

Poultry Vaccine Laboratories in the United States: A Historical Perspective

Stephen B. Hitchner^A

Professor of Avian Diseases, Emeritus, Cornell University, Ithaca, New York 14853

Received 11 September 1995

Abbreviations: AMDAL = Abbott Marketing Division Abbott Laboratories; ASL = American Scientific Laboratories; DPL = Delaware Poultry Laboratories; DVH = duck virus hepatitis; HVT = turkey herpesvirus; ICB = Inter-Continental Biologics; ILT = infectious laryngotracheitis; IMC = International Mineral & Chemical Corp.; MBL = Maine Biological Laboratories; USDA = United States Department of Agriculture

Numerous factors can be cited for the rapid growth of the poultry industry, but one cannot deny that the availability of vaccines to help control infectious diseases has played a significant role in maintaining the productive capacity that the industry enjoys. This has resulted from a long history of close cooperation between research investigators and entrepreneurs to provide the means for combatting and controlling infectious diseases. Pasteur, with his classic experiment on the control of fowl cholera (6), pointed the direction that disease control should take even though his approach to the control of fowl cholera was not felt in a significant way until years later. Avian pox was a disease that received its clue for control from Jenner's work with smallpox. This means of control was explored by research investigators, but its use in field flocks was limited until it was offered in greater quantities by entrepreneurs who recognized the need and filled it.

This article is an effort to record the development of poultry vaccine laboratories and those responsible as initiators before the history of this phase of the industry is lost in time and memory. Already it is evident that many of the details are difficult to retrieve, making it important to record what is known without further delay, even if the details are somewhat sketchy.

VINELAND LABORATORIES, INC.

One of the first to respond to the poultryman's need for protection against fowl pox was

a veterinarian, Dr. Arthur D. Goldhaft (3), who had a large and small animal practice in Vineland, New Jersey, an area with a high concentration of farm poultry flocks. His visits to the farms and the farmers' requests for help with poultry disease problems made Dr. Goldhaft aware of the need and the potential for aiding the poultry industry. After 1919, he devoted more and more time to poultry practice. He started his own company for the manufacture of poultry vaccines, Vineland Poultry Pathological Laboratories, and carried out field trials of a pox vaccine based on a published report by J. R. Beach of California.

By today's standards, the early pox vaccines were crude preparations made by infecting the scarified comb of white leghorn cockerels, harvesting the scabs, and drying them in a bacteriologic incubator. In dry form, the scabs could be kept for some period in the refrigerator. When needed, they were ground in a mortar and suspended in a saline-glycerin solution, then applied by brush to the feather follicles.

The early field trials made Dr. Goldhaft cognizant of the need for investigative research into disease problems. As a result, he and a committee of poultrymen and agriculturists were instrumental in establishing a poultry pathology laboratory at the New Jersey College of Agriculture at Rutgers University in 1923. This laboratory was directed by Dr. Fred R. Beaudette from Kansas State University. Later, a poultry diagnostic laboratory was established at Vineland operated by Dr. James J. Black. As has been seen throughout the history of vaccine laboratories, there was a close association be-

^A24110 Kinnaird Point Drive, Worton, Maryland 21678.

tween the state experiment stations and the commercial laboratories that has been mutually beneficial. In 1928, Dr. Goldhaft erected the first building of the vaccine plant that became known as Vineland Poultry Laboratories.

The emergence of infectious laryngotracheitis (ILT) and the development of a method of immunizing against it cemented the relationship of Rutgers University and Vineland Poultry Laboratories. There was a keen rivalry between Dr. Beach on the west coast and Dr. Beaudette on the east coast as to which should be credited for developing the best vaccination procedure. A publication describing the vent application of the virus by C. B. Hudson and F. R. Beaudette became the early accepted procedure (5). The story that circulated during that period (T. Goldhaft, personal communication) was that Hudson was made an author of the publication because of a facetious remark he was alleged to have made to Beaudette that became the solution for immunization against ILT: "We have tried to immunize the birds cutaneously, subcutaneously, intramuscularly, orally and intravenously and none of them worked, so why not just shove it up the ass." They tried it, first using the eraser end of a pencil as an applicator of the virus to the vent mucosa, and it worked. Later, at the suggestion of Dr. Goldhaft, they used the brush that was employed for pox vaccination.

The vaccine was originally marketed as infectious bronchitis virus (5). A United States Department of Agriculture (USDA) license for the production and sale of ILT vaccine was issued in 1933. A collaborative arrangement was made with the New Jersey College of Agriculture permitting Beaudette and Hudson to participate in the production of the vaccine and supervision of its testing.

Initially, the vaccine was prepared from tracheal scrapings of infected chickens. In 1939, after it became known that viruses could be propagated in embryonating eggs, the company changed the production method for all live virus vaccines, ILT, fowl pox, and pigeon pox, to embryo propagation.

In the meantime, the growth of the organization was such that three family members joined the company. In 1935, Dr. Tevis Goldhaft, Dr. Arthur Goldhaft's son and a graduate veterinarian from Cornell, became affiliated. In 1939, Arthur's daughter, Helen Goldhaft Wer-

nicoff, and her husband, Nathan, both graduate veterinarians from Cornell, also joined as partners in the operation of the laboratories.

