It will be noted from the results of experiments Nos. 1 to 18, inclusive, that the amount of solution required to produce complete local anaesthesia was, in all cases, the same. These results would tend to prove, therefore, that the forms of sterilization described above *do not affect the activity of solutions of Cocaine or Procaine.*

It also should be noted that the unsterilized solutions, the solutions sterilized without heat, and the solutions sterilized with heat all showed exactly the same activity after 3 months as immediately after being prepared.

We will continue our experiments by testing samples from each lot of solution every 3 months, and fresh solutions of the reserve salts every 6 months. The final results of this series of experiments will then be presented in a subsequent paper.

Finally, the author wishes to acknowledge his indebtedness to Mr. Arnold Quici for most of the laboratory work in connection with this paper.

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MICROBIOLOGY IN THE TWO-YEAR COURSE IN PHARMACY.*

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The writer has experienced some doubts as to the wisdom of preparing a paper under this title. If the following remarks be embalmed in type, it is, perhaps, conceivable that they may be read by the pharmaceutical educator of no distant date in somewhat the same spirit in which the economic zoölogist of to-day might pursue the theories of some medieval writer regarding the domestication, training and usefulness of the dodo. Nevertheless, if the most of us, the present writer included, be compelled by necessity to engage, so to speak, in the training of a present-day dodo, we must, for conscience's sake, be concerned in turning him out as respectable and efficient a fowl as his generic limitations permit, though the result thereof may indeed be to perpetuate the species longer than many of us would desire. Future developments must come from present seed, and only in so far as we discharge the responsibilities of to-day worthily may we hope to accelerate the evolution of our "bird" into one with the wings of a baccalaureate degree to elevate him to an equal plane with practitioners of our sister professions.

It is perhaps no wonder that microbiology, or to use the commoner less inclusive term, bacteriology, as a most recent addition to our sciences, has not long claimed a definite place in pharmaceutical education. No pioneer in the matter, certainly, the writer introduced the subject in his curriculum only two years ago, and there are still institutions where, for one reason or another, the study has not obtained a place. In this brief time, however, he has formed certain fairly definite notions as to the scope and place of bacteriology in the brief course in pharmacy. In the hope, therefore, of provoking some thought or discussion which may not be wholly without benefit, he ventures on record at this time, although, unfortunately, he cannot present in person to profit by any discussion which may arise.

The vital need to the modern pharmacist of some knowledge at least of the phenomena of microbiology in relation to human life can hardly be gainsaid. Three major objections to the inclusion in the short course of a separate study of the subject are sometimes cited: lack of time, lack of equipment, and lack of personnel

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adequately trained to give it—serious objections, all of them, in so far as they hold good in a particular case.

As to the time factor, it may as well be conceded at once that this is the prime difficulty. Also, it can be granted without argument that an adequate course in bacteriology cannot be given in the two-year curriculum. The two-year curriculum, indeed, is but a series of inadequacies, and in connection with microbiology it may well enough be held that more inadequacy is better than nothing, for the educator who delays effort on ultimate perfection of circumstance or achievement will long be among those "who only stand and wait." A well-rounded course in this science should, of course, consist both of lecture and laboratory, the latter especially intensively given to small groups under constant personal supervision, with periods better adjusted daily for a comparatively short space of time than recurring once or twice weekly over the longer period which is the common and probably the better plan for courses in chemistry, pharmacy and other laboratory subjects whose experiments and phenomena require less constant attention. This concentration of time is difficult enough to effect in a four-year course, let alone the one under our consideration. Such an intensive course, in most universities and scientific institutions, is given in the third or fourth year. The two-year student, even if time were available, is rarely prepared sufficiently in biology and chemistry to undertake it profitably. Despite all this, the writer, for one, would be very loath to turn any student, of however brief training, loose to bear the relation which the pharmacist must bear to the public, without at least a rudimentary knowledge of germ life in its practical relation to his life work and to the human race in general.

