BOONTON

NEW JERSEY

and its role in the

ELECTRONIC PRECISION INSTRUMENTS INDUSTRY

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BALLANTINE LABORATORIES

Six Major Firms Dominate Precision Instruments Industry, Developed Here

By Edgar M. Weed

Mr. Weed, who is now advertising manager of Measurements Corporation, has a long newspaper background. During the 1920s, he was advertising manager & treasurer of The Jerseyman, one-time Morristown daily, and later (1930-41) was advertising manager of The Morristown Daily Record. He was with Aircraft Radio Corporation during the war before moving to Measurements.

The molding of vulcanized asbestos and the development of radio circuits may seem to be entirely disassociated activities, but it was in a tiny molding department of the Loando Hard Rubber Company that Boonton's world-renowned electronic industries first began. Today these companies, Radio Frequency Laboratories, Boonton Radio Corporation, Ballantine Laboratories, Measurements Corporation, Aircraft Radio Corporation and Ferris Instrument Corporation, are known wherever precision instruments are used.

For many years since the turn of the century, Richard W. Seabury had been engaged in the development of molding processes for bakelite as a licensee under the patents of Dr. Leo H. Baekeland. Mr. Seabury's concern produced a great variety of molded parts including many pieces for electrical equipment.

Business was thriving and the future looked very bright as an enterprising new industry, radio broadcasting, was sweeping the nation. There were big demands for moldings of coil forms and many of the parts that were used in early radio sets but it was soon discovered that material which was satisfactory for ordinary electrical use was a poor insulator at radio frequencies. To solve the problem and thus meet the requirements of his customers, Mr. Seabury engaged a competent radio engineer, Dr. Lewis M. Hull, who years later was to become president of Aircraft Radio Corporation.

Dr. Hull and associates, while working on various molding materials, had to devise new electronic devices for test purposes. In doing so, their creative minds brought forth circuits that were innovations to the art and the radio industry deluged them with new technical problems to solve. Thus a modest molding plant had spawned a highly technical new enterprise that in 1922 became known as Radio Frequency Laboratories (familiarly known to radio men as RFL).

Other financial backers obtained interests in the firm, including Dr. Edward Weston, of instrument fame, the late Valentine B. Havens and Clinton P Townsend, noted attorneys. Additional radio engineers were engaged, one of these being Stuart Ballantine who, until his death in 1944, was to make some of the most important contributions to radio that the half-century was to witness. Another capable engineer who joined this group was William D. Loughlin who held the office of president of RFL from 1930 to 1934 when he established his own company, the Boonton Radio Corporation.

RFL developments included amplifier circuits, a single-control broadcast receiver, automatic volume control and many other improvements which, after being patented, were licensed to such concerns as Stromberg-Carlson, Crosley Radio Corporation, American Bosch, National Carbon Company, Kellogg Switchboard & Supply Company, Sangamo Electric Company, Grigsby-Grunow and De Forest Radio of Canada. Many readers will recall the purchase of a "Majestic" radio set, one of the popular early makes which featured the RFL single-control tuner.

Associated with Mr. Seabury, besides Hull, Ballantine and Loughlin, were other skilled radio engineers who later became prominent in the electronic industry. Two of these men, Mal-

colm Ferris and Harold Snow, played an important part in an enterprise that was soon to expand and develop into several different concerns, each specializing in some particular phase of the electronic art.

Aircraft Radio Corp.

As radio broadcasting grew in popularity, the use of radio for other purposes became increasingly important, particularly in aircraft, not only as a means of communication, but also as a necessity for safe navigation. The then Department of Commerce was developing what is now known as the low frequency ranges for air navigation and was sorely in need of an airborne, high sensitivity receiver to make proper use of the service. In the Fall of 1927 the Aircraft Division of Radio Frequency Laboratories, which later became Aircraft Radio Corporation, undertook the development of such a unit. By the Summer of 1928, this receiver had been completely developed and had gone through a preliminary production by General Radio Company in Cambridge, and arrangements had been made with Stromberg-Carlson in Rochester for production. In addition, the present airport and the first buildings now occupied by Aircraft Radio Corporation were started. They were completed late in 1928 and about that time the Aircraft Division of Radio Frequency Laboratories became a separate entity, Aircraft Radio Corporation, devoted exclusively to the design of airborne electronic equipment.

