veterinary staff, several veterinarians are engaged in research on aerospace travel studies. The Air Base has the ultimate in laboratory animal medicine facilities.

Laboratory animal medicine—One day is spent on Ohio State University campus at the College of Medicine. General principles and the scope of activities are covered.

Animal foods inspection—A modern plant that manufactures a variety of pet foods and slaughters horses under U.S. Department of Agriculture inspection is visited for one day.

Pilot Dogs, Inc.—A training facility for Seeing Eye dogs enables the student to better understand special problems associated with the care and treatment of animals used for this purpose.

Columbus Zoo—Special problems associated with zoo management are discussed during a tour of facilities with the Zoo Director, who is a veterinarian.

Equine health problems—Preventive medicine problems associated with equine practice are discussed with staff clinicians and private practitioners.

Ohio Department of Agriculture Animal Diagnostic Laboratory—Diagnostic services offered to veterinarians, toxicology, feed additives, and chemical residues are covered.

State herds and flocks—Visits are made to herds and flocks at state prison and mental institution farms for the purpose of applying the principles of preventive medicine to herd health problems, especially mastitis control.

Ohio Department of Health Laboratory—One-half day is devoted to the administration and operation of a state public health laboratory. Tests and services useful to veterinarians for diagnostic purposes are covered, and literature categorizing these services and containing the interpretation of test results is given to each student.

Ohio Department of Health Veterinary Medical Unit—Two days are spent presenting and discussing various aspects of problem assignments relating to veterinary preventive medicine.

I think it is obvious that the students in this program have an opportunity to apply basic concepts and principles regarding preventive medicine to an infinite variety of environmental and community health problems. The most important aspect in the student's favorable response to this type of teaching is student participation. Every attempt is made to involve the student rather than to let him merely tour these agencies and facilities.

Official Health Agencies

The part played by the Ohio Department of Health in this program will be discussed in more detail, since this is the portion of the program that I personally am involved in.

The students participating in the program are divided into four groups of six students each. Each of these small groups has a two-hour informal, discussion-type seminar with

a veterinarian from the State Health Department staff. The programs and responsibilities of the Veterinary Medical Section of the Ohio Department of Health are described, and students are encouraged to ask questions and discuss any particular interests they may have regarding public health. This often involves topics such as their legal responsibility after graduation in regard to health agencies and disease reporting, personal protection (including pre-exposure rabies vaccination), employment opportunities in veterinary preventive medicine and public health, rabies control, rabies vaccines, and laboratory services available at the state health laboratory. (A visit to the Ohio Department of Health Laboratory is always scheduled the morning of this seminar.) Printed health education and public health materials issued by the State Health and Agriculture Departments are discussed, and students are urged to contribute, after graduation, to the newsletter *Animal Disease Trends* and also to make good use of the State Health Laboratory and the Ohio Department of Agriculture Animal Diagnostic Laboratory. The importance of the reporting of zoonotic diseases to the detection of human zoonotic infections is stressed. This two-hour seminar is presented to each of the four groups of students each quarter.

Near the end of the quarter all four groups (24 students) are given public health problem assignments. Each of the groups is given a problem and assigned a three-hour period for its presentation and discussion. While a given group is presenting its problem, the other three groups listen and, after the presentation, are encouraged to join in the discussion, with the leader of the presenting group acting as discussion chairman.

Some of the problem assignments are as follows:

- As members of a county veterinary medical association, prepare a workable rabies control

program and present it as you would to a local board of health that had requested you to do so. (Specific situations are set up involving different types of rabies problems. Complete data—such as incidence of rabies over recent years and type of species involved—are included.)

- Make recommendations for a complete and workable meat or poultry hygiene program for a local health department.

- Prepare a plan for setting up better inter-professional relations and liaison in relation to disease reporting and sharing of knowledge between a local veterinary medical society, a medical society, and the local health department.

- Prepare a plan for the ideal reorganization of all veterinarians working at the state level, by departments, programs, and responsibilities.

- Discuss the veterinarian's role in disaster medicine programs.

- Recommend solutions to a number of problems based on situations involving specific zoonotic diseases, either single cases or epidemics, and state your reactions to them as private practicing veterinarians. (Occasionally one of these problems involving an epidemic is to be considered from the official health agency's point of view rather than from the standpoint of the private practicing veterinarian.)

- Prepare guidelines for state legislation concerning some problem involving veterinary preventive medicine (e.g., rabies control, compulsory immunization, or psittacosis regulations).

Always the students are asked to be prepared to defend their recommendations and to give reasons for any decisions. They are asked to make their proposals practical and workable and to conform to Ohio Law and to the restrictions or data presented with the problem.

The problems are always based on actual, confirmed disease outbreaks occurring in Ohio or on actual health needs existing in Ohio, with the obvious exception of the disaster medicine and veterinary services in state government problems. It is realized that it is perfectly possible to prepare problems based on purely hypothetical situations. However, it is felt that by utilizing actual situations the student will be more interested and motivated.

If any special reference material is needed for solving a problem (state dog laws, dis-

case incidence data for Ohio, etc.), this is furnished to the group at the time they are assigned the problem. Otherwise, students are expected to find their own resource material.

A group is allowed to make its entire presentation before being challenged or questioned. After correction of any glaring mistakes and discussion by everyone concerned, the public health veterinarian summarizes the discussion, presents alternative solutions, if any, and relates the problem assigned to the situation actually existing in Ohio at that time.

While this is by no means a perfect solution to the problems of teaching public health, it does accomplish the following:

1. It motivates the student to listen and learn to a much greater extent than he would if he were merely to listen to a lecture on the same topic.

2. It involves the student and encourages him to participate more than he usually would. Each student must participate to some degree, at least in the problem assigned to his group.

3. It acquaints the student with the standpoint of a private practicing veterinarian and his responsibility as such, and at the same time gives him an understanding of the health official's responsibility in the same situation.

4. It requires the student veterinarian to consider client relationships, responsibilities to public agencies, personal protection against infection, and other points he might not think of if he merely writes a paper on a chosen topic.

5. Actual participation in a disease investigation is rarely possible for a number of reasons, but this method permits the use of epidemiological data and confirmed outbreaks for teaching purposes and provides a substitute for participation in epidemiological activities involving veterinarians working in official health agencies.

FIELD TRAINING PROGRAMS

VETERINARY STUDENT ORIENTATION IN THE U.S. DEPARTMENT OF AGRICULTURE

DANIEL F. WERRING, D.V.M.*

In the veterinary student orientation programs of the U.S. Department of Agriculture, remarks center on activities of the Federal veterinarian attached to the Agricultural Research Service, the parent organization of the Animal Health Division. We also refer to the Animal Disease and Parasite Research Division, which provides many of the tools and much of the know-how applied in the control and eradication programs. We identify the following facilities of the latter Division and their areas of research: (1) Plum Island (foreign animal diseases); (2) National Animal Disease Laboratory (native diseases); (3) Southeast Poultry Research Laboratory (poultry diseases); and (4) Beltsville Parasitology Laboratory. These facilities also maintain a diagnostic capability that is of importance to the field programs. The student of veterinary medicine today, we have observed, is increasingly research conscious, as indicated by the questions posed and the interest voiced in possible employment in the Animal Disease and Parasite Research Division.

Another agency of importance is the Veterinary Biologics Division, which is responsible for the regulation of veterinary

biologics production and the testing of such products for safety, purity, and potency. The recognized association of immunizing agents with a relatively large percentage of hog cholera outbreaks makes biologics a prime topic of concern today. The removal of a number of the products as unsafe has spurred interest in the field. Discussions on the use of various approved products under varying situations will assist the student when in practice to select the one most indicated. These decisions will be important to the industry as well as to the hog cholera eradication effort.

The Animal Health Division's activities are naturally covered somewhat more in detail since many of them, particularly the state-Federal programs, directly involve the general veterinarian practitioner and, to some extent, the small animal practitioner. The Division, however, has unilateral programs that elicit student interest and are therefore given attention. One of these involves the precautions taken to prevent the introduction of foreign diseases by controlling the imports of animals, animal products, and certain other related material. This is accomplished by the enforcement of health requirements at point of origin, veterinary inspection at ports of entry, or in some instances, total exclusion of imports from countries where

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certain diseases exist. For example, no domestic cloven-hoofed animals are permitted entry into the United States from areas where foot-and-mouth disease or rinderpest is present. Similar restrictions are imposed with respect to African horse-sickness and contagious bovine pleuropneumonia. As a result there are very limited movements of many animal species into this country other than from countries on the North American continent.

Public stockyard inspection is another unilateral program of the Animal Health Division that is stressed with the student. One half-day is devoted to a tour of the stockyards at South St. Paul. Explanations and discussions supplement observations. Here the student is introduced to the marketing procedure—receipt, sorting, yarding, weighing, and disposition by slaughter or reshipment of animals—and the part that veterinary and lay inspection play in the orderly flow of healthy livestock in commerce. The special handling of reactor animals is observed, with emphasis on precautions to avoid exposure to susceptible nonslaughter animals. The practitioner's responsibility in this area is pointed out, as is the danger of recommending that owners use public facilities to dispose of non-reactor diseased animals with possible contagious diseases. Additional student observations are made of Market Cattle Testing tag application, vehicle cleaning and disinfecting, testing activity in the yards, tissue specimen collections, patrol inspections, and other aspects of the operation. Yard orientation is concluded with a summarization and discussion of observations and the distribution of printed materials.

The rest of the training is concerned with cooperative state-Federal programs and is presented separately at two half-day sessions by veterinarians of the Minnesota Livestock Sanitary Board and the Animal

Health Division. The organizational structure, background, authority, responsibilities, and operative policies of each agency is described and current field programs (there are 10 major programs and a number of lesser scope) are presented.

The State Veterinarian's Office discusses activities at the state level, while we from the Federal Animal Health Division present the national situation. Emphasis is placed on practitioner involvement and actual participation in many of the programs. The practitioner's knowledge and support of all programs is in the interest of industry and public acceptance.

Students are alerted to the need for surveillance against the introduction of foreign diseases and the urgency of prompt reporting of suspicion of such diseases. The practicing veterinarian would normally be the first to encounter these conditions and his immediate action could be the key to preventing extension. Attached to the force is a foreign animal disease diagnostician who recently returned from England, where he assisted in the foot-and-mouth eradication operation. He is available to assist in diagnosis or to collect material for laboratory examination. In case of confirmation, there is within the state an Emergency Disease Organization, composed of joint agency professional and subprofessional personnel, which could institute eradication measures on short notice. This group periodically takes part in hypothetical exercises and would suffice to handle small-scale outbreaks or at least to contain things until additional help arrived in case of larger outbreaks. We are prepared to employ all the eradication measures of inspection, quarantine, appraisal, depopulation, cleaning, disinfecting, and whatever else might be necessary.

Training at the Animal Health Division office is concluded with a discussion of the export-international shipment of livestock

and the involvement of the practitioner in certifying to the health of the animals to be exported. Minimum requirements, by species, are explained, including test interpretations and other details. A health certificate exercise is then presented in which each student prepares a "John Doe" mock certificate from a list of animals of varying status, of which some are qualified for export and others are not. The exercise ends with a review of entries made and a critique of the exercise.

Many areas have been identified in the foregoing where the practicing veterinarian is directly involved in cooperative programs. There are a number of other objectives we in the joint agencies strive for in student training:

1. Our foremost objective is to instill in the student the philosophy of prevention, control, and eradication of animal diseases. A preventive disease attitude is being developed in preference to individual treatment as a total answer to problems.

2. A personal relationship is being established that will lend itself to mutual benefit in disease control.

3. A briefing on the significance and responsibility of veterinary accreditation is made. Material is generally covered that should assist in writing the accreditation examination.

4. Various documents, such as test charts, vaccination records, quarantines, and shipping permits, are discussed and their proper execution and use is stressed.

5. We impress on the student that we in the

cooperating agencies are in fact service groups whose function is to assist the professional and the industry in maintaining a healthy livestock population.

6. The Minnesota Livestock Sanitary Board uses the occasion to advise on the necessity of obtaining permits for administration of certain biologics and to explain other Board controls.

The methods or principles employed in the training have been incorporated in part in a discussion of objectives. Presentations are very informal and questions are invited at all times. Discussions are initiated at frequent intervals to stimulate interest. Visual aids, including slides and charts, are used in order to avoid dry narration. Exercises involving student participation are used whenever possible and appear to be well received. Published materials outlining agency organization and functions are distributed.

In addition to the type of training discussed above, members of the joint agencies participate periodically in seminars which deal with certain programs in greater depth than is possible at the briefing sessions. Two such seminars have recently been held for senior students on tuberculosis and brucellosis. Epidemiologists periodically make presentations.

Working with the students has been a pleasant and rewarding experience. If they have profited to the extent we have, the training can be considered a success.

