fact, that all of them cannot be crowded into the curriculum. A cursory survey of the curricula of the colleges in the Association leads me to estimate that at least twenty years would be required to complete the various subjects required by the different colleges and leading to the Bachelor's Degree. Therefore, to say that any specific branch of learning, except those generally recognized as essential shall be required by all the colleges in the Association will generally arouse discussion or even argument. Personally, I believe that physiological chemistry is a very important subject to the pharmacist, especially to him who proposes to pursue the scientific side of the subject.

My ideal course, therefore, would include it in the four-year curriculum and let it come in the fourth year so that it would rest on a strong foundation of chemistry. I should like to give it as a so-called "separate" course, but in the teaching of it I should continually correlate it with its physiological and pharmaceutical relationships. The student is now ready for such a correlation for, strictly speaking, he is not a beginner. He understands the principles of several divisions of chemistry, he knows how to use advantageously journal articles, reviews and monographs. In the course of his physiological chemistry I should have him profit by much collateral reading. This reference study would not only broaden his knowledge of the fundamental principles, but would impress him with the developmental state of the subject. It would also help him to understand more clearly the chemical basis of immunology, and bacteriology. In short, he should soon realize and appreciate the coöperation of the bio-chemist with the pathologist, the pharmacologist and the physiologist in the revealing of the chemical phases of life. I believe that at least three semester hours could profitably be given to physiological chemistry without infringing upon the time of other desirable subjects.

I shall mention only a few things which the course might include to great advantage for I feel that a detailed account of its scope would be out of place to this audience: (1) A consideration of the composition and chemical properties of protoplasm based upon a thorough study in the class room and laboratory of the colloidal state; (2) a fair understanding of the constituents of living tissue; (3) the three main food stuffs—fats, carbohydrates and proteins, and the chemical processes that render them assimilatable and their products of hydrolysis including the influence of the saliva, the gastric and pancreatic juices and the small-intestinal secretions and the effect of the hydrogen-ion concentration; (4) digestion and the mechanism whereby the end-products of digestion pass through the walls of the intestines into the blood and lymph; (5) tissue formation and the production of energy; (6) blood and lymph; (7) metabolism, catabolism and oxidation changes, urine, etc.; (10) nutrition, including vitamins and mineral requirements; (11) animal calorimetry; (12) pathological conditions and the value of bio-chemical methods of diagnosis.

"PHARMACEUTICAL" BACTERIOLOGY.*

BY E. N. GATHERCOAL.[1]

Bacteriology as a technical science possesses a distinctive and marked pharmaceutical side:

* Read before the Materia Medica Teacher's Conference, Rapid City, S. Dakota, Aug. 26, 1929. [1] University of Illinois.

a The preparation and standardization of culture media involves so many pharmaceutical processes that it may be considered as almost purely pharmaceutical.

b The preparation and standardization of disinfectants and antiseptics is almost purely pharmaceutical. The application of sterilizing and disinfecting processes to pharmaceutical preparations is already extensive and should be much more widely applied.

c A general acquaintance with the fermentative and destructive insects, molds, yeasts and bacteria is common in the realms of agriculture, dairying, domestic science, public health service and many commercial lines involving the handling of perishable foodstuffs and similar materials. The pharmacist should be even better educated in this direction because he not only is responsible for much perishable material in which the need of asepsis and antisepsis is more important than with food material, but because he is the fountain head for the dissemination of general knowledge along these lines.

d From a more purely scientific and general educational side, the pharmacist should be informed upon the great physical and physiological rôles that bacteria and other minute organisms play in the constructive and destructive processes of nature.

e The life history of pathogenic organisms, their prevalence, usefulness and destructiveness to other life and the nature of the products of their metabolism, leading up to the theories of immunity and the production of toxins and other antigens and of antitoxins and other antibodies should be taught all pharmaceutical students. Complete instruction in the commercial production of all the biological sera, vaccines, antigens, etc., should be offered and the preservation of such biologicals and the proper manner of their distribution and sale should be deeply impressed.

f The actual culturing and laboratory study of *all* the pathogenic organisms and a knowledge of the disease processes they bring about is beyond the need of the pharmacist unless he is specializing for a biological or clinical laboratory. In such case the student needs a much broader foundation in physiology, pharmacology and pathology than the pharmaceutical student receives. A few of the more common pathogens should be included in the work mentioned in Paragraph *e*.

g The mastery of the theory and application of the great biological tests such as Schick, Opsonic Index, Wasserman, Tuberculin, etc., lies outside of the pharmaceutical curriculum. As in Paragraph *f* the specialist needs training along these lines. A few scattered pharmacists have become such specialists. A general knowledge of the theory of these tests should be given under the work mentioned in Paragraph *e*.