The recognition that Newcastle disease was present in the United States stimulated Dr. Beaudette to develop a vaccine with the Roakin strain of virus. On June 11, 1948, the USDA issued a license to Vineland Poultry Laboratories for the use of the live virus vaccine containing the Roakin strain and simultaneously approved a similar Massachusetts strain, MK107, produced by Lederle Laboratories. At the time of approval, Vineland had approximately 15 million doses on hand, all of which were sold within 48 hours of the announcement of its availability (T. Goldhaft, personal communication).

Competition from producers of vaccine using the B-1 strain of Newcastle disease virus promoted further investigations by Dr. Beaudette. In 1949, the LaSota strain of Newcastle disease virus was introduced by Vineland as a vaccine for intramuscular application, but later it was applied ocularly, by drinking water, and by spray.

In 1952, "Poultry" was deleted from the name of the company, and the organization became a corporate entity, Vineland Laboratories, Inc. Growth continued with construction of a new building and the licensing of infectious bronchitis vaccine in 1955.

The founder and active participant of all this previous development, Dr. Arthur D. Goldhaft, died in 1960 at age 75. The fruits of his labor continue to grow as a memorial to his vision. Branch laboratories were established in other countries, and although ownership of the company has changed hands, the name Vineland Laboratories, Inc. still prevails. In 1970, the company was acquired by Damon Corporation, which in mid-1980 sold its interest in the company to IGI (Immuno Genetics). Despite the corporate and personnel changes, Vineland Laboratories, Inc. remains as a major producer of poultry vaccines.

AMERICAN SCIENTIFIC LABORATORIES (ASL)

From information obtainable (T. M. Schwartz, personal communication), ASL was established in Chicago in 1921 by a veterinarian, Dr. A. White (9, p. 130). Sometime during the 1920s,

the laboratory was moved to Barrington, Illinois, as revealed in an advertisement in the September 1927 issue of *Poultry Tribune*. It was evident the business catered to poultry growers, offering a free book, *Stop Poultry Diseases*, and advertising an avian mixed bacterin for "prevention of cholera, and infections accompanying roup, colds, catarrh, chicken pox, diphtheria, etc." The business declined during the 1930s because of the ill health of the owner and the effects of the Depression. The laboratory was purchased by H. D. White and was moved to Polo, Illinois, where gradual progress was made during the Depression and World War II.

In 1949, the company was moved to Madison, Wisconsin, becoming family-run by H. D. White and two sons. Kenneth White became manager of the business, and Philip, a Ph.D. microbiologist, was active in the production of Newcastle disease, pox, and laryngotracheitis vaccines and research on new products. As a result of Philip's interest in research, a laboratory building was constructed for research and development of poultry and small animal vaccines. A number of scientists were employed, including G. S. Appleton, S. B. Hitchner, R. W. Winterfield, E. A. Lozano, and E. Marty, who worked on development of new vaccines and improvement of existing products. The results of that activity were published in a number of ASL research reports in addition to scientific journals. Poultry vaccines that received attention at that time were Newcastle disease, infectious bronchitis, laryngotracheitis, and pox. A leading advancement made by ASL was the use of eggs from flocks free of *Mycoplasma gallisepticum* for vaccine production.

ASL vaccines were received favorably by the poultry industry, and the company enjoyed a period of rapid growth. In 1959, ASL was acquired by Schering Corp. and became a part of the Schering Animal Health Division. Shortly thereafter several of the scientific staff resigned. During 1961 to 1965, Dr. Emil Gelenczei was employed to direct virus research (E. Gelenczei, personal communication). In addition to developing bovine, hog cholera, and mink vaccines, he worked on an attenuated infectious bronchitis vaccine and a tissue-culture-modified laryngotracheitis vaccine that was patented. In 1983, the ASL operation in Madison was re-

located to Elkhorn, Nebraska, where production of poultry vaccines continues.

DR. SALSBUARY'S LABORATORIES

Another veterinarian who was not ashamed to include the treatment of poultry along with his large animal practice was Dr. Joseph E. Salsbury. In 1923, he took over the practice of a retired veterinarian in Charles City, Iowa (9, pp. 35-54). Every farm had a poultry flock, and he recognized the need to control lice, worms, and various diseases. In addition to kamala worm capsules, he added a number of other compounds to his armamentarium. In 1929, he constructed a new building and devoted a portion of it to the production of fowl pox vaccine. In 1930, he discontinued his veterinary practice to devote full attention to what was called "Dr. Salsbury's Poultry Service Company." Shortly afterward, the designation was shortened to "Dr. Salsbury's Laboratories."