FIELD TRAINING PROGRAMS

THE ST. PAUL PROGRAM

PAUL J. COX, D.V.M., M.P.H.*

In St. Paul, senior veterinary students who are to take field training are scheduled to appear in the office of Environmental Hygiene at the Bureau of Health, in groups of four to five students, one day a week during the fall quarter. The period of indoctrination is approximately two hours. The sessions are informal and the students are encouraged to participate in the discussions, which are based on the following points.

1. Discuss with the students the function of a veterinarian in a local health department charged with the directorship of environmental hygiene.

2. Identify the public health significance of disease processes in animals and man.

3. Indicate that experience and knowledge gained in practice and formal education are adaptable to the field of public health.

4. Compare the application of a veterinary education in private practice to public health.

5. Construct the administrative organizational chart and the plan of activities of a typical health department.

6. Identify the student's formal veterinary education with the field of public health and state why he is qualified to

function effectively in an organized environmental hygiene program.

The general objectives of this field training can be summarized as follows:

1. Create an awareness of the functions of a veterinarian in a health department.

2. Discuss additional educational requirements for a veterinarian in public health which may be required.

3. Cite public health problems which stimulate feedback from the students.

4. Allow each student to give his perception of a veterinarian's function in environmental hygiene.

5. Contrast the ability of other disciplines to function as effectively as a veterinarian in environmental hygiene.

6. Illustrate how the basic veterinary educational requirements equip a veterinarian to be actively engaged in public health matters while in private practice.

7. Discuss the fact that veterinarians in public health are using their education to as great a degree as a practitioner.

8. Contrast working conditions between a public health official and a practitioner.

9. Allow free discussion among students on points of difference.

10. Truthfully and freely answer personal questions relating to the position of a veterinarian in public health.

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FIELD TRAINING PROGRAMS

THE U.S. DEPARTMENT OF AGRICULTURE MEAT INSPECTION PROGRAM

V. L. DAHL, D.V.M.*

The Meat Inspection Program of the U.S. Department of Agriculture has experienced greater advancement in the basic and continued training of its inspectional personnel in the last decade than during the first 50 years of its existence. This is not to imply that all early training practices were unacceptable. Most supervisors have always recognized the importance of training and have had a deep interest in seeing that personnel were properly trained. Some enjoyed the advantage of having personnel on their rosters with exceptional training talents, and others had geographic concentrations of personnel providing the advantage of assignment flexibility during the periods of training need.

Deficiencies of early training practices were generally recognized to be lack of program uniformity, delayed employee development and self-fulfillment, and reduced manpower flexibility because of incomplete work qualifications of the inspectional force. Three problem elements appeared to be most significant.

First, no time was specifically allotted to training. This problem was most detrimental

in the training of the new employee, since it is most important that the new inspector is introduced to the what, why, when, and how-to of correct procedure. Program policy, however, always gave first priority to having an employee fill an inspectional assignment at the earliest possible moment. His first job was usually a simple one, and from that time on his career consisted of a series of delays in training for new tasks. Manpower shortages caused by vacations, sickness, retirements, resignations, and economic austerity directives were some of the factors which blocked orderly and progressive employee development.

The second significant problem was the lack of training aids and quality trainer personnel. On-the-job training was conducted in most instances by whichever more experienced inspector happened to be assigned to the inspectional station at the time the trainee was to be qualified. There existed in these temporary trainers great variation in technical competence, teaching capability, and interest. Even when these qualities were present in the trainer, training was just another responsibility added to his already demanding job.

The third and probably major underlying cause for the lack of uniform training

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practices in those years was the absence of central program direction. The good training programs that did exist at some locations were the result of local initiative and ingenuity. Training information was not disseminated broadly so it could be utilized where creativity and talent were not strong. Most of the effective training (it was carried out by design rather than by accident) was accomplished through unauthorized use of personnel. Training was always recommended and encouraged, but there were no directions for carrying it out, and there was no provision for time, personnel, and training aids.

Early in 1964 the first nationwide program of in-plant slaughter inspection training was adopted by the Federal Meat Inspection Program. This training was initially applied to veterinarians just entering the inspection service. Recently it has been extended to nonprofessional personnel as well. Basic characteristics of this plan include providing adequate and exclusive time for training, during which training is the sole duty responsibility of the trainee. Qualified trainers are selected on the basis of technical competence and teaching talent, and training is their only duty assignment. Teaching is accomplished by a combination of classroom lectures, laboratory work, and in-plant instruction and practice. The goal is to prepare the employee to be basically functional before reporting to his first duty assignment.

This basic training is now carried out under the direction of the U.S. Department of Agriculture Livestock Slaughter Inspection Division at four strategically located training centers: South St. Paul, Minne-

sota; Omaha, Nebraska; Fort Worth, Texas; and Los Angeles, California. Veterinarians currently receive 12 weeks of basic training and nonprofessional inspectors, four weeks. These centers have a projected capability of training 300 veterinarians and 800 nonprofessional inspectors annually.

Another type of training which has recently received considerable attention is continuing education of field inspectors. The goal here is to broaden the capabilities of inspectors already on the job. The purpose is to increase proficiency in current assignment responsibilities and to prepare employees for advanced grade positions.

The "package concept" has been developed in order to provide training aids and guidance to field supervisors in conducting their local, continuing education programs. The scope of each package is a limited area of inspectional responsibility, such as plant sanitation, sanitary carcass dressing procedures, or trades labels. A package essentially consists of a prepared instruction booklet for the trainee's prestudy use, a discussion guide, and visual aids for the trainer's use in classroom presentation.

Field supervisors have a great need for these training aids for scheduled training, as well as for use during unexpected opportunities arising from nonoperational plant stand-bys. The package concept is considered to have great potential value for orderly and uniform employee development in the field. Singularity of subject matter, authenticity of content, and ready availability are basic qualities of this concept.

THE TEACHING OF DISASTER PREPAREDNESS

DONALD C. BLENDEN, D.V.M., M.S.*

The ever-present threat of disaster has haunted mankind all through history. Under this threat, man has learned to predict certain events of nature so that the effects are minimized. Other natural events cannot be predicted, as evidenced by the fact that citizens of our country are being continually exposed to disasters of different types with little or no warning. Man-made disasters also seem to be an ever-present potential, especially those that might result in widespread trauma, death, or exposure to radiation. Accidental explosions and fires occur from time to time because of human error or neglect. The remote but ever-present threat of enemy attack with nuclear weapons cannot be ignored by responsible professional persons, even though most people prefer to ignore, rather than to nourish, the health concepts of prevention and preparedness. It is this potential of disaster that stimulates multi-disciplinary thought in the teaching of disaster preparedness. The involvement of different professional groups, specifically the veterinary medical profession, seems very important, as the disaster itself may eliminate some of the medical care capa-

bilities of a particular population, or the disaster may overwhelm available capabilities for providing medical care.

The purpose of this paper is to describe the reasons for presenting disaster preparedness to undergraduate students in veterinary medicine and to relay some of the principles of disasters and post-disaster behavior which are used in this teaching.

It would seem necessary first of all, before discussing the implications of disaster and disaster preparedness, to define these terms as they are discussed with students. There are two legitimate schools of thought concerning the definition of disaster. These are represented (1) by those most affected and closest to the disaster, and (2) by those who must record, classify, and analyze disasters in order to predict future events or to render the medical care necessitated by the event. We must assume at this point that the definition of disaster is variable and relative for the individuals involved and that for present purposes a disaster consists of an unforeseen happening resulting in the death or serious injury of 25 or more persons. By this administrative definition, few people realize that about 1,300 deaths have occurred in disasters every year of this century, with an additional 13,000 to 15,000 persons injured annually. This in itself is a staggering figure, but if one were

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to include all "minor disasters" such as automobile accidents, fires, and drownings, the figure might well be unbelievable. Disasters, then, present a serious problem in terms of individual and public health. Even more unfortunate than the losses incurred is the fact revealed by retrospective studies that many or most disaster losses and deaths are preventable. The United States has a rather modest incidence of disaster injury; some countries have had single events killing more persons than all of those killed in one-half century of our own disaster history.

Review of disaster situations where loss of life has been extensive reveals that the use of any one of the several preventive measures available at each incident would have greatly reduced the loss of life. Experience proves that once the chain of events leading to disaster has been initiated, it is too late to institute effective casualty-reducing measures. For this reason adequate preventive measures must be built into community, professional, and individual thinking so that they are more or less a part of everyday life. Then, when an event begins that can potentially become a disaster, the preventive program automatically takes up where preparedness programs leave off. To accomplish this objective, the philosophy of preparedness must be instilled during the educational years when persons are receptive to ideas and are actively engaged in the learning process and then maintained on a continuing basis.

This, then, is the concept of disaster preparedness, or adequate preparation for disaster. Veterinarians, by and large, have taken a head-in-the-sand approach until lately. It appears quite obvious that this concept will be properly accepted only during the learning years of an individual. Members of the health professions must be well acquainted with the concept of disaster

preparedness, as they are the ones who will be called on for leadership and for the various ramifications of management and medical care. For example, what community is prepared to accommodate 50, 100, or even 1,000 persons injured at the same time, with all the attendant problems in food and water handling, sanitation, animals, utility breakdowns, and the many other problems that few persons think of until they do occur? These, of course, are not unreasonable figures to contemplate with natural disasters and would be magnified manyfold in the more unlikely event of a nuclear disaster.

Importance of the Concept of Disaster Preparedness in the Veterinary Medical Curriculum

Disaster preparedness programs have been in effect for several years in medical schools under the Medical Education for National Defense (MEND) Program. Since disaster preparedness is being recognized as a multidisciplinary endeavor, the other health professions are now becoming involved. Programs are under way in schools of nursing, dentistry, and pharmacy. The purpose of the program in schools of veterinary medicine is to acquaint the potential veterinarian with the fact that he does have a role and a community responsibility in a post-disaster situation. It is obvious that the veterinarian has a great background of training and experience in the concepts of health care and will be looked to as a community leader in a situation of this sort.

A secondary but equally important facet of the teaching of disaster preparedness exists. Disaster preparedness is used as a dramatic tool to illustrate to students that public health embraces more than the traditional areas of meat and milk hygiene or even infectious disease epidemiology. The

student is quite interested in the fact that public health encompasses a variety of fields which have little to do with the traditional infectious disease control approach.

Principles of Disasters

It is interesting that the epidemiologic method can be applied in describing disaster occurrences and in selecting the bases for control programs of future disasters. It is true that there is a basic host-agent-environment relationship. Also, the incident may be related to the basic epidemiologic parameters of time, place, and person. For example, tornadoes and hurricanes have both a seasonal and a geographic distribution. Earthquakes have a geographic distribution. Municipal riots seem to have seasonal and social relationships. In many instances, disasters can be characterized according to the persons that are affected; indeed, it seems that there would actually be risk groups to certain types of disaster. The epidemiologic principles involved in disaster can be used to minimize casualties and deaths by the prediction of so-called warning times of the events. In the teaching of epidemiology to veterinary medical students, disasters can be used as examples just as realistically as cardiovascular disease or an outbreak of food poisoning.

The principles of disaster and disaster behavior should be presented to students. They should be oriented to the fact that post-disaster behavior can be divided into four distinct phases. The first two phases are undergone by all persons, including responsible health and disaster-oriented individuals. The prime purpose of disaster planning is to minimize the length of time involved in adjusting to these two phases so that the disaster is not entirely a new experience to all people. The four phases are:

Phase I. This is a stage of apathy and disbelief, in which persons are dazed and stunned and undertake purposeless activity.

Phase II. This is a stage of gratitude for any help that can be given. The individual yields to any suggestions but is highly inefficient.

Phase III. This phase is distinguished by euphoria, feelings of brotherhood, and pleas to "take care of everyone else first as they need help worse than I."

Phase IV. This phase develops after several weeks, when disaster victims are recovering from the effects of the disaster and are beginning to come back to the realism of life. During this phase people become annoyed and criticize the way officials handled the disaster.

In the post-disaster period the so-called "phenomenon of convergence" is of special importance. This is a rather formidable term applied to the simple principle that all things seem to flow into a disaster area and very few things seem to flow out. This can cause tremendous problems in restoring services with emergency personnel and in the management of casualties and deaths. For example, immediately after a disaster, people descend upon the area to see what has happened. Some rush home to see what has happened to relatives or friends. Others, perhaps a majority, are simply curiosity hunters and thrill-seekers. In any event, the disaster scene becomes choked with people, automobiles, airplanes, motorcycles, and many other basically nonessential personnel and vehicles. Convergence has become so extreme in some disasters that officials have seen fit to organize conducted tours through certain parts of the area to control traffic rather than let it roam in a haphazard fashion.