The other objections cited can at present be given but casual attention. With equipment, few of us are apt to be overburdened. If we have the facilities of a well-equipped university laboratory specially devoted to the subject, well and good, but not all of us are so fortunate. The better and more plentiful the apparatus, naturally, the better should be the course, but a comparatively small outlay will provide at least enough to make a start, and, if success with little prompt the powers that be to give us more, so much the better. The writer, for one, would fit his course up from the ten-cent-store rather than give it up altogether. As to the matter of the instructor's requisites, he would also touch that but briefly. The picture he would draw of the ideal teacher of microbiology would hardly be recognized by his students. While he once had the title at least of "bacteriologist," at the present development of the science he would scarcely venture to assert a present claim to it. He is not at all sure, however, that the highly trained technical expert in modern microbiology is just one to present the subject in the two-year pharmacy course. Years of specialized training and concentration are apt to erase from the mind the conception or remembrance of the tyro's viewpoint—a thing that must not be lost sight of in this all too brief exposition to students all too briefly prepared. Breadth, though not the breadth of shallowness, rather than depth of training is desirable; few subjects indeed demand a greater breadth of thought and experience.

To return again to the time element, economy here may be served by not concentrating all the attention to bacteriology in a single course. The course in botany, which should precede it, should lay a foundation by encouraging the

development in the student's mind of what may be termed the biological viewpoint, a conception, sketchy though it may be, of the interrelationship of organisms in the scheme of nature. A course in human physiology, or, better, of hygiene, accompanying or following, may stress the relationship of microörganisms to human pathology. Chemistry may consider briefly the phenomena of fermentation. Pharmacy, in the laboratory, often furnishes striking and "practical" examples of the work of molds and bacteria. It has been the writer's practice, for various reasons, to treat of serums and vaccines and the phenomena of immunology mainly in the courses in materia medica, which are also under his leadership. It may be objected that such a general scheme of coördination may lead to the trespassing of one instructor on the field of another, with possibly, some discordance of impression on the student mind. A curriculum the work of which is not planned to interrelate, however, is not much of a curriculum, and such evils, under proper management, can be at least reduced to a minimum. It is not meant, of course, that the attention to the matters mentioned above should be entirely delegated to the subjects named; rather, a groundwork should be laid here upon which the instructor in microbiology can build a united structure. Such coöperation will not materially interfere with the conduct of these other courses; nothing, indeed, has been mentioned which is not legitimately a part of them, and it will materially facilitate progress in the brief time which can be given microbiology as a separate subject.

It has not been found feasible, in the writer's experience, to include laboratory practice in the course given two-year men. Many a student, impressed by the limitations of knowledge merely gained didactically, has complained of this, but it is a limitation imposed by the intensive demands of the more characteristically professional studies in the two-year curriculum, and is, of course, only another illustration of the inadequacy of the two-year term for the well-rounded development of the modern pharmacist. A two-hour lecture course, with some table demonstrations, lasting through one semester of the second year, has seemed thus far to us the best solution of the problem.

As to the subject matter to be presented, no attempt has been made to develop what might strictly be called a course in pharmaceutical bacteriology. Neither is it what ordinarily passes for a course in general bacteriology. We have medical bacteriology, agricultural bacteriology, the chemical microbiology of fermentation—Volstead Law or not—and bacteriology for nurses, for public health workers, and other specialized branches of the science. Eventually, no doubt, we shall have a well-grounded pharmaceutical microbiology, but this branch of the science, thus far, unfortunately, has few exponents, though they are growing in number. A study in a professional course, however, may not be without "practical" applications; the one given at Reserve may not improperly be styled every-day bacteriology with pharmaceutical applications.

As an introduction, to arrest the severely "practical" mind of our two-year man, some general illustrations of the importance of the relation of bacterial life to the human species may be given; for example, the statistics last year compiled by the Cleveland Hospital Foundation were drawn upon to show the economic loss annually caused by communicable disease in the locality where most of the students had their homes. A somewhat sketchy outline of the brief but wonderful

past of microbiology follows. Then, of course, some conception of the morphology and physiology of microscopic life must be given. It is best, no doubt, to devote major attention to the bacteria proper, but a course could hardly be given without some illuminative mention of the commoner fungi—the molds and the yeasts, at least—and of the pathogenic protozoa. The course in botany, which with us is under the same leadership, is so planned that much of this will be in the nature of recapitulation, rather than a sudden flooding of the student mind with new and unfamiliar facts. In the matter of morphology, a lantern, with slides prepared for projection, is of much advantage.

Through physiology, and the consideration of nutrients, one passes naturally to the mention of inhibiting agents, antiseptics, disinfectants and methods of sterilization. By coöperation with the Department of Pharmacy, oftentimes, the students may at this time get actual if brief experience in the sterile preparation of various substances used in pharmaceutical practice. Besides the methods of preservation of medicaments, the sterilization of dressing, etc., it is in order here to devote some attention to the methods ordinarily used in preserving foodstuffs, especially syrups, ice creams, etc., which are served in most drug stores. The practice and necessity of cleanliness and sanitation in the serving of these products should by no means be neglected. A lecture here by some live official engaged in enforcing city or state sanitary codes is well worth while. One main object of the course, naturally, is to put the future pharmacist in sympathy with such legislation and its enforcement.