To produce pox vaccine, he started using pox scabs from infected birds, grinding the dried material and suspending it in glycerin. When the technique of propagating viruses in embryonating eggs became known, this procedure was adopted, which greatly improved production of pox vaccines. The use of embryonating eggs was not without risks, as Dr. Salsbury learned from a costly experience. Certain serials of pox vaccine were produced in eggs from a supplier who had inadvertently added some hens to his flock without confirming their pullosum-free status. This resulted in pox vaccine contaminated with *S. pullorum*, which infected numerous hatchery supply flocks. When known, the vaccine was recalled and the users were reimbursed for their losses. As a result of this occurrence, the Bureau of Animal Industry imposed much more stringent control tests to prove a vaccine safe, pure, and effective.

When Newcastle disease appeared, Dr. Salsbury joined in the battle to control it. In 1948, the laboratory was licensed along with Vineland and Lederle to produce live-virus Newcastle disease vaccine. Initially, they produced vaccine containing a mesogenic strain, but Dr. Oliver Peterson obtained a sample of the B-1 strain in 1949, made comparative studies, and began producing vaccine with the B-1 strain of virus in 1950. A new building was constructed in 1953 for biologics production. Live-virus bron-

chitis vaccine was licensed that year and became available on the market in 1954. Avian encephalomyelitis live-virus vaccine was approved under a special license in 1962, followed by a regular license in 1972.

In 1961, Dr. Salsbury relinquished his position as president of the company and turned his responsibilities over to his son, John G. Salsbury, a veterinarian, who had served in the company since 1945 as Vice President and General Manager. Dr. Joseph Salsbury continued to be active in the company as Chairman of the Board until his death in 1967.

By early 1970, the cause of Marek's disease and a method of control by the use of turkey herpesvirus (HVT) were established. Salsbury's was one of the first licensed producers of Marek's disease vaccine, others were Merck and Sterwin. The vaccine was initially distributed frozen in liquid nitrogen. Later, when the technique of freeze-drying HVT was published, this method of vaccine production was also employed.

Other poultry vaccines were added to the market list as the diseases became known and vaccination became relevant to their control. In addition, the company expanded into producing other products for poultry and, with the acquisition of Fromm Laboratories, became a producer of vaccines and other products for the livestock industry. In 1979, Salsbury Laboratories (Dr. had been dropped from the name several years previously) were purchased by Solvay and Cie of Brussels, Belgium, with a change in the name to Solvay Animal Health, Inc. The headquarters of the new owners was located in Mendota Heights, Minnesota, leaving the production plants in Charles City and Grafton.

I. D. RUSSELL CO. LABORATORIES

The poultry industry is rife with individuals who entered it from different backgrounds. A good example is I. D. Russell, a school teacher, who encountered the poultry industry and learned there were opportunities to show poultrymen how they could control lice in their flocks and to market other nostrums popular in the 1918 era (1).

Located in Kansas City, Missouri, the business prospered. When the technique for growing viruses in embryonating eggs became known, he saw the opportunity to offer addi-

tional service to poultry clients through poultry vaccines. In 1941, he became a charter member of the Animal Health Institute and was issued veterinary biologics license no. 210 to produce poultry vaccines. He employed Dr. Konrad Fiesselman to supervise vaccine production and Dr. A. E. Thompson to provide diagnostic service. Initially, the laboratory marketed pox and laryngotracheitis vaccines and bacterins (D. Russell, personal communication). Newcastle disease vaccine was added later. As more laboratories entered the market and pricing of vaccines became competitive, they discontinued producing live-virus vaccines. Production shifted to bacterins for a while, but eventually vaccines were displaced by pharmaceuticals for poultry and livestock, which currently is the company's emphasis.

The company has remained a family organization. I. D. Russell's son, Dr. Dan Russell, joined the firm in 1951 after graduation from Kansas State Veterinary College. Since then, his son, Dr. I. D. Russell, and a nephew, John, who is currently President, have been a part of the organization. Among the family-organized poultry laboratories, I. D. Russell Laboratories is one of the two remaining family-owned companies.

LEDERLE LABORATORIES

Lederle Laboratories, located at Pearl River, New York, a pharmaceutical house producing human biologicals, became involved with poultry vaccines during the early period in the 1930s and 1940s. Their entry was undoubtedly stimulated by the demonstration that viruses of fowl pox and laryngotracheitis could be propagated in embryonating eggs. Little is known of the early participants other than Dr. Charles Gibbs, who was employed by Lederle from 1936 to 1940 (7). After 1940, research on poultry vaccines took place in the virus department under Dr. Harold Cox, with Dr. Floyd Markham specializing in the poultry vaccines (L. Shor, personal communication). One significant innovation from that department was the development of a dust vaccine for mass vaccination against Newcastle disease. A well-known individual in the Lederle organization was Dr. C. A. Bottorff, Director of Technical Services and organizer of the Bear Mountain meetings, a forum for keeping poultry diagnos-

ticians updated on poultry diseases and their control.

There were no separate facilities for poultry vaccine production. Poultry vaccines were produced under contract with the department that made Lederle's human vaccines. Consequently, the same overhead charges were applied to poultry vaccines, and in the early 1950s, Lederle could not compete pricewise with competitors. As a result, poultry vaccine production was discontinued (L. Shor, personal communication).