The Veterinarian's Role

A fact easily overlooked by relief officials is that the veterinary hospital and clinic has a large stock of dressing, drugs, antibiotics, sedatives, sutures, instruments, and plaster bandages, as well as facilities for

sterilization, radiography, administration of oxygen, first aid, and minor surgery, not to mention intravenous setups, clinical laboratories, and so on. Consider, too, the large animal practitioner who possesses portable refrigeration units, mobile clinics complete with sinks and hot running water, sterilizers, refrigerators, and two-way radios, and who has an intimate knowledge of roads, bridges, and terrain. Equipment and facilities are tangible things, easily evaluated as to whether or not they are adequate. More difficult to evaluate are the professional judgment and skills of veterinarians. It would appear that the most obvious function of the veterinarian during and after disaster would consist primarily of expansions of his routine functions modified to the new and stressful situation.

The activities of a veterinarian following a disaster might be expected to follow this pattern:

1. Like everyone else, the veterinarian will take action to safeguard his own life and that of his family. Certainly, aside from any aspects of basic self-preservation, persons who are incapacitated will be of no service in a post-disaster period. Also, it has been demonstrated, even in persons experienced in disaster management, that their first impulse is to make sure their own families are secure.

2. Following the immediate post-disaster period, the veterinarian should determine how he can be of greatest service, preferably by acting according to a prearranged disaster plan or else by checking with the health officer or other responsible officials. Immediate needs will depend on the nature of the disaster, the available medical care, previous disaster plans, transportation, communication facilities, and so forth.

3. Perhaps the most obvious and important contribution that the veterinary professional can and should make is to supervise sources of food of animal origin and

assure that foods provided the surviving population are safe for consumption. This type of work should be closely coordinated with sanitarians of the local health units.

4. Veterinarians should participate in surveillance for communicable diseases in the surviving population by the application of epidemiologic methods. They should help define and eliminate or control sources of infection for human populations.

5. Able and highly trained veterinarians' assistants could be invaluable aid in disaster situations.

It must be remembered that physicians, only some of whom may be able to function, will be overwhelmed with direct medical care services and must be relieved of all services which the paramedical professions can adequately handle. Should it happen that the veterinarian is called upon to give direct medical care to injured individuals, it would seem that in most, if not all, cases this care would be first aid, which most persons are qualified to give, or that such care would be under the direct supervision of a physician, who would therefore be responsible. While many veterinarians express great fear of this type of endeavor, it seems doubtful that many would relinquish these responsibilities when confronted with an actual emergency situation.

Applications of Principles in Specific Disasters

Many types of disasters that occur regularly throughout the United States provide realistic examples of what might be expected of the veterinary student. For example, the severe floods of northern California and the Northwestern coast illustrate some primary and secondary effects that might be anticipated. This particular type of disaster illustrates that large numbers of dead and injured animals, as well as frightened but otherwise normal animals,

must be dealt with. The veterinarian is, of course, in one of the best positions to assist and supervise operations of this nature. Sometimes assistance will take the form of helping to establish a portable water supply to be used by surviving populations. Occasionally large numbers of deaths of domestic animals occur, so that the disposal of carcasses presents a tremendous problem. Chaos resulted from an unusual situation in which a recent tornado swept through Topeka, Kansas, and destroyed the physical facilities of the health department itself. In such an instance, of course, a disaster plan will fall apart if the health department is the main focal point of supervised responsibility.

It is also of great importance that disaster plans be given a test of their effectiveness at regular intervals through the performance of disaster exercises. It is only through this type of exercise that the effectiveness of a disaster plan can be evaluated.

Summary

Disasters are thrust upon us at frequent intervals, and disaster preparedness is the

responsibility of all of the health-related professions. The benefit of advanced training and disaster preparedness becomes clear when we consider that most disaster injuries and deaths are preventable.

Disaster preparedness should be taught in the undergraduate curriculum of veterinary medicine for two reasons: (1) The disaster-oriented veterinarian merely modifies his normal routine enough to provide expanded service in the new situation; and (2) disaster preparedness can be used as a model to illustrate the noninfectious aspects of disease, with which veterinary public health has professional concern.

Disasters can be studied by the epidemiologic method. They have predictable phases of human behavior. The phenomenon of convergence occurs at all disaster sites. Disaster plans and regular disaster exercises help minimize the effects and increase speed of rehabilitation. The veterinarian should be oriented toward disaster preparedness and, should the occasion arise, find his role as a respected community health leader.

Part II

BIOMEDICAL COMMUNICATIONS

SOME IMPLICATIONS OF RESEARCH FOR THE DESIGN OF INSTRUCTIONAL MATERIAL*

WILLIAM T. STICKLEY, PH.D.†

Research and development in the preparation and employment of instructional materials are essential if the design of instructional systems is to pass through progressive stages of refinement. Change in any social system is notably difficult to achieve. Those who are concerned with the preparation of instructional materials and with innovation in education, especially in higher education, must accept as fact this reluctance to change. In *The Prince*, Machiavelli described the danger of initiating a new order of things:

It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who would profit by the new order, this lukewarmness arising partly from fear of their adversaries, who have the laws in their favour; and partly from the incredulity of mankind, who do not truly believe in anything new until they have had actual experience of it. Thus it arises that on every opportunity for attacking the reformer, his opponents do so with the zeal of partisans, the others only defend him half-heartedly, so that between them he runs great danger (19).

In a theoretical and research-based study, Evans (5) documented the reluctance to change in higher education by recording many of the difficulties which

emerged from the introduction of instructional television into higher education.

Yet the proper approaches to change may increase the likelihood of its occurrence. In a discussion of the Case Western Reserve program, Ham (10) described one way to provide an environment receptive to change: "Change is built into this organizational structure so that the curriculum has never been fixed or static. Change is considered inevitable, essential, predictable, and to be a steady state itself."

It is impossible in a paper of this size to summarize experimental findings for the multifarious variables that concern the producer and user of instructional materials. A mere outline of these variables would prove extremely long (?). Several reviews of the literature are available, however, that furnish the producer with listings of the chief experimental studies (8, 12, 15, 22, 25).

This paper will focus on a few principles of programmed instruction that apply to the preparation of many types of instructional materials. The delineation of principles and guidelines should assist the subject-matter expert when he considers the transformation from traditional instructional methods to newer methods of instruction.

The works of Fry, Lysaught, Taber, and Lange, as well as other writings, set down the principles of programmed instruction (7, 14, 17, 18, 30). I myself am not a strong advocate of the kind of programmed instruction that is exemplified by many of

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the commercial programs now available because of their low degree of sophistication, with regard to the quality both of the information they attempt to impart and of the techniques they employ. However, the principles which underlie programmed instruction offer basic approaches to the preparation and use of instructional materials of many types and to the relation of research to practice. Although programmed instruction principles are an outgrowth of operant conditioning (despite Skinner's disclaimer), they are similar to the learning principles generally accepted by most learning theorists (11, 28, 31).

This paper will emphasize four principles for the design of programmed instruction: (1) preparation and use of instructional objectives, (2) active student participation, (3) logical sequencing of material, and (4) feedback of information.

Preparation and Use of Instructional Objectives

Ralph Tyler, as early as the 1930's, stressed the importance of defining educational objectives in behavioral terms. Not until the 1950's, however, was formulation of objectives accepted as an essential and regular principle by a significant number of producers of instructional materials. Emphasis on explicitly stated objectives has been supported by Bloom's *Taxonomy of Educational Objectives* (3) and by Robert Mager's engaging book entitled *Preparing Instructional Objectives* (21). The stress on task specification and task analysis in military and industrial training programs has also had an important effect. Some producers of programmed materials have even taken the position that it is impossible to prepare programmed instruction without the statement of objectives in behavioral terms.

Despite the recognized importance of instructional objectives, they are not in wide use in higher education. The number of experimental studies that attempt to assess the value of objectives is indeed small. In part, this paucity results from the difficulty of defining objectives and the time required to do so. In summarizing research on learning from television, Schramm (24) compared learning from television with learning from ordinary classroom instruction. The findings from 393 reported experiments showed that 83 favored television instruction, 255 revealed no significant difference, and 55 favored the traditional classroom instruction. While many of these studies can be criticized from the standpoint of their experimental design, it is possible that these equivocal results occur because explicit objectives for both the television instruction and conventional instruction were absent.

Active Student Participation

Student involvement is a long-term goal of producers of instructional materials (23). Lumsdaine (15) and Allen (1) report that high student involvement is one of the most fruitful areas of advance in educational research in recent years. In the early stages of the programmed instruction movement, an active student response was considered identical to high student involvement and was thus thought to assure learning. Most programmed instruction material commercially available was therefore of the linear type, providing space for the student to write a short answer for each frame. It was surprising when some studies reported that those students instructed to only "think" the response often performed as well on post-test evaluations as did those students instructed to write in the response. And the covert (thinking the answer)

group frequently completed the program in less time than the overt (writing the answer) group.

The results, however, are not surprising when the programs are examined upon which these studies are based. Instructional programs that call for one-word responses are boring and usually will not spark the imagination of the bright graduate student. He is accustomed to attacking difficult, provocative questions and to focusing attention for long periods of time before resolving problems. When preparing materials for medical students and other adult learners, the aim is to seek how best to structure the instructional environment to assure involvement and participation to a degree that fits the learner. Student participation that "builds in" little challenge will not result in high involvement but will lead to rejection of the material. Conversely, material that is too difficult and too challenging leads to frustration.

Glaser (9) has pointed out that the full spectrum of response variables has not yet been touched, despite the numerous research reports on student participation. Continued research in exploring new ways of providing heightened interaction between the student and the environment furnished by the instructional material is clearly needed.

The Division of Research in Medical Education of the School of Medicine, Case Western Reserve University, is currently engaged in a study that demonstrates high student involvement in a structured environment. This study uses a programmed unit titled *Labor* (29) for fourth-year medical students in their clerkship on obstetrics-gynecology. Subject-matter specialists determined that a certain amount of core information should be learned by students during the clerkship. The traditional lecture was considered an inappropriate means of imparting that information, and

many of the existing textbooks on the subject were reported to be difficult to understand. After examining alternate methods, a workbook was devised that was similar, in some respects, to the programs developed by Wilds and Zachert (32, 33). The first part of the Stenchever-Kitay workbook is devoted to a written description or syllabus of basic information about labor and includes many matching, multiple-choice, and constructed-response questions. The answers and a short explanation of the questions are included in this part. The second part consists of six case problems, each containing a series of questions that attempt to place the student in the role of the physician as he goes through the decision-making process. Some of the questions contained in the first case are presented in Figure 1.

Each case is graded in difficulty so that the student encounters a simple first case and challenging last case. Students on the clerkship have delivery floor duty every third night, and that setting was judged appropriate for the use of the workbook. After the student reads the first part of *Labor* and works through the cases in the second part, he is requested to arrange a conference with his resident preceptor to discuss the cases. The student's environment has been arranged so that he has little alternative but to become highly involved with the material. The material is available to each student to keep and use in a manner to fit his needs. Our initial studies with this workbook indicate that students are enthusiastic about this approach. Resident preceptors also respond well, because their conferences with students can be conducted at high levels of sophistication.

Logical Sequencing of Material

Early investigators who prepared programmed materials pointed out the im-

CASE PROBLEM 1

22-year-old gravida 1 para 0 white female at term. Past history: uneventful. Antepartum course: uneventful. Pelvis: adequate gynecoid clinically. Contractions began six hours prior to admission but were somewhat irregular and between 7 and 20 minutes apart. During the hour lower case p.t.a. contractions are every 5 minutes, lasting 30-35 seconds. On admission the EFW is 7#, cervix 100% effaced, 4 cm. dilated and the vertex is at station 0 with membranes intact and bulging slightly. Fetal heart is heard at 144 in RLQ.

1. What is your impression of this patient? _____

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2. Which of the following best describes this patient?

- A primigravida with uterine dysfunction
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- A primigravida in the late latent stage
go on to page 60
- A primigravida in false labor
go on to page 61
- A primigravida with cephalo-pelvic disproportion and dystocia
go on to page 62

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A PRIMIGRAVIDA WITH UTERINE DYSFUNCTION

Uterine dysfunction may be of the hypertonic or hypotonic variety. In the former, contractions are strong and frequent and may be accompanied by evidence of fetal distress. In the latter case, contractions are usually poor and irregular and are associated with failure of progress in dilatation. This patient has not been observed long enough for such a diagnosis, but on the basis of facts given, she is probably not a problem of uterine dysfunction to this point.

Ref. Williams' Obstetrics, p. 823-837,
then go back to page 58 and select
another possibility

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A PRIMIGRAVIDA IN THE LATE LATENT STAGE

The best bet on the basis of the data given. The head is engaged, all anatomical relationships are probably normal, and the labor seems to be progressing as one would predict.

go on to page 63

Figure 1. Sample questions and pages from the Stenchever-Kitay workbook (29).

portance of logical sequencing in arrangement of information. Difficulties arose, however, when it was realized that the sequence considered logical by the subject-matter specialist was not always the same as that regarded as logical by the student. Branching programs of the multiple-choice type were included in early attempts at flexibility in the sequence of presentation. Students who readily grasped the material could proceed directly through the program with little or no remedial help. The student who made an incorrect response was referred to a frame that "told" him he was incorrect. An explanation was provided; then he was sent back to the original frame to select another response, hopefully the correct one. When branching programs are compared with linear programs, results have shown no large differences in student learning (15, 25).

