The History of Bacteriology in Indiana

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This paper will attempt to summarize the beginnings of this area of biological science in Indiana. Since the history of the development at **Indiana University** (6), **Purdue University** (10), **Butler University** (7), **DePauw University** (11), and **Notre Dame University** (3) has been the subject of previous reviews in the Proceedings of the Indiana Academy of Science stress will not be given to these locations. Additional information has been published on the germ-free laboratories at Notre Dame (3, 4, 8, 9). In expressing my appreciation to the various individuals who have supplied the data on which this compilation has been based, I regret that it will not be possible to give credit to each individual by name. Some have supplied more information than could be used while others have supplied less than might be desired. All of the letters and other material which I have collected for this review will be placed in the Archives of the American Society for Microbiology —now housed in the Lilly Library on the Bloomington campus of Indiana University. Thus others, who may in the future desire additional material, may have access to the complete details.

At **Ball State University** (earlier Ball State Teachers College) in Muncie, O. B. Christy introduced—upon his appointment to the faculty in 1918—a course in bacteriology for agriculture students. In 1936 different introductory courses in this science were offered according to the major subject area of the student, and in 1942 a course was added for home economics majors. In addition to the usual laboratory experiments, the courses included field trips to local milk plants, sewage disposal installations, clinical laboratories, and industrial companies. Dr. Christy first published his laboratory manual in 1940; this was titled *A Guide for Laboratory Instructions in Bacteriology.* A revision with Robert H. Cooper was published in 1942. Upon the retirement of Dr. Christy in 1950, the responsibility for instruction in bacteriology was assumed by George Welker, who with Christy and Cooper revised the laboratory manual. Christy's interest in applied microbiology and the sanitary standards of the local dairy products is reflected in the short course he gave in 1947 for the employees in the dairies in Muncie.

At **Earlham College,** about the turn of the century, the first course in bacteriology was offered by David Worth Dennis. Legend, if not accurate history, indicates that the once heavily bearded professor became clean-shaven after concluding—following his study of bacteriology—that beards were not sanitary. In later years bacteriology was taught by M. S. Markle and Carrolle Anderson Markle. None of these individuals held bacteriology as the primary interest.

The first organized course in bacteriology at **Franklin College** appears to have been offered by J. W. Adams in 1909. The catalog description includes "This course is mainly one of technic. The student prepares all media, inoculates specimens with many different forms of bacteria and studies growth and action of the same. He also will be

given a fair idea of the methods of identification of common forms, making slides from cultures. The relation of the subject to hygiene and to infectious diseases, together with the history and relation to medicine will also be considered." A similar course has been continued to the present in the curriculum of the Department of Biology.

S. W. Witmer, now Professor Emeritus, introduced the first course in bacteriology at **Goshen College** in the winter quarter of 1921 for 5 term hours. With the change to the semester plan in 1921-22, the course was offered for 3 semester hours credit at the sophomore level. From the beginning, an introductory course in the biological sciences was a prerequisite. By 1932 the course was moved to the junior level. Other instructors included H. Clair Amstutz, M.D., and O. J. Eigsti. By 1950 a course in microbiology was added at the sophomore level and designed for students in the pre-nursing program. Alta Schrock offered, 1948 to 1951, both courses. With the retirement of Professor Witmer in 1962, J. N. Roth assumed responsibility for the courses—except in 1964-65 they were taught by Albert Isaak who served as a visiting instructor.

At **Manchester College** apparently the first course was offered in 1932 by O. W. Neher. This was continued until his retirement in 1954 when Philip A. Orpurt, whose primary interest is in mycology, joined the faculty.

At **Marian College** (Indianapolis) Sister John Joseph Blackwell, M.D., first offered a course in the second semester of 1944-45. The laboratory was conducted in the former Allison greenhouse which had been converted to science laboratories. Until 1963 the course was offered in alternate years but is now offered each year with Sister Marie Bernard Witte as instructor. An additional course was initiated in 1957 for nurses from St. Vincent Hospital. With the opening, in 1954, of Marian Hall the laboratory sessions are now held in a modern well-equipped laboratory with the usual equipment—a far cry from the beginning days with a pressure cooker in a converted greenhouse!

From 1934-37 the introductory course in microbiology at **Marion College** (Marion) was offered by James Young who had been trained in biochemistry. Charles DeVol, Paul Parker, Elizabeth Poe, Thomas Davidson, and Maurice Burns followed in successive years. Only the latter was trained in bacteriology as a major area.