CUTTER LABORATORIES

It is difficult to find someone who can provide the historical facts, but Cutter was another human pharmaceutical company, located on the west coast, that produced poultry vaccines for approximately the same period as Lederle. Dr. Norwood Casselberry was the veterinarian involved with poultry products. It is possible they discontinued production for the same reason as Lederle—that poultry vaccines could not compete when the same overhead charges were applied as for human vaccines.

The widespread appearance of Newcastle disease and the development of vaccines to control it brought many new entrepreneurs into the business. Many of them not only produced Newcastle disease vaccine but added other vaccines, conducted research and development on new products, provided technical services, and, through competitive pricing, made disease control by vaccination within the reach of every poultryman.

DELAWARE POULTRY LABORATORIES (DPL)

In May 1950, Dr. Hiram Lasher, a Cornell graduate, in partnership with Dr. Francis Mullen, a Penn graduate, William H. Mitchell, Clarence Gassaway, and Victor Keen, founded DPL in Millsboro, Delaware, in response to the demand for an effective live-virus Newcastle disease vaccine. Production started with a frozen B-1 vaccine that was distributed locally. In June 1952, a federal license allowing national distribution was issued (H. Lasher, personal communication).

Under the direction of Dr. Lasher, DPL grew rapidly from the beginning. New vaccines of

high quality were added as the needs of the poultry industry became known. Dr. Lasher had the propensity for knowing what was occurring in the field, in the research laboratories, and in the regulatory offices and, as a result, moved decisively when the need arose. Although he was a formidable competitor, his dedication to providing quality vaccines gained him the respect of his competitors. The company grew rapidly based on research, technical services, increased production capacity, and distribution facilities. In 1958, DPL became a subsidiary of Sterling Drug, Inc., retaining the name DPL with Dr. Lasher in charge as Vice President.

In 1957, Dr. A. S. Cosgrove, one of DPL's diagnosticians, recognized a new entity, Gumboro disease. From 1965 to 1970, Dr. Emil Gelenczei served as Director of Research, responsible for development of poultry biologics. During this period, activities included development of a Marek's disease vaccine, a tissue-culture-modified fowl pox vaccine (patented), a new type of laryngotracheitis vaccine, and a tissue-culture-modified infectious bursal disease vaccine (E. Gelenczei, personal communications). Also during this period, a license was issued for the first bursal disease vaccine of chick embryo origin, Bursa Vac® (H. Lasher, personal communication).

STERWIN LABORATORIES INC.

In 1968, Sterling Drug, Inc. consolidated the Animal Health Division and DPL biological production into a single unit under the name Sterwin Laboratories. In 1970, the headquarters for the new unit was moved from New York to Millsboro, Delaware, with Dr. Lasher as President. To supply the international market, a distribution arm, Winthrop Products, was formed in 1970, which distributed Sterwin products in 53 foreign countries. In 1978, exports accounted for 15% of Sterwin's production (H. Lasher, personal communication).

Sterwin Laboratories became a leading producer of poultry vaccines, constantly working to improve existing vaccines and adding new products for commercial use as the need became apparent. They also provided service and technical assistance to the poultry industry. During his career, Dr. Lasher had made decisions independently and moved decisively,

which was contrary to the way large corporations moved. Thus, when corporate officers did not support his views for inactivated vaccines in March of 1979, he relinquished his position as President in July 1979. At that time, Sterwin enjoyed about 50% of the broiler vaccine market in the United State. In his place, Tom Fraher, Jr., was appointed President. Much of the corporate responsibilities returned to New York as a component of the Pharmaceutical Group of Sterling Drug, Inc. Dr. Fred Melchior, Jr., was appointed Vice President and General Manager of the Millsboro facility. Earlier, Dr. Melchior had served as Director of Research.

In 1984, Sterwin Laboratories were acquired by International Mineral & Chemical Corp. (IMC). The corporate management of IMC became acquisition minded during the next decade, purchasing Mallinckrodt in 1986, Pitman Moore in 1987, Glaxo in 1988, and Cooper Animal Health in 1989. These four became the Pitman Moore Veterinary Group, of which Sterwin was a part. In October 1994, Sterwin's name was changed to Poultry Health Products Group of Mallinckrodt Veterinary (F. Melchior, personal communication). It is hoped the laboratory that started in 1950 and has had a distinguished record in serving the poultry industry does not get lost in the corporate shuffle.

INTER-CONTINENTAL BIOLOGICS (ICB)

After his retirement from Sterwin Laboratories in 1979, Dr. Hiram Lasher established a new poultry biologics company. In keeping with his vision of a global market, he gave it the name Inter-Continental Biologics. Undaunted by the competition, he constructed his new facility in 1980 in Millsboro, the same town where he had launched his vaccine enterprise 30 years earlier.

The new plant was constructed with the latest concepts in construction and equipment (4). The facility comprised three units, a technical service laboratory, administrative offices, vaccine production and quality control areas, and a research laboratory. Dr. Lasher was back in his element doing what he liked best, directing the production of quality vaccines, investigating new products, and exploring ways to better serve the poultry industry. The potential of the company again attracted corporate interest, and Intervet International, B.V. of Boxmeer, The

Netherlands, part of the AKZO Group, acquired Dr. Lasher's new company. The combined vaccine production expertise and research capabilities of the two organizations extended the global position of ICB even further.