Although material can be sequenced according to several different schemes, it is the sequence viewed as logical by the learner that probably has the greatest validity. A necessary corollary is the value of testing instructional materials before publication. Lumsdaine proposes such an approach, which he calls product-testing (16), sometimes referred to as formative evaluation by other writers. He cites, however, the scarcity of studies that report student learning improvement from one version of the program to the next. One obstacle to prepublication product-testing is that it significantly increases the total publication cost.

Mager reported (20) an approach that placed the learner in the position of generating his own sequence. If the student knows what is expected of him and where he is, he is perhaps the person best able to determine the sequence of instruction. This approach has a certain appeal, in that the learner will need to apply precisely this

method after the conclusion of his formal education.

The use of the computer to prescribe sequences of instruction is now under investigation. Using the computer to prescribe instruction to fit individual needs is somewhat different from the concept of computer-assisted instruction. In contrast to computer-assisted instruction, in which the student may spend long periods of time at a computer terminal at an almost prohibitive cost, computer-prescribed instruction requires minimal computer time per student. The computer can administer diagnostic tests, keep a running record of a student's progress, and prescribe sequences of self-instruction on an individual basis. Individual prescription of instruction has been described by Glaser (9), Flanagan (6), Kooi (13), Silberman (26), and others.

Feedback of Information

Many writers, in discussions of the feedback of information to students, try to equate feedback, or knowledge of results, with reinforcement. If reinforcement is defined as making the occurrence of a given response more probable, then under some conditions when a student responds correctly to a question and receives immediate confirmation, reinforcement may be said to have occurred. Annet (2) and others, on the other hand, have raised questions about equating knowledge of results with reinforcement. The positive effects of feedback on performance and learning are probably dependent upon the type of task required and the level of the learner. If involvement of the learner with a problem is held at a high level, it may be necessary to withhold knowledge of results for a finite period. In a recent study, Daniel (4) compared two groups of students who took an achievement test after instruction in experimental

psychology. One group was immediately given the correct responses on the test; the other group did not receive the proper responses until 24 hours later. Both groups were tested again one week later. Although it might have been predicted that the group that received immediate feedback would show the greatest gain on the post-test, this was not the case. The students who received the delayed feedback scored significantly higher. When one observes the amount of student interaction in the hall outside the classroom after a "good" examination, this result is not surprising. Sustained involvement appears to increase the retention of information.

When one extrapolates the research on participation and feedback to the development of instructional materials, it becomes evident that these are vital factors to consider in the technology of displays of motion picture and television. If these media are treated as just another means of "spray-painting" the student with information, then we are guilty of limiting the use of this technology to didactic methods. Films that show phenomena without an interpretive sound track can be used effectively to increase participation between students and teachers and to provide feedback on questions that concern the student. Examples are some recent films produced by the Education Development Center in Boston. Research indicates that television and motion pictures can be used appropriately to require student participation through discussion or programmed instruction, accompanied by adjudication of responses. Smith discusses, in great detail, the value of feedback in instructional systems (27).

A Sample Program

A study under investigation at the School of Medicine of Case Western Reserve University will be described in some detail to

relate the principles of instruction described above to the design and preparation of a complete teaching unit. The subject is congenital heart disease as taught to second-year medical students during a period of approximately nine hours. The program of instruction was prepared in conjunction with Dr. Jerome Liebman, a pediatric cardiologist. Congenital heart disease had traditionally been taught by lecture and laboratory demonstration. A brief description of the material prepared for the new program is included, to show how certain principles were applied to transform the instructional system in order to incorporate intensified student participation and to encourage in the student the responsibility to learn on his own.

1. *Objectives.* Each student received a five-page outline of objectives that included a clear-cut description of what the student should be able to do upon completion of the unit. At least one example of test questions was included for each objective. Answers to these questions were *not* made available to the student. He had to seek the answer on his own. The rationale was that if a student could answer these questions he would know that he had attained a satisfactory level of competency. A sampling of the objectives and questions follows:

Example of Congenital Heart Disease Objectives

Given data on the catheter position, blood oxygen saturation, and the pressures, the student should be able to:

- A. State the anatomic diagnosis.
- B. Describe the degree and direction of any existing shunt.
- C. Predict other pressures and oxygen saturations not given.

Example of Congenital Heart Disease Test Question

A 25-year-old male had cardiac catheterization. The catheter was passed through the right

brachial vein into the superior vena cava, right atrium, right ventricle, and pulmonary artery.

Data were:

Oxygen saturation (per cent)	Catheter tip position	mm Hg pressure
70	Superior vena cava	$m = 3$
70	Right atrium	$m = 3$
80	Right ventricle	100/3
80	Pulmonary artery	20/3
98	Brachial artery	120/80

The diagnosis is:

1. Anatomic diagnosis _____
2. Physiology, including direction of shunt _____
3. Characterize the probable pulmonary vascular bed _____

2. *Lecture material.* Information traditionally given in four one-hour lectures was distributed in syllabus form to the students two weeks prior to class instruction. These printed lectures gave details of the basic pathology and physiology of congenital heart disease. Professors were thus no longer committed to dispensing a stream of information during the scheduled lecture periods and could devote time to answering questions and discussing unknown case problems that are described below. In anticipation of possible student queries, basic diagrams on heart physiology were prepared on overhead-projection transparencies. Many students did not attend the scheduled question-and-discussion periods since they were satisfied with their comprehension of the material and preferred to use the time in other ways.

3. *Motion picture film.* "Roentgen Anatomy of the Normal Heart," prepared by Dr. Mason Sones, Jr., was an 8-mm continuous-loop film, with sound, for use in a cartridge in the Fairchild Mark IV projector. Two copies of this film were placed in the laboratory for students to view at their convenience as reference materials.

4. *Case problems.* Six case problems on congenital heart disease were prepared in

writing and distributed to students as unknowns. Each case problem included 10 to 20 questions for students to answer. The correct responses to these problems were available at the end of each case. The student was encouraged not to "peek" at the answers until he had worked through the case. At the end of each case, the student was instructed to view a cineangiogram to confirm his diagnosis. The cineangiogram was a short (10 to 20 second) motion picture which showed the injection of radio opaque dye into various chambers of the heart. The motion picture was prepared as an 8-mm continuous-loop film in a cartridge for use on a technicolor projector without sound. Students were able to stop the film or advance it one frame at a time. Since the film was an endless loop, it could be viewed any number of times with minimum inconvenience. The vigorous nature of the students' discussion as they attempted to solve the case problems with the cineangiograms was evidence of their extremely high involvement with this material. It was apparent that students participated actively in the process of solving clinical cases.

5. *Slides with script.* Slides (35 mm), with descriptive material, were supplied on two topics, Cardiac Catheterization and Pathology of Congenital Heart Disease. The slides were encased in a Carousel projector and made available to students in the laboratory in a rear-screen projection system. Although this projection system could have been controlled by an audio tape that advanced the slides automatically, this method was not used because it might have inhibited discussion by the students. It had been observed in preliminary trials that, while students read the script and looked at the slides, they discussed the material and occasionally drew on the chalk board. An audio presentation with the slides, it

was felt, would discourage this type of response.

6. *Laboratory.* The pathology laboratory period was structured around a television demonstration of common congenital heart defects, allowing close-up magnification of the method of examining the heart. After the demonstration, small groups of students examined gross specimens themselves. This was a "view it, then do it" type of exercise. Clear presentation, followed by individual participation, appeared desirable.

In summary, there was a conscious, consistent effort throughout the planning for this unit to relate programmed instruction principles to the production of instructional materials and the arrangement of learning experiences. The student was told the terminal behavior expected of him; active participation was included; the student decided the sequence for use of the material and set his own pace; and the student himself could know where he was and how he was doing.

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APPLICATION OF LEARNING RESOURCES IN THE VETERINARY CURRICULUM

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Within the past two decades the scope of veterinary medicine has been broadened to include many new courses in the curriculum in addition to the time-honored study of such basic courses as anatomy and physiology. New courses are continually being added to the curriculum and existing courses are being expanded. More and more students must be taught with little increase in available manpower. In addition, we must fit into the same time allocation vast amounts of new material. Faced with similar educational problems, the armed forces, industry, and educators in other fields have met this challenge by instigating various visual and audiovisual methods of presentation (1, 2). Computers and other electronic systems for retrieval and correlation of stored information are now occupying a dominant position in the broad concept of automation. Their application in medicine is increasing. However, in this paper I shall confine my remarks to the various audiovisual methods of presentation available, rather than discuss data retrieval systems in general.

For the past 50 years medical education and veterinary medical education have progressively raised their standards. Formal medical education and training now requires a minimum of seven years and veterinary medical education a minimum of

six years. The majority of students spend more time in the academic environment, and a lifetime of learning is universally endorsed in principle, if not in fact. Every field needs more trained teachers and personnel, and certainly medicine and public health are not exceptions. Continuing education is equally vital.

In recent years there has been an increased demand for veterinarians trained in public health and preventive medicine. Human health and welfare are dependent upon an adequate food supply. Thus, the veterinarian has a dual responsibility, both economically and toward his fellowman, for his efforts are also concerned directly with human health problems. Consequently, there will continue to be a great demand and a need for more individuals trained not only in veterinary medicine in general but, more specifically, in veterinary public health and preventive medicine.

Two questions can logically be raised: How can we meet this challenge? And how we go about finding the means, the money, the men, material, and motivation to accomplish our goals and objectives?

Audiovisual Aids

To remain within the confines of my topic, I shall first list the audiovisual aids that we have at our disposal and mention certain advantages of a few:

1. Old-fashioned blackboard and chalk
2. Overhead projection

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3. Color pictures
4. Three-dimensional camera and slides
5. Plastic-mounted specimens
6. Corrosion specimens
7. Dry specimens
8. Moist specimens
9. Sound films
10. Polaroid transparency systems
11. Microprojection
12. Television

It is interesting to note that I listed these same audiovisual aids in 1956 in a paper entitled "Teaching Aids in Veterinary Medicine" (3). I also discussed some of the advantages of these visual aids in 1954 in a paper entitled "Visual Aids and Their Application to the Teaching of Veterinary Medicine" (4). I mention these previous presentations to emphasize the fact that many of the visual aids that are being discussed today in educational circles were available 15 and even 20 years ago. Relatively few new teaching devices have become available in recent years, namely, videotapes, cartridge film, and the cartridge projector, which can be synchronized with a standard tape recorder.

Before discussing the merits of the older so-called multimedia approaches to audiovisual education and the advantages of the newer hardware, we should ask ourselves why we continue to suffer from the century-old predominance of the spoken word in the usual teacher-student classroom lecture procedure.

One educator has indicated that there is a strong alliance by the students as well as the staff and the administration to adhere to the old. This may have been true in the past, but the present generation of students—even medical students—now reject this passive role. They demand the right to participate in educational decisions and policy-making (5). The students of today want to take an active part in their own education. This changing attitude is, in itself, a compelling reason for the use of

the newer concepts that utilize audiovisual devices for individual self-instruction. The student can set his own pace if physical plant facilities, such as carrels equipped with modern audiovisual self-instructional hardware and software, are available (6).

Before discussing the newer audiovisual media in detail, it would be remiss not to emphasize again the fact that many of the visual aids that are now at our disposal have been readily available for many years, but unfortunately their true potential has not been fully exploited (7).

The infrequent use of the overhead projector is a good example. In spite of the many advantages of these projectors, there are those who shy away from them simply because they do not know all that can be done with them. Others who do use them fail to recognize the full extent of their versatility. With the use of an overhead projector, for example, radiographs may be projected. Overlays may be made in different colors, thus building up a detailed concept such as the ascending and descending tracts of the spinal cord. The overhead projector enables the speaker, while he talks, to create visuals that are immediately enlarged and projected on a viewing screen. The illuminating system is such that one can leave the lights on in the room and still obtain satisfactory projection. The operator can face the audience while presenting his material. The instructor can draw or write on a cellophane roll and have the image of what he is writing or drawing projected on the screen. The projected drawings can be used as negatives for the printing of pictures and graphs, which can be passed out to the student during the lecture or used in continuing education. Thus, the student or practitioner has a permanent, accurate record of the drawing. This saves the student the time that would otherwise be spent in copying the drawing from the blackboard. There are many other

relatively inexpensive visual aids whose true potential has not been completely exploited.

Even colored movies and three-dimensional pictures are not beyond the realm of the average departmental budget. We have been producing our own movies for years in the Department of Veterinary Anatomy at Iowa State University on what we consider to be a shoestring budget, and yet the movies have not only been well received in our own University but have been purchased by fellow institutions, translated into several languages, and shipped abroad, which certainly indicates the need for material of this type. One does not have to have a budget of \$30,000 or \$40,000 to make a single movie or an audio-visual aid. Our films were made at a cost of approximately \$300 each (4, 8, 9, 10).