When **St. Joseph's College** (Rensselaer) was advanced from a junior to a senior college in 1936, Reverend C. Kroeckel first offered a semester course in bacteriology. In 1946 this was taken over by Reverend Urbon J. Siegrist, who, in addition to formal class instruction, has found time to do research on effect of *Azotobacter* on germination and growth of *Helianthus* and other plants; on effect of plant extracts on inhibition and/or regression of the Rous sarcoma virus in fowls; and on human and veterinary pathogens.

Bacteriology was introduced at **Saint-Mary-of-the-Woods** in 1920 as a requirement for majors in home economics, but by 1931 this was changed to a general course and in 1963 the course name was changed to Microbiology. Beginning in 1943, an additional course "Determinative Bacteriology" was offered to provide further training. This was dis-

continued in 1951 to allow use of the more general course title "Problems in Biology." Student interest in bacteriology has been stimulated by speakers at the Mendelian Club on topics of current significance in bacteriology.

Bacteriology appears to have been mentioned first at **Saint Mary's College** in the description of the curriculum for the junior year of 1963-64. In 1917 a course for home economics majors was offered by Sister Laurita who was succeeded in 1919 by a Dr. Powers from Notre Dame. In 1935 Sister Amadeo assumed charge and the relatively simple tables and equipment were replaced.

Wabash College will compete with the few colleges which claim to have been the first to offer a course in bacteriology. The course there was introduced in 1892 by Mason B. Thomas. He was followed in 1913 by Harry W. Anderson (1913-1917), Richard M. Holman (1918-1920), Albert R. Bechtel (1921-1953), and Richard A. Laubengayer (1946-1966). In 1966 James Cavender, the first of the group to be trained as a microbiologist, was added to the faculty. His primary interest is in the slime molds, reflecting his training with Kenneth Raper.

At **Valparaiso University**, bacteriology seems to have been listed as a requirement in pharmacy as early as 1906. It appears that a formal course was offered only infrequently until 1944 when William W. Bloom assumed responsibility for the introductory course. In more recent years Robert Hanson has served as the instructor and an advanced course has been added.

Of equal importance to the development of bacteriology in Indiana with the curricular development in the various colleges and universities is the development of bacteriology in various industries. Representative companies should be mentioned. The **Eli Lilly and Company**, later to become one of the largest and best known pharmaceutical companies in this country, had its origin (May 10, 1876) in the small shop opened in Indianapolis by the founder—Eli Lilly—in the year of the Centennial. I have been unable to determine the earliest date on which a person with bacteriological training was employed, but certainly this must have been by the turn of the century—or before—for from the beginning Colonel Lilly had decided to manufacture products for use by the physician. In 1882 J. K. Lilly, a graduate of the Philadelphia College of Pharmacy, had joined the business as superintendent of the laboratories. It should be unnecessary to detail the development of this company and to record the important discoveries and advances made by the bacteriologists of the Production and Research Divisions in vaccines, antisera, antibiotics, and other specific antimicrobial compounds. Many interesting details are recorded in the book of Clark (1).

The **Pitman-Moore Biological Laboratories**, now a division of the Dow Chemical Company, were constructed in 1913 to produce hog cholera serum and virus for the veterinary profession. Later, standardized veterinary bacterins were added to the early line of products, and by 1932 the laboratories entered the field of human medicine. Approximately 40 biologicals are now produced and the following partial list of products with date of government licensing indicates the rapid growth and development of these laboratories:

1939—Equine encephalomyelitis vaccine (Eastern and Western strains)—first vaccine produced in fertile eggs.

1949—Immune serum globulin—produced from human placental tissue using the alcohol precipitation method.

1955—Poliomyelitis vaccine (Types 1, 2, and 3)—first human vaccine using tissue culture methods.

1960—Diphtheria and tetanus toxoids.

1965—Measles virus vaccine (live virus, attenuated).

Microbiology at **Miles Laboratories, Inc.** (at Elkhart) was developed initially as part of an effort to become independent of supplies of citric acid which the company used in large tonnage. A consultant was employed, who demonstrated a microbial production of citric acid early in 1940. The demonstration was not considered to represent a commercially feasible process, and research on the problem was initiated by members of the Miles staff. These early studies developed the use of ion exchange resins for culture medium purification. Both surface and submerged fermentation citric acid plant construction was started. Throughout this period, considerable culture isolation and mutation work were done.

The first formally organized bacteriology laboratory was formed in 1946 by L. B. Schweiger. Studies on the citric acid fermentation were continued and brought to a successful outcome.

The range of bacteriological studies within the company was broadened considerably during the 1950's and the development and marketing of the household antiseptic, BACTINE^{R}, resulted from this increased interest in the field of microbiology. Fermentation research was further broadened by the transfer of the enzyme laboratory of the Takamine Laboratories, now part of Miles Chemical Division, from Clifton, New Jersey to Elkhart in 1962.