On January 1, 1982, Dr. Lasher severed his connections with ICB. He was succeeded by Dr. Ben Foord as President and Ruud Hein as Director of Technical Services. In 1983, the laboratory's name was changed to Intervet, Inc.

One might suspect that surely Dr. Lasher would retire now. That, however, was not his intent. He had acquired a wealth of information on vaccines and vaccine production and too much experience to be put on the shelf. Consequently, he founded Lasher Associates, Inc., from which base his expertise has been sought from around the world.

DORN & MITCHELL, INC.

This laboratory was founded by Ira Dorn and Ralph Mitchell to produce and market a coccidiosis vaccine that had been developed by Dr. Allen Edgar at Auburn University. The rights to market the vaccine were obtained from the university in about 1954. A production facility was established in Opelika, near Auburn, where production of the vaccine was under Dr. Edgar's direction. Initially the product, sold under the name Coccivac, contained only *E. tenella*, but other species were added later.

In 1958, the company was acquired by Sterling Drug, and shortly thereafter a limited number of poultry virus vaccines were added to the production schedule. In 1968, when Sterwin Laboratories, Inc. was formed, Dorn & Mitchell became a part of the Animal Health Division of Sterwin Chemicals, Inc. A new vaccine production facility was built near Auburn and operated under the subsidiary name of Sterwin Laboratories until 1984, when it was closed and its vaccine production activities were moved to Sterwin Laboratories in Millsboro, Delaware (H. Lasher and A. Edgar, personal communication).

MAINE BIOLOGICAL LABORATORIES (MBL)

Here was a company started in 1957 by two veterinarians who were well acquainted with the poultry industry and who decided to put into

play the golden opportunity that exists in the American enterprise system. Dr. Kenneth H. Eskelund bonded with chickens while caring for a flock of 20,000 broilers, the profits of which assisted in his veterinary education. Dr. Harold Chute, a professor at the University of Maine, had a grasp of the poultry industry problems and needs through his teaching and research at the university. Together they established MBL at Waterville, Maine, with ready access to the Maine broiler industry. Newcastle vaccine was a big item in disease control at the time, and MBL capitalized on its use by setting up a market for its vaccines with a vaccinating service by spray and, later, organized crews to apply vaccine by eye drop and debeak chicks at 10 to 14 days of age. MBL's early growth could be attributed to service, which later spawned independent service organizations to serve the poultry industry (K. Eskelund, personal communication).

Although initially MBL sales were in the State of Maine, a USDA veterinary biological license was obtained that permitted marketing throughout the United States. MBL did not depend on a sales representative or advertising. Business was built on service and the distribution of their products through outlets, frequently through other vaccine laboratories.

After 9 years of continual growth, MBL was sold in 1966 to Norwich Pharmacal Company of Norwich, New York. Dr. Eskelund was retained as President and General Manager, but corporate marketing of vaccines failed to produce the results that were obtained with the previous personal attention. After 7 years, Dr. Eskelund was relieved of his position in the company. However, a long separation was not in the cards. After 2 years of business losses under the new management of Norwich, MBL was back on the market. Dr. Eskelund states that he reluctantly bought it back in 1975.

It took a while to rebuild the business. Emphasis shifted from live-virus vaccines to inactivated vaccines. Dr. Eskelund was one of the first to recognize and fill the need for an inactivated infectious bursal disease vaccine, which was followed by other inactivated products. The success of these vaccines was recognized not only nationally but also internationally and became a significant part of the business. With renewed growth, 5000 square feet of space was added to the laboratory building in 1982 and

another 8000 square feet in 1988. With around 30% of the sales in the international market, GEN Corporation of Gifu City, Japan, saw an opportunity to expand the global market and purchased MBL in 1988, retaining Dr. Eskelund as President with a 5-year contract. He resigned in 1993, and Dr. John Donahoe became President. Dr. Eskelund can look back upon a number of achievements, not only the development of a successful vaccine laboratory but also being instrumental in the spawning of a number of other businesses in the local community.

L & M LABORATORIES

From 1954 to 1960, Elbridge B. Murray and Donald J. Lynch owned and operated L & M Distributors in Selbyville, Delaware. They sold vaccines and poultry supplies and in addition operated a vaccination service to protect flocks against Newcastle disease. A diagnostic service, under the direction of Dr. A. Cosgrove, also became part of the business. As a result of these activities, they became one of the largest distributors of ASL vaccines. Because they were using and selling vaccines in such quantities, they asked "Why not produce vaccines ourselves?" That question resulted in the invitation to three members of the scientific staff of ASL, G. S. Appleton, R. W. Winterfield, and S. B. Hitchner, to join them in founding a company for the production of poultry vaccines.