It is quite evident that we have had at our disposal for many years ample visual aids and the hardware that would lend itself to alleviating some of the problems that have been raised in recent years because of the information explosion and the massive amount of material that must be assimilated in formal education in shorter periods of time. Until our faculties and administrators fully appreciate and recognize the value of modern biomedical communications technologies, we will continue to suffer from not employing to the fullest extent the technology that is at our disposal. I feel that the inertia in this area is due to a lack of knowledge.

Workshops

In order to remedy this situation in part, I propose that workshops be set up at individual professional schools about the country and, hopefully, within each veterinary school—during which the staff, students, and administrators (and practitioners as well) would become educated in the use

of existing facilities and in the use of multimedia devices for large and small groups and individual learning situations. These workshops could discuss photography, closed circuit television, programmed learning material, videotapes, and the proper and effective use of the time-honored 2×2" lantern-slide projectors and movie projectors. The net result, I believe, would be a better appreciation of biomedical communications in general and an upgrading of education at all levels. The multimedia approach to education, while not a substitute for the good teacher, should and can be used to improve the level of teaching by reaching larger audiences more effectively and efficiently. We have the hardware; it is only a matter of knowing how to put it to good use.

A second factor to consider is the lack of software. This situation could be improved if workshops were conducted in this and other countries. With an increased realization of the many values and potentials of the hardware in existence, more and more time could be spent in the production of software.

Core Material and Integration

The basic concept of modern teaching emphasizes the need for conceptual methods of teaching broad principles—or core material. Gaps must be filled in by newer and different teaching methods. The integration of subject matter can, in many instances, be accomplished with programmed material as well as with concept films and videotapes. The need for additional staff and larger budgets to prepare and obtain this material is evident.

Separate Department of Biomedical Communications

It is hoped that all U.S. colleges of veterinary medicine will soon have a depart-

ment of biomedical communications. Many of our health-related professions have for a long time recognized the need for such departments. Dr. Ian C. Bennett, speaking at the Ninth Annual Meeting of the Council on Medical Television in New York City in May 1967—on “Why a Division of Communication in a Medical Center?”—stated that 25 out of the existing 88 medical schools then had a medical communications expert and a division of medical communications.

In our opinion (6, 7, 9), this department should be charged with the responsibility of developing audiovisual material and stimulating the use of audiovisual equipment as well as aiding in the technical and professional aspects of visual aids in general and television in particular. The establishment of such a department would facilitate undergraduate, graduate, and continuing education in our veterinary schools. In many medical schools, the director of such a program is listed as the Dean of Medical Communications. His staff should include a full-time artist, a professional photographer, computer and data retrieval experts, and assistants with Ph.D. degrees in education.

Learning Resource Center

With the possible advent of new physical plant facilities at Iowa State University, it is hoped that a Learning Resource Center will be built which will utilize and capitalize on the many available and newer facets of audiovisual education. This Learning Resource Center should be composed of rooms in which the student can, on his own time, use any and all available visual and audiovisual aids such as concept films, videotapes, and programmed material. It would be a library of visual and audiovisual aids instead of textbooks. This would allow the student to preview and

review material, to correct errors in his thinking which might be revealed by examinations, and actually to assume responsibility for his own education. The student's dependence on repetition in formal lectures would be nullified in time by the realization that his progress is largely his own responsibility and by putting at his disposal at all times of the day this Learning Resource Center, which would permit him literally to dial information from a retrieval center encompassing visual aids of all types.

Anatomy Teaching Modules

I would like to discuss briefly my concept of an anatomy teaching module and its integration into the over-all biomedical communications approach to veterinary education. This particular module (Figure 1) is for 20 students and one instructor and could be used for many disciplines in both undergraduate and graduate teaching. The room is designed to accommodate students studying both macroscopic and microscopic anatomy. The installation of TV monitors and a two-way audio system would enable the instructors in the module to communicate with the professor who presents the demonstration from another portion of the medical complex. The student can direct questions either to the instructor in his module or, by way of the audio system, to the demonstrator himself. Combining the teaching of both macroscopic and microscopic anatomy in one module will save not only space but also money and, in addition, will provide a more effective and efficient means of presenting the material.

Closed Circuit Television and Videotapes

The closed circuit TV arrangement would include the use and preparation of video-

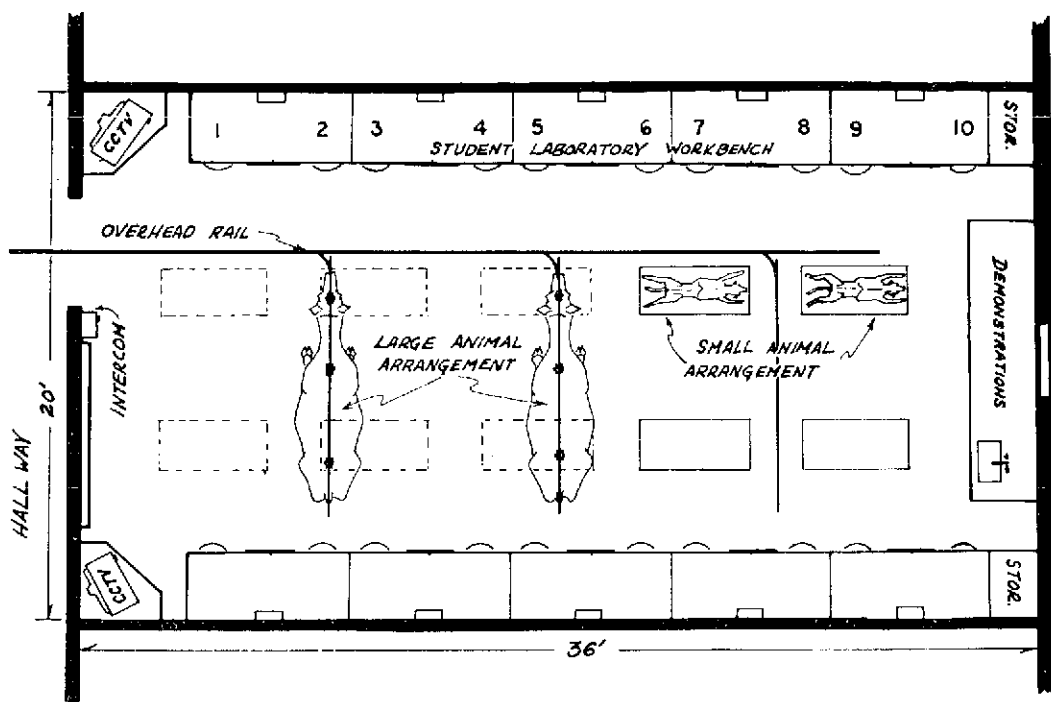


Figure 1. Proposed teaching module for a department of veterinary anatomy (gross and microscopic).

tapes for the teaching of both macroscopic and microscopic anatomy. We already are utilizing this method at Iowa State University in the Department of Veterinary Anatomy (6). The videotapes for the lessons (or at least the core material) of each subject would be shown during classroom-teaching time and would also be available for student use in the carrels that are to be built in our audiovisual research center.

The role of television in medical education has been clearly outlined and defined (11, 12, 13), and the general field of biomedical communications, its problems and its resources have been summarized in excellent fashion by Lieberman (14). In his introductory remarks, made at a conference on this subject, Dr. Lieberman stated: "In the field of medicine, man's discovery of knowledge threatens to bog down because of unequal efforts to assess

and apply that knowledge. This is not because of a lack of technology with which to move information but rather because the new tools are not being employed. I would concur with this statement completely and add that veterinary medicine, in my opinion, should lead in the use of audiovisuals, since it is concerned with more than half a dozen species, whereas the other health-related sciences are concerned primarily with only one species—man. Thus, in one respect, time is a greater factor in the teaching of veterinary medicine. It is imperative that our veterinary colleges and our state and national organizations catch up with the other health-related sciences in educational methodology (15). I have presented possible solutions to some of these educational problems in several publications (7, 9). The use of television in teaching large university classes has been well

described by Drs. Roberston and Pyke (16). Winifred Hector (17) discussed the theory of programmed learning, emphasizing that the student should progress at his own speed and respond actively at every stage in order to demonstrate his understanding of each step in the logical sequence of the lesson; Hector concludes that learning must take place at the student's own pace and outlines the steps necessary to present a lesson in programmed learning.

Dr. Novak, in the opening speech to the Audiovisual Conference of Medical and Allied Sciences held in Washington, D.C., in 1966, pointed out that individualized study units with integrated multimedia presentations produced a higher achievement level than did conventional laboratory presentations. This was attributed to the fact that students were able to control their own rate of learning through the combined facilities of closed circuit TV, individual audiotaped lessons, 8-mm loop films, printed study guides, and small-group seminars. The integrated approach to learning with emphasis on independent study has also been evaluated by Drs. Postlethwait, Novak, and Murray (18).

Cartridge Film Projectors and Audiovisual Tapes

In my opinion, two of the most significant audiovisual innovations since the 1950's have been the development of the cartridge film projector and the development of audiovisual tapes. Movable audiovisual tape recorders are now available at prices within the reach of many university departments.

The advantages of cartridge projectors and films lie in the fact that the student both in the classroom and in the field can project short concept films at a time and place of his own choosing. The staff and administration does not have to be con-

cerned about the possibility of destruction of expensive equipment or film, since cartridge film is almost foolproof. There is no film threading or rewinding, and one can change the film in a matter of seconds. The small Technicolor Super 8 Instant Movie Projector also lends itself to self-instructional procedures.

As the cost of videotape recorders continues to decline, the simple storage of unusual or complicated demonstrations (seasonal syndromes, rare clinical cases, animals showing toxicity symptoms, etc.) may be captured on film and placed on tape or on cartridge films, to be rerun at a later time by the staff or the student, or shipped to other areas of the world. Dangerous, complicated, or time-consuming demonstrations need only be performed once if they are captured on videotape. In a matter of minutes material can be demonstrated that would ordinarily take hours of preparation and many hours to demonstrate to small groups of students. The integration of pre-clinical and clinical subject matter can in many instances be brought about by programmed material, concept films, and videotapes.

Classroom without Walls

There is a saying that we now have classrooms without walls. This is a reference not only to open and closed circuit TV but also to the fact that videotapes can now be sent by mail to various parts of the state, the country, and the world. In March 1968 videotape classroom lectures were initiated at industrial sites in many cities of Iowa where engineers and industrial managers were attending the lectures as graduate students of the Iowa State University College of Engineering. The courses were given through videotape instructional television in combination with direct telephone hookup with the instructor on the Iowa State Uni-

versity campus. Closed circuit television and videotapes had been utilized for partial presentation of many courses at Iowa State University for some time, but this was the first time that a complete off-campus course had been offered in this way (19). Another course (Nutrition during Human Growth and Development) was offered by the Home Economics Department, using a similar combination of videotape and telephone, the instructor visiting the off-campus site at least once a week. The fact that the small Ampex 1-inch tape recorder, which is compatible with all Ampex tapes and which sold (in 1968) for \$995, weighs only about 60 pounds make this type of extension teaching possible. The advantages of such a system are as follows:

1. The tapes can be made on the campus in black and white or in color (if the more expensive Ampex tape recorder is available).
2. The viewing audience is not required to listen to a certain closed circuit TV hookup at a specific time (or at a particular place); videotapes can be sent anywhere for use by any audience.
3. The material can be repeated several times in one day or several times during the week for those who may have missed one or more lessons.

It is my understanding that the entire State of Colorado has now been classified as a residence campus for the use of videotapes and that credit is now being given in many courses at the Master's level for this type of teaching (19).

In our own profession of veterinary medicine it requires but little imagination to foresee the time when much short-course material, including courses for credit, will be placed on tape and mailed to area extension offices or hand-carried by extension veterinarians to regional veterinary association facilities, where they can be shown and

questions can be asked. Another method would be to ship the tapes out on a weekly basis, followed by a visit of the extension veterinarian (or the instructor or professor in charge of the course), thus updating veterinarians throughout the state on newer methods of treatment, diagnoses, surgical procedures, and public health problems.

The time may not be too distant when practicing veterinarians in the field, as well as those in governmental and other institutional positions, can take many courses for credit which must now be obtained by personal attendance and on-campus residence. The fact that Colorado has now declared the entire state a residence campus for videotaped courses indicates a trend which will probably be accepted state by state throughout the country.

Audiovisual education has grown beyond the classroom stage. It has spread from university campuses to the countryside and to communities throughout the nation. With the growing availability of audiovideotape recorders and the production of more audiovisual educational material by properly trained and audiovisual-oriented college personnel, with the blessings of college administrations and (hopefully) the financial assistance of both state and Federal government, all the health-related professions will be able to remain abreast of the constantly changing modern health sciences.

Distribution of Audiovisuals on a World-Wide Basis

It seems reasonable to hope that, within the near future, television monitors, videotapes, and cartridge films will be as common to the teaching process as the blackboard or the textbook. The following four-part proposal, which I made at a meeting of the Association of Land Grant Colleges in Denver in 1956 and subsequently published in

the Association's Proceedings (3), is as applicable today as it was in 1956.