Methods of staining and of isolation of organisms, and the preparation of media, in such a course, can be given but brief attention, but should not be left without some exposition and demonstration.

Next one considers specialized types of microbiology. The study of pathogenic organisms naturally predominates, but the student must not be sent away with the idea that the only or principal importance of microörganisms is in the causation of disease. The theories and conditions of infection and immunity, the actions and nature of toxins, the methods of preparation and preservation of bacterins, serums and vaccines are studied or reviewed.

This leads to some detailed attention to disease-producing organisms by groups and individuals. Under each heading it is well to capitulate the organism's importance, its means of spread and of production of disease, and something of the medical means of defense against it. Here means of avoidance, prophylaxis, and sanitation should be strongly stressed, particularly as regards diseases which may be spread by improper or careless practice in the drug store—a considerable group. In the matter of differentiation between such common diseases as the different types of rheumatism, digestive disturbances, etc., where infective agents often play a part, illustrations can be given of the dangers of "counter-prescription."

A course so planned, naturally, cannot, and should not, escape a considerable discussion of the venereal diseases—a subject not wholly easy to present before a mixed and more or less mentally immature audience. Yet with the lessons of the great war so strongly before us, in so far as those under our charge sin ignorantly, the sin is our own, though we may escape the suffering, and an instructor in such a course certainly would be grossly culpable should he shirk a frank discussion of some facts which are so well known to the most of us that we forget, oftentimes, the perverted and erroneous ideas that often prevail among the adoles-

cent. Actual difficulties, in such discussions, are more often foreboded than realized; if the instructor give the subject the earnest and serious attention it deserves, considering his students less as exemplars of either sex, than as students with an earnest purpose and necessity for learning, he will rarely find his audience, in the mass or individually, forgetting that it is composed of ladies and gentlemen.

In consideration of these diseases comes a most important specialized application. The propaganda carried on by the United States Government against the irresponsible sale by pharmacists of proprietary "remedies" for venereal disease is too well founded and too close to the public weal to escape emphasis here. Our students, in coming years at least, too young for the most part to have had this at first hand, must not go away from us without forceful warning of the stern realities in the matter. As educators we are unworthy the name if we leave wholly for legislation or public opinion the task of stamping in the mind of the future pharmacist of the vending of these far worse than useless nostrums.

A course such as outlined above will crowd its time limits to the utmost—the more so that much of it must be presented not wholly from textbook, but by carefully prepared lectures. It is no disparagement of the many excellent works on general or specialized bacteriology to state that none of which the writer knows are adequate for our purpose. Many are valuable as adjuncts, but must not remain unsupported. With a good work on general microbiology as text, the material on disinfection and sterilization in the U. S. P. and the N. F., especially in the latter, are of value. The matter of requiring reference reading, in a two-year course, is a matter of judgment. Usually there is little enough time for that, but many students, of their own volition, will seek more knowledge than can be imparted in the scant limits of the lecture or text.

The reaction of the student mind to innovation is always of interest, especially to the innovator. If one has in his audience what he can hardly escape—what may be termed the "State-Board mind" centered only on the two-year obligatory course and as little as possible of that—he can hardly expect enthusiastic coöperation from that source, the more so as examiners, for the most part, give little attention to bacteriology. This type of intellect, fortunately, is in rapid dimunition at the institution which the writer serves. The course is, frankly, one not of technicalities, but of responsibilities. To the thoughtful student, with a sense of his relationships as an individual and as a professional man, the course has not proved unacceptable, though no effort has been made to render it a snap course or an entertainment course. The writer is frank to admit, in this respect, that he has aimed the work rather at the higher portion of his audience than those below it, though he has often been surprised at the response to it of students not especially intellectually blessed. To save the worthy among the latter, it may sometimes be necessary to grade with unusual circumspection to save really earnest students into whose pint cup it has proved impossible to convey a quart of learning.

The course as outlined is not, the writer hopes, a static one. It may, we hope, be improved from year to year, and any suggestions for its strengthening from those whose experience has led them in similar paths will be deeply appreciated.

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