The facility for L & M Laboratories was constructed in Berlin, Maryland, during late 1960. By May of the following year, a USDA license to produce biologics was issued. The former experience of the participants paved the way for the rapid development of a line of vaccines and for ready acceptance by poultrymen. Through service, research, and development, the company grew, and after 4 years of production, it was acquired by Abbott Laboratories.

The marketing label for the Blen line of vaccines was changed from L & M to AMDAL (Abbott Marketing Division Abbott Laboratories) from 1964 to 1970. For the next decade, the AMDAL label was discontinued and vaccines were sold under the Agricultural Products Division label of Abbott Laboratories. In 1980, the enterprise was purchased by CEVA Laboratories, Inc., a subsidiary of Sanofi, Inc. The vaccines were marketed under the CEVA label

until 1990, at which time the products were sold under the Sanofi label (L. Manogue and H. Correll, personal communication). On April 1, 1995, the company again changed ownership when it was acquired by Rhone Merieux of France.

POULTRY HEALTH LABORATORIES

On the west coast, Dr. Robert Wichmann, William Zontine, and two poultrymen founded a laboratory in Davis, California, to produce a tissue-culture-propagated Newcastle disease vaccine developed by Dr. R. A. Bankowski (2). Initially, the vaccine was marketed in California only. In 1962, a USDA license to produce Newcastle vaccine was obtained along with a special license to produce a live-culture coryza vaccine and a paracolon bacterin for turkeys. Later, other poultry vaccines were added to the line. In 1966, the laboratory was reincorporated, with the ownership going to Dr. Wichmann's two sons, Jeffrey and Tom Hanzo, and an employee, Midge Holmes.

KEEVET LABORATORIES, INC.

Keevet Laboratories, Inc., owned by Robert D. Keenum, is one of the few wholly American-owned companies in the avian biologics field. A USDA license to produce vaccines was granted in 1980. John Carrozza, Ph.D., formerly with Amerlab, Gainesville, Georgia, is General Manager.

Keevet Laboratories, under the leadership of Mr. Keenum and Dr. Carrozza, has been credited with several "firsts" in the poultry vaccine field, among which are the first to receive a license to produce inactivated reovirus vaccine, the successful use of an intravenous bag in the hatchery for dispensing Marek's disease vaccine extender diluent, and a product license for quail pox vaccine.

All domestic vaccine production is currently marketed with private label under an agreement with Biomune, Lenexa, Kansas. Products are marketed internationally under the Keevet label (R. Keenum, personal communication).

In addition to those already described, there are three laboratories that produced vaccines for a period of time but eventually, for various reasons, ceased operation. Unfortunately, their discontinuance and the demise of some of those

involved leave a somewhat sketchy history. Two of these laboratories were in New Jersey and one in Connecticut.

WENE POULTRY LABORATORIES

In the 1930s and 1940s, Elmer Wene had a prosperous hatchery business selling millions of chicks, mainly by mail order, in lots of 100 to 500 (T. Goldhaft, personal communication). He established Wene Poultry Laboratories in Pleasantville, New Jersey, with Dr. Charles Gibbs as Technical Director. The vaccines marketed were fowl pox, laryngotracheitis, and Newcastle disease. Production of vaccines was terminated in 1960 (7).

MELINI LABORATORIES

Another vaccine producer, United Poultry Laboratories, Inc., was started in Vineland, New Jersey, around 1951 by Al Rudolph with the collaboration of a former Wene employee. Two young men, Al Melini and C. Lafforty, who operated vaccination service crews in the area, used considerable quantities of pox, laryngotracheitis, and Newcastle disease vaccines. They purchased Rudolph's share of the United Poultry Laboratories, and eventually Nello Melini, who operated one of the largest hatcheries in New Jersey, became a part owner. In 1954, Dr. James Bivins was employed as Director of the laboratory. In 1957, the firm's name was changed to Melini Laboratories, Inc. Infectious bronchitis vaccine was licensed in 1960. The greatest market for the vaccines was in the Delmarva area plus some export trade. Dr. Bivins resigned his position in 1962, and with his resignation, the laboratory ceased vaccine production (J. Bivins, personal communication).

MARSHALL LABORATORIES

Newcastle disease vaccine was in such demand after World War II that some found the only way to secure a constant supply was to produce it themselves. Such was the circumstance of a farmers' cooperative in Connecticut that stimulated the formation of Marshall Laboratories under the direction of Dr. Bernard Lipman. A license was issued in 1951 by the State of Connecticut to produce Newcastle disease vaccine. A USDA license was obtained in

1953 to produce Newcastle disease and infectious bronchitis vaccines (B. Lipman, personal communication).

One of the main achievements of Marshall Laboratories was the development of a liquid stabilizer for the viruses that avoided the necessity for lyophilization. The procedure apparently was very successful because during their period of operation they never had a serial of vaccine that had to be recalled. However, competition from large vaccine producers became so acute that the company discontinued production in 1968.

Another period of vaccine laboratory expansion came with the identification of the cause of Marek's disease and the development of the technology for the growth of the virus and the application of vaccine to prevent it. Because Marek's disease was one of the most important poultry diseases causing death and condemnation at the dressing plant, once a means of prevention was found, the demand for the vaccine spurred the formation of several new vaccine laboratories.