1. Perhaps it would be wise if all colleges and universities would have a committee or department of medical communications charged with the responsibility of developing and stimulating the use of audiovisual equipment, films, etc., at their disposal in their respective institutions.

2. Perhaps a quarterly or biannual newsletter, circulated to various institutions throughout the country by a central agency such as the American Veterinary Medical Association, could keep us abreast of new films, contemplated and in production, and the availability of 2×2" lantern slides, kineoscopes, and other audiovisual aids and tools.

3. Perhaps the publication and circulation of an audiovisual handbook enumerating the audiovisual materials available in the field of veterinary medicine would prove useful. The selection, evaluation, and proper utilization of the numerous multisensory materials available could be outlined and emphasized. It is hoped that this information would prove helpful to both administrators and teachers.

4. It seems imperative that we evaluate the present audiovisual methods now at our command and appraise their strength and their weaknesses as they contribute to our own university educational program.

I believe that the above recommendations, which I made over 12 years ago, are still worthy of consideration. In fact, we need only add that today the above suggestions are applicable not only on the state and national levels but on a world-wide basis.

With the advent of the cartridge film and cartridge film projectors and with the availability of videotapes and lightweight, movable videotape recorders, the most recent developments in public health and preven-

tive medicine can be distributed to those countries and areas that the World Health Organization deems most appropriate. The old saying that "the sky is the limit" may be literally true, for the time is near when commercial and noncommercial educational programs will be transmitted across the country and around the world by means of satellite television systems. In many instances, this would eliminate the necessity of personnel spending many months or years as technical advisers in other parts of the world.

Audiovisual material produced for the use of one college could be translated into any language and sent to any country which does not have the hardware to produce its own audiovisual materials. The already existing system of international cooperation between colleges could be extended, or even slightly revised so that, instead of sending technical advisers out of the country at considerable cost, audiovisual materials made for the use of a university in this country could be converted and translated by that university (or the World Health Organization) and sent to a sister university in another country. By using tapes easily made on inexpensive portable tape recorders, specific questions and on-the-spot advice could be conveyed back and forth via the mail.

Unquestionably, the need and the challenge are here, and our only deterrents are our lack of vision and the lack of funds at our disposal to explore these challenges and their many far-reaching ramifications.

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THE COMPUTER FACT BANK

MULTIDISCIPLINARY LABORATORY INTERRELATIONSHIPS

FRED W. CLAYTON, D.V.M.*

The Fact Bank Project at the University of Missouri is designed to locate, mobilize, and display for members of the health team appropriate selections of the latest biomedical information available. Practicing physicians and paramedical personnel alike will find the Fact Bank helpful (1) in improving their understanding of mechanisms and patterns of health and disease; (2) in contributing to and stimulating their interest in lifelong learning; and above all, (3) in contributing to quality patient care.

The Fact Bank itself is an open-ended collection of several hundred thousand pages of selected current facts, definitions, and basic science, clinical and research information. A small but exceedingly important portion of the Fact Bank will be in machine-readable form (i.e., on magnetic tape). The major portion of the collection will at first be on 16-mm microfilm in cartridges, or on microfiche. Any one of these pages, or any item in the machine-readable portion of the file may be displayed automatically within a few seconds, by means of existing programs with existing equipment.

When increased volumes of machine-readable textual information become available, almost as by-products of the printing industry, more and more of the Fact Bank will be on magnetic tape, because this form

permits multiple low-cost transformations of input data.

The key that unlocks the wealth of detail in the Fact Bank is the unique Depth Index, or thesaurus, now under construction. The Depth Index will be entirely in machine-readable form on magnetic tape and will display important relationships between key words and concepts with the aid of carefully framed definitions and word association maps. Emphasis will be on interdisciplinary usage and quantitative relationships.

Several rich sources of condensed medical information are now available and will be used in constructing the Depth Index. These include the American Medical Association's *Current Medical Terminology*, the National Library of Medicine's MEDLARS-MESH System, and the American College of Physician's *Systematized Nomenclature of Pathology*, all available in machine-interpretable form. Combined they will furnish (1) thousands of key words and concepts; (2) important synonyms, near-synonyms, and related words; and (3) cross-references, nomenclature code numbers, and hierarchical relationships.

The Depth Index will be far more than a conventional thesaurus. It will be used as an authorized list for indexers in indexing, for searchers in locating answers to specific questions, and for users generally, who.

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through its use, will become aware of important new knowledge and hitherto unsuspected relationships.

The user will (1) enter the Fact Bank via the Depth Index, using the *key word* or concept of his own choice; (2) be led rapidly to the *preferred terms* in the system; and (3) be shown the present word association map, or *universe of discourse*, centering around these terms. In effect, he will be negotiating the question himself and will secure direct machine output when it is available from machine-readable stores. The indexes will be keypunched to selected relevant literature in the microfilm collection (with page numbers), which will provide additional important keywords for consideration. These keywords can be manipulated with the aid of such computer programs as B. G. Lamson's "English In, English Out" system for surgical pathology. Dr. Lamson's system can display hierarchical relationships, to seven levels in all, and will accept new terms, if desired, and establish links with other terms as appropriate.

In summary, the Fact Bank and its associated Depth Index will enable the user:

1. To choose material containing answers to his specific questions *at the time of his greatest interest and clinical need*.
2. To become aware at the same time of the availability of additional new information, some of which, perhaps, he was not consciously seeking.
3. To re-establish active contact with an ongoing information system designed to

challenge him and to promote habits of life-long learning in his chosen profession.

In accordance with important requirements of the Kansas-Missouri Regional Medical Program, the Fact Bank Project will concentrate on information about heart disease, cancer, and (especially) stroke, emphasizing basic medical science and clinical and research information. It will also include representative collections on congenital, neonatal, renal, and infectious diseases, emphasizing pathophysiology and causal mechanisms of disease.

A specialized collection of some 100,000 pages of carefully selected basic science and clinical information is needed to work effectively in any major discipline, such as pathology, or in any categorical research area, such as stroke, cancer, or heart disease. The American Medical Association's *Current Medical Terminology* contains much machine-readable information related to all of these areas. We have contacted the editors of major medical journals who seem receptive to the idea of making machine-readable text available for experimental uses (almost as a by-product of their publishing processes). Our policy will be to use such sources of authentic and up-to-date information on tapes to the maximum extent possible, in order to permit the multiple low-cost transformations of input data required to assemble, condense, and integrate information from many disciplines. For many years to come, microfilm collections will be needed to supplement machine-readable information, especially in covering the older literature.

AUDIOVISUAL COMMUNICATIONS

AN ACTION PROGRAM

NORMAN L. COLE, PH.D.*

Almost daily, communications problems are brought to representatives of the National Medical Audiovisual Center of the National Library of Medicine for solution. The problems are posed by professional persons from leading schools throughout the United States, from schools abroad, from regional medical programs, or from national health and medical organizations. In many instances, a person with great expertise in his own medical specialty finds himself in a full- or part-time situation requiring communications knowledge that he does not possess but which is necessary to solve an otherwise seemingly insoluble problem. Or the problem may have originated with a national organization which, realizing the magnitude of a problem in continuing education, desires to reappraise its position and develop a plan for action.

The time for such action plans is now, and some organizations are moving rapidly in this direction. Viewing the situation *in toto*, however, we find that there have been many plans, much talk, and surprisingly little action, except on an individual basis.

The various reactions to our discussions of audiovisuals at the National Medical Audiovisual Center give insight into some of the problems and concerns of profes-

sional persons related to the use of such materials. Instructors welcome the possibility of using audiovisual materials to communicate routine information. They complain that they spend so much time answering such questions as "What's a tibia?" that they are unable to serve the purpose for which the school hired them. Their attitudes toward communication problems vary from placing the burden of learning entirely on the student to assuming that the student must be "spoon-fed." Their attitudes toward the purchase of new audiovisual equipment vary from a desire to purchase the latest equipment without consideration as to whether it is really needed to a hesitancy to make any purchases because, next year, better equipment will undoubtedly be available. In addition, some instructors express a dislike for the idea of putting their presentations into audiovisual form. They do not have time for the advance planning required and occasionally express fear of criticism that may result when colleagues view their presentations. I am not surprised at their resistance, for in attempting to use audiovisuals as we know them today, many instructors have met with justifiable frustration.

The instructor cannot be expected to use audiovisual material in conjunction with classroom presentations unless its use is easy. He does not want the embarrassment

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of mechanical failures. And, last but certainly not least, he does not want to use material that is not specifically fitted to his needs.

A school that wants its instructors to use audiovisuals should plan to provide a person—other than the instructor—to be responsible for the acquisition, maintenance, and distribution of audiovisual equipment, if not also for its operation, and for the location and procurement of software such as films and videotapes.

In addition, each classroom should be so designed and equipped as to provide both an ideal learning environment for the student and an ideal teaching environment for the instructor. To some degree, most schools, even the most modern, have features which we consider to result from poor classroom design. We see these problems even in the blueprint stage when plans are brought to us for review. Effective audiovisual communication demands adequate facilities. Therefore, any plan for action at the local level should include a careful study of learning spaces and of the requirements of those who will use them and a review of all architectural plans in progress. Faculty and students should not have to adapt themselves to adverse environmental and structural conditions. Rather, the building and environment should be adapted to meet human needs and, parenthetically, there should be a functional relationship among the various buildings and their parts.

You may be able to perform this survey yourself, or you may wish to secure the assistance of an architect specially trained in classroom design. Unfortunately, there are few specialists so trained. Students' viewing angles should be checked. Both acoustics and physical comfort are of major importance. Consideration should be given to the way in which each room is to be used. Such features as console control of projection equipment and room lights by the

instructor, low-level illumination for student note-taking, and access to audiovisual equipment when and where it is needed are "musts."

On many occasions, we at the National Medical Audiovisual Center have been asked to visit schools which want an evaluation either of their existing facilities or of plans for new or modified facilities. Generally, when construction is contemplated, we discuss ideas and review blueprints with the architects. It would be conservative to say that such a review is well worth while. We find that, from an architectural and engineering standpoint, the drawings are well done. But the architect produces his drawings from the requirements given him, and he cannot be expected to produce an adequate plan unless he is told in detail how each room will be used—each laboratory as well as each classroom—both today and 10 years from now. Only then can he consider the feasibility of various plans, such as vertical and horizontal access for television cable. Without information as to specific needs, he can design little more than boxes.

The question of whether it is practical to produce audiovisual materials locally to meet one's own needs is not an easy one to answer. However, it is both possible and practical to produce audiovisual material at the local level with a minimum of means. A plan for action at the local level should, therefore, include a study of the feasibility of producing materials for use with any one of the more common delivery systems. (In its simplest form such a plan would be concerned perhaps with slides, then with slides plus audiotapes, and so on.)

In addition to documentation of visual material on slides, film, or videotape, one might consider the possible advantage of preparing more sophisticated productions. Such productions are time-consuming, how-

ever, and may require skills which the average instructor may not have.

The instructor cannot be expected to produce audiovisual material unless its production is easy. To assist in this—and for other reasons stated earlier—we therefore recommend, as Dr. Getty did as far back as 1956, that each school of veterinary medicine seriously consider the feasibility of establishing a department of biomedical communication. The staff of such a department would be competent in those skills and talents required to work with faculty members, to analyze curriculum content and specific communications problems, and to come up with means or products for their solution. Such a department would also serve as the focal point for ordering and maintaining audiovisual equipment, so as to ensure ease of operation and compatibility throughout the school.

We envision the administrator of such an activity as having either department chairman status or operating out of the dean's office. Ideally he should have in-depth familiarity with the fields of veterinary medicine, education, and audiovisual communications. Such persons are now being trained in at least one graduate program. Under this administrator's supervision, as budget allowed, would be project directors and technicians with specific communications skills—artists, photographers, and an electronics specialist, to mention but a few.

The administrator's first task might well be the analysis of school needs and the exploration of ways in which the school might work cooperatively with other communications resource persons and organizations within the university and community. A community medical television system such as that in Atlanta, which utilizes the 2,500-megahertz bandwidth, is an example of one such cooperative relationship.

Often, excellent motion picture footage or slides are photographed by individual

faculty members. Regrettably, much of this material is not accessible to others who could use it.

Its inaccessibility may be due to an internal communications problem—one instructor does not know what another has stored in his desk, and the students, unless they happened to see the material used in class, are also unaware of its existence. Therefore, in every school, we recommend expansion of the library to provide a comprehensive service for the storage and retrieval, by both faculty and students, of information in as wide a variety of forms as possible. Ideally, this learning resource center should not only be staffed by at least one full-time librarian but should be provided with a mechanism for duplicating the still photographs, slides, motion picture footage, audiotapes, and videotapes of the faculty. These duplicate materials would be available for use on demand, with the originals protectively stored. Moreover, a central card catalog would list all available materials on a specific subject, regardless of the medium. It would thus refer the user to texts, other publications, films, videotapes, still photographs, etc., in a single search operation.