Serological and immunological work, with possible applications in the diagnostic field, was initiated in the research laboratories of the Ames Division of Miles Laboratories, Inc. in 1961. Biological manufacturing in Elkhart was initated with the opening of the citric acid plant in 1952. An additional plant to make enzymes and dextrose syrups was opened in 1965. Over the years, the microbiological staff of Miles Laboratories, Inc. has developed competence in the following areas: surface and submerged fermentation, production of cells, bulk chemicals, enzymes, vitamins, growth factors, allergens, and in the areas of serology and immunology as they relate to the diagnosis and clinical evaluation of disease conditions.

Bacteriology at **Mead Johnson and Company** (Evansville) had its beginning in the early twenties. At that time, direct microscopic counts were being made on milk deliveries along with chemical tests for lactic acid content. During this early period, Mead Johnson was already making a cultured lactic acid milk product. Around 1925, methylene blue reduction tests were made on milk samples at Mead Johnson's subsidiary plant in Zeeland, Michigan. This test was required at that time to conform to standards set by the Chicago Board of Health.

Until 1928 there was no bacteriologist at Mead Johnson. In that year, Robert P. Meyers (Ph.D., Cornell) joined the existing but small scientific staff with the responsibility for establishing a bacteriological laboratory. His tenure with the company was rather short, and in 1929 Paul S. Prickett (Ph.D., Cornell) came to Mead Johnson. It was under his direction that many bacteriological developments were made. Dr. Prickett retired in 1964, but during his years with Mead Johnson he applied sound sanitary principles to bacteriological problems and was instrumental in establishing high standards of microbiological quality for company products.

With the assistance of Norman J. Miller (B.Sc., Iowa State) and a small bacteriological staff, studies requiring interdiscipline cooperation were conducted in several areas during the thirties and forties. Pablum cereal was developed and patented. The ergosterol content of yeast and bacteria were studied as a possible high yielding vitamin D source. The effect of vitamins on resistance of rats to *Staphylococcus aureus* was investigated. Studies of egg white extracted lysozyme were made in an effort to control the intestinal flora of infants. Microbiological methods for examining dried milk products were devised; *e.g.*, lithinum hydroxide was first used for dissolving milk solids thereby diminishing the possibility of confusion with bacterial colonies. Some early work in the field of ethylene exide sterilization of food products was conducted in the Mead Johnson Bacteriological Laboratory.

Microbiological assays of vitamins were being made at Mead Johnson in the early forties. In addition, the nutritional quality of proteins as assayed by microorganism was studied. The development of a protein hydrolysate for parenteral administration involved the application of immunological principles to the detection and elimination of hypersensitivity and pyrogens. Further studies were also made concerning the use of pectin and agar in the control of diarrhea.

A management decision to expand company interest to pharmaceuticals as well as nutritional products was implemented in the early fifties and was followed by an expansion of the scientific staff and increased microbiological efforts. Bacteriological studies from then on were done in several different departments of the Research Center. Attention was given to chemotherapeutic agents and antibiotics; and work was done on sulfa drugs, helminthics and with tetracycline. Bacterial genetics studies with antibiotics producing strains of microorganisms were also pursued, and microorganisms were employed in the search for additional growth factors. More recently, Mead Johnson undertook the development of the antibiotic Lysostaphin first detected at the University of Texas. This enzyme selectively lyses staphylococcal cells.

A Mead Johnson innovation which required a great deal of bacteriological work concerned development of the Beniflex System of infant formula feeding. Disposable nursers are filled from cans of formula and used for infant feedings in hospitals. All components of this system are sterile and the opening and filling operation require aseptic technique. With this system, the need for refrigeration is eliminated.

The last industrial laboratory to be mentioned is the **Commercial Solvents Corporation** (Terre Haute). This, as described by Kelley (5),

was a product of the needs of World War I for acetone, a product of bacterial fermentation of corn. Chaim Weizmann, a native of Russia but for many years a resident in England, had been attempting the production of synthetic rubber for which he needed commercial quantities of butanol. He had isolated an organism, later named *Clostridium acetobutylicum*, which produced butanol, acetone, and a small quantity of ethanol by fermentation of carbohydrates. After the United States entered the war, the British War Mission bought the plant of the Commercial Distillery at Terre Haute and later the U. S. government bought the Majestic Distillery. These operations were incorporated under the name Commercial Solvents Corporation, and the plants remodeled for the butyl fermentation. The product line of the company was later extended, and it should be noted that this company (and also the Lilly Laboratories) aided greatly the industrial production of penicillin.

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