TRI BIO LABORATORIES, INC.

In 1970, a laboratory under the name of Penn Bio was formed by Dr. Robert Gentry and Max Braune for the purpose of producing a Marek's vaccine for distribution under a Pennsylvania license. Dennis C. Winkler was employed to supervise production. In May 1972, as a result of demand from individuals in Michigan and Georgia for a federally licensed vaccine, the name was changed to Tri Bio Laboratories. In 1974, a USDA license was obtained for national distribution of Marek's disease vaccine.

From that beginning, the company expanded production and personnel and by 1989, through research and development, began adding other poultry vaccines to its market line. In 1992, Tri Bio acquired the production facility of Agri-Bio in Gainesville, Georgia. Currently, the laboratory holds 20 USDA licenses, has 12 distribution centers in the United States, and has expanded into international markets. One of the most recent developments is production of vaccines especially designed for use with the in-ovo injection method. Dennis C. Winkler, the production supervisor 25 years ago, has risen through the ranks and currently serves as

President and Chief Executive Officer of Tri Bio.

SELECT LABORATORIES, INC.

Select Laboratories, Inc. was founded in 1971 in Athens, Georgia, by three poultry growers, Homer Wilson, Max Ward, and James Evans, to assure themselves a source of vaccine (8). Close proximity to the University of Georgia permitted them to draw on the technical proficiency of the university scientists. Initially, production was permitted under a state license for in-state use. In 1974, the owners decided to build a laboratory in Gainesville, a center of poultry production.

In 1978, application was made for a USDA license to permit expansion of production and marketing of their product throughout the United States. From a modest beginning, the laboratory has grown through research, innovation, and service to become one of the major poultry vaccine companies. It started with production of the frozen cell-associated Marek's disease vaccine. When the profitability of the product declined, the owners saw the need to expand into other vaccines as well as the need to provide poultrymen with more efficient ways of administering them. In 1980, Dr. Dale King was appointed President and Director of the laboratories.

Select has been at the forefront of the industry with new developments such as larger dose packages and the use of liquid nitrogen in the distribution of frozen vaccines for Marek's disease, Newcastle disease, and bronchitis. They introduced the Beak-O-Vac system of in-hatchery vaccination, which was followed by the Spray-Vac system of vaccinating day-old chicks with a coarse spray in a cabinet. They have kept abreast of the field problems and have introduced new vaccines and altered virus combinations and package sizes to make vaccine application in the field more efficient and effective.

In June 1988, Select Laboratories was acquired by Rhone Merieux Laboratories, Lyon, France. Select currently holds 64 USDA-approved vaccine licenses and, with the collaboration in technology with the French company, undoubtedly will continue to serve the industry with additional products.

AGRI-BIO CORP.

Babcock Poultry Farms, Jacksonville, New York, established the Agri-Bio Corp. in 1969 to enable them to provide their franchises with a Marek's disease vaccine. In 1970, Dr. Emil Gelenczei was employed as General Manager, and as a result of his work, a federal license to produce the frozen cell-associated Marek's disease vaccine was obtained. Later, the first freeze-dried Marek's disease vaccine was mass produced. To expand their marketing of vaccines, an arrangement was made with Maine Biological Co. to have the latter's chick-embryo-origin vaccines marketed under the Agri-Bio label (E. Gelenczei, personal communication).

In 1975, Dr. Gelenczei terminated his connection with Agri-Bio and the managership of the company was passed to Dr. Lincoln Easterbrook, who maintained the position until his retirement in 1990 (L. Easterbrook, personal communication). During the period 1975–1985, the company developed a line of poultry biologics under the direction of Dr. Robert Liauw and James McVey. Agri-Bio promoted the automated vaccinator and debeaker developed in France by Zootechniques. This machine was upgraded to become the Bio-Jector. Another mechanical development was the Bio-Beaker, invented at Auburn University.

During the period 1978–1980, two significant changes occurred. Ownership of Agri-Bio was acquired by A. H. Robins Co. of Richmond, Virginia, and a fire that destroyed a good portion of the laboratory prompted a decision to make future expansion through the acquisition of the abandoned but well-equipped Amerlab, Inc. in Gainesville, Georgia.

In the mid-1980s, Agri-Bio shifted its interest from vaccines and vaccine development to the marketing of A. H. Robins' ionophore coccidiostat, salinomycin, Bio-Cox. Consequently, the vaccine facilities and business were sold to Tri-Bio Laboratories. Subsequent ownership passed from A. H. Robins to American Home Products, Inc. in 1988 and then to Hoffman-LaRoche in 1994. As a result of the corporate maneuvers, Agri-Bio no longer operates as a separate entity.

DEKALB BIOLOGICS

DeKalb was another major poultry breeder that decided to produce Marek's disease vaccine

for in-house use with their own flocks and those of their franchises. In 1971, the laboratory was initiated under the direction of Dr. Reed Rumsey and Dr. Peter H. Matischeck. USDA license no. 271 was issued for production of Marek's disease vaccine in May 1972. The company did not expand into production of other poultry vaccines (G. Waters, personal communications).