Learning resource material produced at the local level might also be of use nationally. Much of it, unfortunately, is not available for national use. It is conceivable that, in individual schools of veterinary medicine, money and time are expended documenting or producing instructional materials of essentially the same type as those produced in other schools. This duplication is, of course, wasteful wherever it occurs.

To avoid duplication and provide assistance at the local level, any plan for action, therefore, should take into account the problem of locating what has already been done and is being done, both locally and nationally, in the area of audiovisual pro-

duction. I do not have even the remotest idea of the number of separate items in any single medium that might potentially be useful to veterinarians, but I assume the number would be considerable. In our own experience, an intensive search for films in the area of cancer turned up approximately 1,300 titles, of which 1,200 were found to be still available. A comparable number of films were located in the area of neurological and sensory diseases. Whether they are useful and current, one can only surmise, for no attempt was made to review and evaluate them.

Catalogs at various levels of sophistication, and consequent usefulness, will require evaluations of several types, varying with the information sought:

1. At the first level, there is an urgent need for a comprehensive catalog of all available materials in a particular subject area. Learning of such materials is not an easy task. It requires surveying schools and producers, searching the literature, and getting one's name on distributors' mailing lists. These steps only begin to solve the problem. The information obtained will vary in format and completeness. Sometimes the information will be inaccurate; sometimes the items listed will be out of date or no longer available.

I would estimate that there are several thousand audiovisual productions that, according to the standard information given, would appear to be of use to instructors of veterinary medicine and public health. The available listings of this type need to be assembled and put into some sort of order. Duplicate listings, which occur when the same item is distributed and publicized by several sources, must be eliminated. Since many present listings describe films of peripheral interest, titles and descriptions must be culled and items of little apparent value eliminated.

An investigation of this type might reveal

that the amount of available material which would be of use to veterinarians is limited. If such should prove to be the case, a service will still have been performed. Even a negative report regarding resource material in specific subject matter areas is valuable. Until such a survey has been made, we will not know what is available and what is not and cannot be sure that time and money spent on new productions will not be wasted through duplication.

Perhaps a search of the type outlined above has already been made. To my knowledge, however, not even the scope of such a search has been defined, or a summary of subject categories outlined.

2. At the next level, there is need for a catalog of audiovisual productions being used in the profession and recommended as helpful. Such a catalog could be prepared as a result of a survey in which reporting forms might be sent to every school of veterinary medicine and public health in the United States and Canada. In addition to title and description, the form could include the information required to key the use of the material to a specific point in the curriculum.

A second method of compiling a catalog of the above type would be to establish a committee of subject-matter specialists to evaluate those slides, films, and other audiovisual materials which have promising descriptions. Logistically, however, this is a time-consuming task, since someone needs to borrow the items, arrange for their review, and return them to their sources.

Evaluations of this type would be subjective. While subjective evaluations can be helpful, they should not be accepted without reservations, for they do not measure whether the material will or will not actually be effective when used by the students for whom it was designed.

3. At the highest level, there is an urgent

need for a comprehensive catalog in which all audiovisual materials useful in veterinary medicine and public health are adequately described. The instructor planning a series of presentations (perhaps a series of videotapes), the researcher wanting to know what has already been done in a particular area, the practitioner with a particular problem, the student seeking information—all could use such a catalog. A catalog adequately describing educational material should provide information that will assist the user in judging the instructional potential of available materials with his particular group.

Who should undertake the task of locating and evaluating useful audiovisual learning resource material? It is my opinion that the individual instructor should do what he can to help improve his own communications at the local level. It is also my opinion that the job of satisfying total cataloging and evaluation needs, especially as they relate to continuing education, is too big a job for any one instructor to handle, with the limited resources of a single school.

If a school cannot do the job, who can? The instructor is in a better position to analyze the curriculum, the audience, and the possible uses of audiovisual materials by his students than is a committee representing a group of schools or a national organization. On the other hand, a national group is in a better position to provide personnel, equipment, and time—resources critical to the development of effective communication materials. A broadly based, well-organized, coordinated effort is the only solution to the problem. Whether such a time-consuming and costly effort would be worthwhile, only you can decide. Who should take the leadership and assume the responsibility? Again, only you can decide.

One advantage of documenting the availability and usefulness of audiovisual materials is that it uncovers the possible need

for new production by the profession. Review of a well-prepared catalog, in conjunction with analysis of the total need for learning resource materials, would result in a clear picture of gaps which might be filled through audiovisual means. Priorities could then be set and a broad coordinated production program started.

It will not be easy to determine those parts of the curriculum where audiovisual support might be useful. I suggest, however, that there might be merit in establishing an ongoing program to identify such areas and to produce, periodically review, and update learning resources. This does not necessarily mean the establishment of a core curriculum, because I realize that needs vary, but it does mean that I recommend consideration of the production, on a priority basis, of a wide variety of materials that can be put into learning resource centers—so that faculty and students can draw, cafeteria-style, as with texts on shelves, those items which best suit their immediate purposes.

Just as an individual instructor will not personally attempt to produce every text that will be useful to him, neither will he try to produce every videotape or motion picture that he might deem useful. And just as specialists write texts in specific subject areas, they might produce other media in their specialties. The learning resource center, then, would house a comprehensive series of productions, representative of existing opinions and methodologies. Thus the instructor, in planning his own presentation, would not be limited by lack of supportive material and would have a wealth of material from which to draw, the production of any item of which might be beyond his individual resources.

A new day will come if we want it to come. There are many things possible with the technology we now have. Whether we really want to do something about it is

another question. The old shoe is comfortable and can be worn as long as it holds together. As to the age-old problem of learning, there are undoubtedly other solutions which I have not touched upon and of which I have not dreamed—but I do hope I have directed attention to the possible advantages of working toward the development of a plan of action for the improved production, storage, retrieval, and use of audiovisual resource material.

The plan I have suggested involves both local and national participation. Questions of leadership need to be decided and courses of action mapped out. I hope educators in veterinary public health and preventive medicine will give this matter careful consideration and that, individually or as a group, they will explore further the opportunities that will result from more intensive activity in this area.

Part III
EVALUATION

EVALUATING THE STUDENT'S LEARNING

EDWIN F. ROSINSKI, ED.D.*

HOW WE DECIDE WHAT TO TEACH

Before the question of objectives, or deciding what to teach, is considered, a particular educational term must be defined. That term is *evaluation*. To the educator this term has a specific meaning and contains certain ingredients. These ingredients are (1) objectives, (2) criteria, and (3) measurement. Therefore, in the process of evaluation the first step is to decide what to teach (objectives); the second step is to spell out the standards by which these objectives should be achieved (criteria); and the final step is to develop the tools for appraising whether the objectives are a fact (measurement).

This is quite different from the normal or lay use of the term. In its common usage the concern is usually with the measurement or appraisal part of the term. In this paper, evaluation as defined above will serve as the frame of reference.

Now to consider the first part of evaluation—objectives—or, to state it another way, how to determine what it is that our students are to achieve. To this end, several questions will be posed and answered.

Why Do We Need Objectives?

There are three paramount reasons why we need objectives. Others may come to

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your attention, but these three seem to be the most significant.

1. *Curriculum design depends on objectives.* In all the literature dealing with curriculum development, a *sine qua non* of sound curriculum planning is the development of objectives. A curriculum cannot be designed until it is firmly decided what the curriculum should achieve. Thus, an objective in veterinary medicine might be for a student to be able to integrate and correlate all his knowledge in physiology and anatomy so that he can effectively utilize it in a clinical setting. A curriculum (with all its ramifications and complications) will have to be designed so as to provide this kind of experience. Or, if another objective states that a student should develop skill in the practical application of his knowledge in veterinary medicine, then the curriculum will have to be so designed as to provide opportunity for him to put into practice the knowledge he has gained in veterinary medicine.

Obviously this point could be discussed in considerable detail, but the discussion above should suffice.

2. *Teaching methodology depends on objectives.* The particular teaching materials and methods to use cannot be decided until objectives have been stated! As an example, if an objective veterinary medicine calls for a student to develop proficiency in performing skills, obviously he will not achieve this proficiency by merely listening to a teacher lecturing about them. True,

some proficiency can be imparted in a lecture, but the student will also have to see demonstrations of these skills and have the opportunity to actually perform them with patient care. Three different kinds of teaching methods have been considered here because of the way the objective was stated: lecture, demonstration, and clinical performance. The same kind of thinking will have to take place when making plans on how to achieve any particular objective.

3. *Appraising student progress depends on objectives.* It should be obvious that what a student has achieved cannot be measured unless it is first clearly understood what he was to achieve. For example, if a student is to acquire certain knowledge, devices to measure this knowledge will have to be developed. If he is to develop a certain skill, then ways by which the skills can be observed will have to be formulated. In this case the kind of measuring device to be developed depends entirely on the objective.

Is There a Difference between the Kinds of Objectives We Have?

There appear to be three major kinds of objectives.

1. *Objectives dealing with structure.* These would be objectives that provide the broad physical setting for a particular educational program. These types of objectives are few and encompass an entire educational program. Under this heading might be listed such objectives as: "To develop an operational school of veterinary medicine." This objective deals with merely providing a school of veterinary medicine. This classification may seem elementary; nevertheless, objectives can be classified in this category.

2. *Objectives dealing with process.* These objectives provide the particular setting in which something will take place in a school

of veterinary medicine. Such objectives as providing a lecture, a laboratory, a demonstration, or a clinical setting, can be classified as objectives dealing with process. Process objectives are satisfied when the particular teaching exercise takes place. These objectives are not concerned with whether a student has actually achieved.

3. *Objectives dealing with product.* These are the objectives with which all (or most) teachers are concerned. They deal with behavioral changes in the student. It is universally agreed that the primary purpose in teaching veterinary medicine is to bring about changes in the student so that he acquires certain kinds of knowledge, skills, understanding, and attitudes. In short, certain changes are to occur in the individual by virtue of teaching-learning.

What follows deals with such product objectives, i.e., the changes that occur in students.

Are There Different Levels of Objectives Dealing with Product?

To answer this question it is necessary to classify objectives into specific categories. Here, again, three classifications seem appropriate.

1. *Over-all objectives.* These might legitimately be called institutional objectives, such as the objectives of a school of veterinary medicine. Specifically, these deal with the kind of end product a school of veterinary medicine wishes to produce. Usually this product is a student so educated that he or she can be certified as a veterinarian upon completion of the educational program. To achieve this objective, the kinds of knowledge, skills, attitudes, and understanding a student is to possess will have to be stated in general terms. While these are classified as over-all objectives, they are still the concern of every teacher, for unit

and teaching objectives as described below must be in harmony with the objectives of the institution.

2. *Unit objectives.* These are the objectives of a particular department, such as physiology or anatomy. In unit objectives a particular department refines the institutional objectives to an operational level. Unit objectives are an attempt to particularize the objectives stated by an institution. A department of physiology (or anatomy) will clearly have to spell out what it is that a student should acquire during his tenure in the department.

3. *Teaching objectives.* As teachers, these are the objectives with which each of us is concerned. The daily lesson plan is for all intents and purposes an attempt to satisfy teaching objectives. Every time a teacher lectures, runs a laboratory, gives a demonstration, or teaches in the clinic, he is attempting to satisfy certain teaching objectives.

How Do We Decide What Our Objectives Should Be?

Again, it seems that three major factors determine objectives. Stated another way, there are three major sources which must be considered when developing objectives.

1. *The health needs of society.* If we consider society in general, we can readily see that our population is growing; that it will have a larger proportion of younger and older citizens; that it will be highly mobile; that a larger portion of our population will carry hospitalization (*ergo*, larger numbers will be hospitalized); and that greater emphasis on ambulatory patient care will be stressed. If it is agreed that all of these are factors of our society, then they will undoubtedly affect the kind of medical service veterinary medicine will have to provide. Therefore, in developing objectives

for veterinary medicine, the needs of society will have to be considered.

2. *The needs of the profession.* Is, or will, veterinary medicine be content with merely producing practicing veterinarians? Will there be a greater need for practitioners in hospitals, for practitioners in private offices, for practitioners in federally supported institutions, or for teachers in schools of veterinary medicine? Is there going to be an increased need for veterinarians interested in research, and is there going to be a place for technical assistants for veterinarians? All of these questions will have to be considered in terms of how they will affect the future program in veterinary medicine. The significant and crucial problems of the profession will have to be considered when objectives are being developed.

3. *Scientific developments.* As discoveries in medicine and medical care develop, these will have a role to play in the development of veterinary medicine programs. With the development of new drugs and techniques, the content of a veterinary medicine program will depend a great deal on scientific discoveries. The contributions of science must always be considered when developing objectives.

How Can We Decide Whether Objectives Are "Good"?