DIDACTIC AND LABORATORY INSTRUCTION.

No technical science can be properly taught to a body of students by didactic instruction alone. Pharmaceutical bacteriology cannot be properly taught by lectures and recitations from a text. Actual laboratory practice is essential. At least double, if not three or four times as many clock hours should be spent in the laboratory as in the lecture room. Perhaps this condition is even more essential in the teaching of pharmaceutical bacteriology than in that of medical bacteriology.

TEXTBOOKS.

A textbook of bacteriology suitable for pharmacy students has not been found until the work recently published by Gershenfeld of the Philadelphia College of Pharmacy and Science was received.

A study has been made of the bacteriology texts as they have appeared for the last 20 years. Jordan's General Bacteriology is very well written and Park and Williams Pathogenic Microörganisms is a really wonderful textbook. In both instances the personal experiences of the author are so evident in the text, that these texts are very readable and yet every statement bears the mark of authority. However, in both textbooks the medical side is greatly enhanced at the cost of the pharmaceutical. Gershenfeld's work is largely based on Park and Williams' text but does not contain the personal references and is poorly illustrated. It does, however, emphasize the pharmaceutical side beyond the medical and hence is valuable in the pharmaceutical school.

The bacteriology texts by Jordan, Novy, Park and Williams, Conn, Marshall, Giltner, etc., and the classification by Bergey should all be available to the student.

SYLLABI OF DIDACTIC AND LABORATORY INSTRUCTION.

A mimeographed syllabus of the lecture and recitation course as given at the University of Illinois School of Pharmacy in fifty clock hours (one semester) is presented.

You will note that there are four distinct divisions, *viz.*:

I. Sterilization, Disinfection, Pasteurization and Antisepsis; II. The Physical and Chemical Characters of Bacteria, Their Habitat and Place in Nature, Their Physiological Characteristics and Metabolic Products; III. The Theories and Processes of Immunity, the Biological Tests and the Preparation, Preservation and Use of Bacteriological Sera, Vaccines and Antigens; IV. The Pathogens Among Bacteria, Yeasts, Molds and Protozoa.

A similar syllabus of the laboratory work given in 150 clock hours (one semester) also indicates four distinct divisions, *viz.*:—I. The Preparation of Culture Media; II. The Isolation and Identification of a Bacterium; III. The Culturing, Mounting and Study of about 30 Different Organisms, Including Pathogens on Special Media, Anaerobes, etc.; IV. Practical Laboratory Processes such as the Phenol Coefficient Valuation of Disinfectants, the Bacteriological Count of Water, Milk and Other Materials by Various Methods, the Differential Characteristics of the Members of the Colon-Typhoid Group, etc. Each student or pair of students chooses one type of work and gives the whole month to it, thus perfecting his technic until he is able to get concordant results and acquire confidence in his own ability.

Our Laboratory Outlines are very explicit in the working directions for each operation, but oral instruction is given when necessary in the laboratory. Assistant Instructors give constant personal instruction.

It is to be noted that the didactic and laboratory courses are not concordant in their content though given simultaneously, yet they do supplement each other very fully. Little is said in the lecture work about culture media, stains and staining methods, laboratory technic, etc.

Please note also that each division in each course covers approximately a month and at the end of each month's work a written examination is given on the work accomplished during the month. The eight ratings averaged give the student's grade for the course, unless the student because of low grades desires to take a final examination.

SYLLABUS OF THE LECTURE COURSE IN BACTERIOLOGY.[1]

50 CLOCK HOURS.

I. Sterilization, Disinfection, Pasteurization, Antisepsis (12 hours)

By means of heat

Direct burning, oven heat, boiling water, steam under pressure, "live" steam, heat less than steam

By means of chemicals

Halogens and other oxidizers
Heavy metals, phenols, alcohols and other coagulators
Cresols, aldehydes and non-coagulators
Acids, alkalies, salts, cyanides, sulphites, etc.