Diseases have appeared in the avian field for which preventative vaccines have been developed but none of the major vaccine companies would produce them because the volume would be so small. It has been said that if a vaccine would not generate a quarter of a million dollars in income, the major laboratories would not consider producing it. A number of laboratories have ignored that yardstick and placed vaccine need as first priority. These are niche laboratories.

INTERNATIONAL DUCK RESEARCH COOPERATIVE, INC.

In 1977, the USDA Veterinary Biological Division issued a license to the Long Island Duck Research Cooperative to produce a modified live duck virus hepatitis (DVH) vaccine and a DVH yolk antibody preparation. In 1993, the name was changed from Long Island to International Duck Research Cooperative, Inc. and the following vaccines in the United States and Canada were marketed: duck virus hepatitis, live and inactivated; duck virus enteritis, modified live; *Pasteurella anatispestifer*, live avirulent and a bacterin; and autogenous bacterins as needed. These products are produced under the direction of Dr. Tirath Sandhu (T. Sandhu, personal communication).

BIOMUNE

In 1988, Biomune was founded by Dr. Joan Leonard and her husband, Ronald Plylar, in Lenexa, Kansas. Currently, they are the only licensed laboratory catering to the pet bird industry providing live canary pox vaccine and inactivated Pacheco disease vaccine. They also specialize in producing autogenous bacterins for pet birds, turkeys, and chickens. In addition, they produce a line of inactivated vaccines for infectious bursal disease, infectious bronchitis, Newcastle disease, and reovirus infections. In

July 1992, the laboratory was acquired by Lohmann Breeding Company of Germany.

H & N INC.

A significant niche was filled in the protection of H&N flocks against Marek's disease prior to the availability of commercial vaccines. Dr. D. V. Zander and R. G. Raymond had observed that a specific-pathogen-free flock held in isolation for several generations showed no evidence of tumors, but in 1969, they found that the birds were viremic with an apathogenic strain of herpesvirus designated HN-1. Blood from such birds inoculated into day-old chicks gave excellent protection against virulent Marek's disease virus. Flocks were protected when only 10% of the flock was inoculated, which then served as "seeder" to immunize the remainder of the flock. This procedure was discontinued in 1976 when commercial Marek's disease vaccines became readily available. However, the seeding program has been resumed with dramatic results on some farms where the mortality and condemnations have not been adequately controlled by routine vaccination (10).

A number of other laboratories have been active participants in vaccine production during certain periods, but lack of specific details prohibits an accurate account of their places in a historical resume. Such is the case with Beebe, Wyeth, and Fort Dodge Laboratories, which produced Newcastle disease vaccines during the early Newcastle disease outbreaks. A number of laboratories in California were issued state licenses for production of vaccines to fill specific needs of the poultrymen. Maag & Easterbrook, Inc. for a time operated state-licensed laboratories for the production of Marek's disease vaccine in North Carolina, Alabama, and Georgia. Undoubtedly, there are others that have been overlooked.

A historical review of poultry vaccine laboratories would not be complete without men-

tioning the important role of the Veterinary Biologics Division of the USDA. Because the USDA requires adequate vaccine production facilities and enforces production standards, the poultry industry is assured of quality products that are safe and effective. People often rail against government supervision, but a certain amount of policing is necessary to ensure that producers comply with standards. The standards for poultry vaccines were established by the Veterinary Biologics Division in collaboration with vaccine-producing laboratories and poultry disease researchers.

REFERENCES

1. American Poultry Historical Society. American Poultry History 1823-1973. American Printing and Publishing, Inc. 1974.
2. Bankowski, R. A., and W. H. Boynton. Preliminary report on the propagation of avian pneumoencephalitis virus (Newcastle disease) in vitro. *Vet. Med.* 43:305. 1948.
3. Goldhaft, A. D. The golden egg. Horizon Press. 1957. pp. 314.
4. Haffert, W. A., Jr. Nation's latest state of the art vaccine plant. *Broiler Industry*. pp. 90-92. January 1982.
5. Hudson, C. B., and F. R. Beaudette. Infection of the cloaca with the virus of infectious bronchitis. *Science* 76:34. 1932.
6. Pasteur, L. De l'attenuation du virus cholera des poules. *C. R. Acad. Sci.* 91:673. 1880.
7. The Press. Dr. Gibbs wants to enjoy life. Atlantic City, New Jersey. April 24, 1972.
8. Shane, S. M. Select Laboratories market growth through client service. *Zootech. Int.* 28-31. June 1994.
9. Stalheim, O. H. V. The winning of animal health. Iowa State University Press, Ames, Iowa. 1994.
10. Zander, D. V., and R. G. Raymond. Partial flock inoculation with a apathogenic strain of chicken herpesvirus of Marek's disease to immunize chicken flocks against pathogenic field strains of MD. *Proc. International Symposium Marek's Disease*. pp. 514-530. 1985.