This question can be answered only by a faculty that is charged with the responsibility of developing objectives. However, there are criteria that can be applied to objectives to determine if they qualify as "good." The following questions represent these criteria and can be applied to any set of objectives, whether they be over-all objectives, unit objectives, or teaching objectives.

1. *Are the objectives understandable?* Or, asked in another way, does everyone know

the meaning of the stated objectives? To satisfy this criterion, objectives should be stated in such a manner that there is no difference of opinion as to the meaning of the words used. This calls for the best use of language so that misunderstanding does not occur. The importance of this criterion should be obvious; if objectives are not understood by all the faculty, then it is likely that, in teaching, members of the faculty will be working at cross-purposes. What this criterion implies is that objectives should be stated in terms that mean the same to all readers.

2. *Are the objectives real?* Objectives should be practical. They should not deal in sweeping generalities or in such futuristic concepts or in such altruistic ideals that it would be impossible for any educational program to achieve them. Ideals are laudable and have a place in the educational program but being too idealistic borders on the unrealistic. Objectives should deal with specifics and should, if possible, be attainable within the educational program.

3. *Are the objectives measurable?* An educational program, in order to prove its effectiveness, should be able to produce some data that will prove that what it set out to do has been accomplished. To achieve this, objectives should be stated in terms that can be measured. Measurability can be classified into three additional categories.

Immediately measurable. At the completion of a particular teaching session, various measurement devices can be used to see whether a student has actually achieved the desired outcomes. Immediately measurable objectives are those that are part of the teaching objectives.

Intermediately measurable. These are the unit objectives that can be measured at the end of a particular course of study. In addition, the outcomes of an entire educational program, such as certification examinations, can be classified as devices for measuring the intermediate processes of an educational program. Perhaps the sole difference between immediately and intermediately measurable objectives is the

difference in the time span. However, both types of objectives apply to the formal educational program.

Ultimately measurable. This is the most difficult type of measurability to achieve since, once a student has left the confines of an educational setting, it is difficult to attest whether he is actually achieving and performing that which the educational program had hoped to instill or develop in him.

There is a strong relationship between this and the preceding criterion (are objectives realistic?). If objectives are unrealistic, it is impossible to tell in an immediate, intermediate, or ultimate setting if they are actually being achieved. While ultimate measurement is difficult to accomplish, it should not be discounted. There are plenty of ways in which follow-up studies can be constructed to determine whether, in a setting outside the educational institution, a student is actually performing as he should perform. As previously stated, this is an extremely difficult means of measurement.

MEASURING WHAT WE HAVE TAUGHT AND WHAT THE STUDENT HAS LEARNED

Before considering the measurement phase in the process of evaluation, it would be appropriate to discuss the interval between the time that objectives are stated and the time they are measured.

During that interval the whole teaching-learning process takes place. It is at this time that the individual teacher must decide on the teaching methodology he will use to achieve the objectives, and it is then that he must select the appropriate teaching materials to supplement the teaching methodology and decide on the learning theories most suitable for his students. In addition, the teacher will have to display a sensitivity to individual student differences and an awareness of individual student problems

and of all the other factors that comprise the educational environment. Between the time that the objectives are stated and the time that they are actually measured, a whole galaxy of teaching-learning activities takes place.

This brief summary is not intended to minimize the effects of the teaching-learning process but merely to bring into perspective all the other material covered at this Symposium and how it ultimately affects the process of evaluation. No single entity—teaching-learning, teaching method, evaluation—is of itself the most single important factor but, woven together, these entities create the pattern for an educational program.

At the beginning, measurement was mentioned as a part of evaluation. Another way that this might be stated is that, in this phase of evaluation, the concern is with appraising the extent to which students actually achieve the formulated objectives, whether they be over-all, unit, or teaching objectives.

Before deciding on a particular measuring device, it is important to consider the essentials that comprise a good measuring device. These criteria, or essentials, are applicable to either a classroom or a laboratory situation. They are concerned with measurement per se and, as such, have applicability to any kind of measurement technique or device.

There are several criteria for a "good" measurement device:

Objectivity

In interpreting the results of a test—if the test is to be perfectly objective—there can be one and only one answer. This is what is meant by objectivity. If a student's response to a test item was made available to a group of judges in order to meet the criterion of objectivity, regardless of the

number of judges looking at the student's response, all would have to agree as to the rightness or wrongness of the answer. If the judges disagree, this particular test item would not satisfy the criterion of objectivity. What objectivity means, then, is that there can be no difference of opinion as to what constitutes an interpretation of an answer.

Often references are made to the terms objective and subjective. In examinations, test items also fall into these categories. The usual paper-and-pencil test, consisting of such items as multiple-choice questions, can be classified as an objective examination. Essay-type or discussion examinations fall into the category of subjective because more often than not there is a difference of opinion as to what should be the correct response to a posed question.

Even when dealing with essay questions, there are specific techniques that can be used to make essay-type examinations much more objective than they are at present. In developing test items, examinations, or any kind of a measurement device, objectivity should always be a goal.

Practicability

A synonym for practicability might be economy. What this criterion means is that measurement devices should not become so elaborate, complicated, or expensive that the actual process of producing, administering, or scoring the examination is so time-consuming that it would be impossible to accomplish in a reasonable time. Undoubtedly it is possible to create measurement devices that could actually achieve all that they were designed to do, but these devices would be so involved and complicated that their use would be quite unrealistic.

Therefore, in developing a measuring device certain sacrifices will have to be

made. Perhaps the examination cannot be quite as objective as it might be if it were longer and more detailed. Individual judgment will have to play an important role in deciding what measurement devices are practicable for classroom use.

Reliability

By reliability is meant that a measurement device must have consistency. For example, if a student took an examination on Tuesday and then took the very same examination on Thursday—all things being equal—he should obtain the same score on Thursday that he obtained on Tuesday. This is what is meant by reliability. Now, because certain things do happen between the time the student takes the examinations, perfect reliability in educational measurement is never obtained. All things are never equal! The goal, then, is a measurement device that is as reliable as possible.

To make sure that an examination device does approximate perfect reliability, ambiguous statements, double-barreled statements, leading statements, and the like should be avoided. By avoiding these pitfalls in constructing measurement devices, the reliability of the instrument is improved.

Validity

Validity can best be defined by a question: Does the measuring device measure what it is suppose to measure? Or, to put it another way: What is the relation between the measurement device and its criterion? Validity, while one of the most important criteria, is in its purest sense the most difficult to obtain. The more elaborate means of obtaining validity will not be considered here.

Generally speaking, making an empirical decision as to whether a measurement

device actually does measure what it is suppose to measure is a form of validity. If an examination in physiology is supposed to measure understanding of physiology, obviously merely looking at the examination and seeing if physiology questions are included satisfies a superficial type of validity. If the examination contains questions on microbiology, it would obviously not be a valid examination because it is not measuring what it is supposed to measure. This is a very elementary form of validity, but it is an accepted form.

There are other ways of obtaining validity, but these are statistical. The means of obtaining statistical validity are more complicated than those for obtaining reliability. But, again, they are worth investigating.

Once the essentials of a "good" measuring device are clearly established and accepted, it is possible to consider what to measure.

A close scrutiny of any set of over-all, unit, or teaching objectives reveals that normally they deal with such areas as knowledge, skills, and attitudes. Each of these will be considered in turn and illustrations of the various ways in which they can be measured will be cited.

Knowledge

The usual procedure for measuring knowledge is through paper-and-pencil tests. These take various forms. They may be essay-type or the more common "objective" (or multiple-choice) type of examinations. Essay examinations have fallen from favor in the past few years. This is an unfortunate development, since this type of examination has a definite place in a testing program, especially in measuring a student's understanding. The reason they have fallen into disfavor is the poor way in which the essay questions were posed.

Often such words as "discuss," "describe," and "outline," are used as introductory statements in essay examinations. The failure of teachers to state essay questions in clear, concise terms so that a student clearly knows what he is supposed to do has also caused problems in scoring. What one individual instructor may consider an appropriate discussion of a question, another may not. What has happened is that essay examinations have failed to be objective.

To correct this situation there has been a trend in the use of objective, multiple-choice questions. Multiple-choice questions fall into several categories: true-or-false, completion, matching, or actual multiple-choice questions, where several options or choices are provided for each question. These types of questions have gained in prominence in the past few years because, while they are not necessarily easier to construct, they are considerably easier to score. If well constructed, they are highly objective, but even in the construction of these objective-type questions there are numerous pitfalls which a test constructor must avoid.

Another way to measure knowledge is through interview or a form of oral examination. The laboratory is a good example of a place where interviews or questions can be asked students to determine their level of comprehension of a particular subject. Well-worded questions can divulge more than basic knowledge. They can also give some indication of a student's level of comprehension and his ability to synthesize and correlate the basic information that he has gathered.

The formal interview, as a technique for measuring knowledge, will be discussed in greater detail in the section on measuring skills, below.

Another good way to measure knowledge is through observation, but observation of

itself is not enough, since a clear delineation of what is to be observed has to be formulated. Observation as a measuring technique will also be discussed in greater detail in the section on skills.

These are the three major ways to measure knowledge. The paper-and-pencil test is perhaps the most practical since it provides specific data about those objectives dealing with knowledge. These testing techniques have their place but should be studied more carefully.

Skills

In the field of physical therapy the acquisition of certain skills is of the utmost importance. Yet little formal effort is made to discover whether skill objectives have actually been achieved.

The first way to measure skills involves the process of observation. Normally students are observed performing in a laboratory or in a clinical setting, and some generalizations as to student proficiency are made, but when the teachers are asked to define proficiency in finite terms, many are at a loss. It is not enough to say that an individual is proficient in, say, doing a physical examination. The observer must determine what it is in a physical that the student does or does not do.

In the final analysis, observation, in gross terms, is not enough. The specifics to be observed must be listed so that a student's strengths and weaknesses can be pointed out to him. This may involve the development of some sort of rating scale by which a student's proficiency in each of the skills can be checked. The more refined the instrument, the more information it provides. The use of rating scales has a beneficial effect on the learning process of the student, since he actually comes to know his own weaknesses and strengths and can take steps to correct deficiencies and further improve his ability.

Another way to measure the student's skill is through the development of performance tests. These are not too dissimilar from the tests in which a student places blocks in assigned spaces or strings various sizes of beads. I do not know whether this approach is practical for veterinary medicine. I would, however, pose the question of whether this approach has ever been fully investigated by veterinarians in their educational programs. It might be possible to develop a test in which a student actually has to perform a particular activity while being checked to see whether he has achieved the required level of proficiency.

For all intents and purposes it is safe to assume that the best single way to measure skills is through the process of observation. The observation itself can be refined through use of an observation form or through some sort of performance test.

Attitudes

Every professional school seems to agree that one of its primary objectives is the development of "sound, wholesome, ethical, attitudes." Whether these attitudes concern fellow human beings or ethical behavior in the profession is irrelevant; the fact that such attitudes should be developed is important. Yet, when a member of the faculty is asked how he measures whether students have actually acquired these attitudes the answer is usually a blank stare or an indefinite response such as "I know what they have (or have not) acquired." When faculty members are asked to provide objective evidence as to whether these attitudes have actually been achieved, nine times out of ten there is no evidence.

One of the reasons for this is that the devices to measure attitudes, such as in-

ventories and scales, are rather complicated and detailed as described in the literature. Understandably, the faculty avoids the development of such devices. There are certain other steps, however, that can be taken to measure—although not quite so perfectly—whether attitudes are being developed.

One of the best and most simple ways this kind of information on attitudes can be obtained is through *anecdotal* data. This involves maintaining a file on each student. Whenever a member of the faculty observes or hears some negative or positive statement about a student's behavior—whether it concerns a fellow student, a patient, or the faculty—this bit of evidence is entered in the student's folder. After several years a number of these anecdotes become available, and a pattern regarding the student's behavior can be detected. The use of anecdotal records is perhaps the most practical approach for classroom teachers, since it does not involve the amount of time that would be required in the creation of more refined instruments. While anecdotal records are not perfect, they at least provide *some* information about the student's attitudes.

These, then, constitute some of the major ways in which knowledge, skill, and attitudes can be measured. The measurement of understanding has been deliberately omitted, since there are differences of opinion as to what constitutes understanding. The kinds of devices usually used to measure understanding are classified under paper-and-pencil tests and have been discussed above, under the heading of Knowledge.

Recent years have seen the creation of various hybrid forms of examinations. These are now being investigated. The use of a test for diagnostic skills developed by Dr. H. J. Rimoldi of Stritch Medical School at Loyola University in Chicago may be

adaptable for use in veterinary medicine education. The University of Colorado School of Medicine has developed a series of films that measure a student's ability to observe patient behavior and to correlate this measurement with other data. The work of other schools actively engaged in preliminary work in the field of measurement shows tremendous promise.

It would seem expedient for every school of veterinary medicine to actively consider the development of new measurement techniques. There is enough evidence in the literature to indicate that the measurement devices developed for public education and for medical and dental education can be applied to problems in veterinary medicine. They deserve your attention.

Appendix

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