By means of filtration

Clay bougies, cotton or glass wool (air filters) and sand

By means of cleansing

By means of light

Sunlight, ultraviolet, etc.

By means of cold

Freezing, refrigeration, cooling

By other means

Practical applications in surgery, rooms, buildings, ships, other conveyances, books, water, milk, foods, apparatus, pharmaceuticals, surgical supplies, etc.

II. General Morphology and Physiology (12 hours)

Habitat and natural classification
Size, shape, structure, motility, growth, reproduction, spore formation
Chemical composition
Feeding and temperature requirements
Influence of chemicals, light, radium, electricity, pressure, osmosis, desiccation, etc.
The nitrogen cycle
Fermentation and enzymes
Production of pigment, light, heat
Poisonous products of decomposition

III. Infection and Immunity (12 hours)

Disease: causes and results
Parasitic microörganisms
Infection: kinds, means of transmission, essential conditions, virulence, susceptibility, routes, types and effects
Defenses against infection
Immunity: natural, acquired, active, passive
Antigens and antibodies: antitoxic, anti-protein, anti-microbial
Allergy, anaphylaxis, etc.
The biologic tests for susceptibility to diphtheria, scarlet fever, typhoid fever, syphilis, tuberculosis, pollen and protein extracts, etc.
Hormones and vitamins

IV. The Pathogens (12 hours)

Staphylococci, streptococci, pneumococcus, gonococcus, meningococcus
The colon-typhoid group
The influenza and black plague groups
The spore-bearing anaerobes
Organisms of diphtheria and tuberculosis
The yeast and molds; the protozoa

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[1] University of Illinois School of Pharmacy.

SYLLABUS OF THE LABORATORY COURSE IN BACTERIOLOGY.

150 CLOCK HOURS IN ONE SEMESTER.

I. The Preparation of Culture Media (36 hours)
- Cleaning of glassware
- Stoppering of culture tubes and flasks
- Sterilization of glassware
- Preparation of culture media
- Tubing and sterilization of culture media
- Labelling and preservation of culture media
- First Rating: Each student is to present for inspection and rating 10 tubes of broth, 10 tubes of gelatin, 50 tubes of agar (40 slated), 10 tubes of potato, 5 tubes of litmus milk, 5 fermentation tubes of dextrose broth, 5 fermentation tubes of lactose broth, 5 tubes of Dunham's peptone solution and 5 tubes of nitrate peptone solution

II. The Isolation and Identification of a Bacterium (36 hours)
- Cleaning slides and cover glasses
- Preparation and use of platinum needles
- Obtaining material for study
- Preparation of plate cultures
- Incubation of cultures
- Preparation of staining solutions
- Study of plate cultures
- Preparation of tube cultures and their study
- Cover-glass preparations
- Use of the microscope, drawing bacteria
- Testing cultures for indol, nitrites, ammonia, acids, gas formations, etc.
- Study of type forms of bacteria; motility, flagella, endospores, capsules, Gram's stain, etc.
- Second Rating: Present for inspection and rating one species in gelatin and agar plate cultures, gelatin stab, agar slant, potato, broth and litmus milk cultures, and mounts showing the ordinary stain, Gram's stain, any special stains, spore formation and flagella if present. Also include fermentation tubes and cultures for applying indol and nitrite tests, if these are positive for your organism. Drawing and notes indicating the steps in the identification are to accompany the cultures and mounts.

III. Pure Cultures
- About 60 organisms in pure culture are made available to the class, partly those isolated by members of the class and partly furnished by the teacher. Among these are staphylococci, streptocci, spirilla, about 10 members of the colon-typhoid group, "butter milk" bacteria, sporeformers, anaerobes, the organisms of pneumonia, diptheria and tuberculosis, yeasts and molds, etc.
- Third Rating: Twenty-five organisms in pure culture, accompanied by stained mounts and descriptions and drawings of each will be presented for inspection and rating. Those organisms in the list marked by a star are required. Use the printed blanks for your descriptions and drawings.

IV. Practical Laboratory Processes (36 or more hours; only one subject is undertaken by each student or pair of students, but perfection in technic until concordant results are obtained is required)
- Phenol coefficient of disinfectants
  (Several different methods are used on commercial disinfectants)
- Bacterial count of milk and water
  (3 or 4 different methods are employed and commercial bottled milks and waters are tested)
- Differentiation of the members of the colon-typhoid group
  (Several special media are prepared and used)