Many highly-trained radio engineers and other technical men joined the organization and several were later promoted to important executive positions. One of this group, John E. Johanson, assisted in the design of much of Aircraft's precision components. He was formerly vice president in charge of production of ARC, having left in 1945 to form his own company, the Johanson Manufacturing Corporation located in Rockaway Valley.

It was not until several years later that the decision to include not only the research and development but also the manufacture and sale of electronic equipment under one roof took effect. New buildings were erected as the company grew and today the plant occupies many acres with a modern laboratory building, production departments, warehouses and a large new hanger.

The first airborne range receiver was installed in airmail planes and Aircraft Radio Corporation designed and manufactured the receiving and transmitting equipment used by Jimmy Doolittle in his now famous first all-blind flight in 1929. The design and development of airborne communication and navigation equipment of high quality soon became a specialty of the company and by 1932 the design of lightweight two-way voice communication equipment had been completed which won an industry-wide design competition sponsored by the Army. At about the same time, the Navy accepted a similar design by ARC and 1933 saw ARC designed equipment in the first fighter squadrons of the Air Force and the Navy.

From its inception, Aircraft Radio Corporation has maintained the policy of developing and selling specialized equipment in which they have learned to be experts and their success in this field can be attested to by radio officers and men in both the Air Force and the Navy who have operated the equipment through the years.

The company continues at present to specialize in airborne communication and electronic equipment but, due to the type of personnel and machinery required, has been able to expand its operation into the development of specialized test equipment in this field, including three types of signal generators for testing airborne electronic equipment. The officers of Aircraft Radio Corporation include: Richard W. Seabury, chairman of the board; Dr. Lewis M. Hull, president and treasurer; Dr. Frederick H. Drake, executive vice president; Paul O. Farnham, vice president, research; Nils Sundstrom, vice president, manufacturing; A. W. Parkes jr, vice president, field engineering

and sales; Berton E. Holley, secretary.

Ballantine Laboratories

During this time many other changes were were made. RFL had sold all of its patents to the Radio Corporation of America and had executed license agreements with this organization, with the American Telephone & Telegraph Company and with the Hazeltine Corporation, to sell radio transmitters and receivers for aircraft. In 1929 Stuart Ballantine and two other stockholders of RFL formed a new corporation for the continuation of electronic research and development work operating under the name of the Boonton Research Corporation. This corporation continued until 1932 when it was dissolved following the sale of important inventions in vacuum tubes and associated equipment. All of the assets of this corporation, laboratory buildings, apparatus, land and tools were acquired by Mr. Ballantine who organized in 1932 the present Ballantine Laboratories Inc. for the purpose of carrying on the same type of activity engaged in by the original corporation.

Following a period of depression, during which it was necessary to build up the business and develop new inventions and devices, Ballantine Laboratories marketed some new precision measuring equipment which is still being manufactured. The laboratories worked in cooperation with the Navy in the development of highly confidential equipment and, at its own expense, developed the first successful throat microphone to be used by the Army Air Corps. After a long period of testing, the instrument was finally standardized by the Army and many thousand were manufactured for the Air Corps.

These developments were chiefly the result of Mr. Ballantine's work as is also true of many of the earlier developments processed in his own laboratory or in its predecessors. The history of Ballantine Laboratories from its inception until the death of its founder in May 1944 is largely concerned with the individual efforts of this one man. A brilliant physicist and engineer, his activities ranged from fundamental analysis and measurement of acoustic phenomena to engineering development of tubes and circuits in radio broadcasting and reception. Some fifty scientific papers, thirty patents and one book in his name attest to his high degree of standing in the electronic field.

Mr. Ballantine was the recipient of many honors. In 1920 he received a special award and citation by the Secretary of the Navy for the development of a radio direction-finder. In 1923 he was elected a John Tyndall Fellow in Mathematical Physics at Harvard University. In 1931 he received the Morris Liebmann Award of the Institute of Radio Engineers. In 1934 he was awarded the Elliott Cresson Gold Medal by the Franklin Institute of Philadelphia.

In 1947 he was posthumously awarded the Armstrong Medal of the Radio Club of America, and the following citation: "The Armstrong Medal of the Radio Club of America is awarded to Charles Stuart Ballantine for outstanding contributions to the art.

"In the period of 1908 to 1916 he pioneered in radio in the Philadelphia area just as the members of the newly born Radio Club similarly pioneered in the New York area.

"Out of that early experience came his book 'Radio Telephony for Amateurs' which was, in effect, the first amateur "bible" and from which the long line of similar publications has since descended.

"During World War I and building on the discovery of others of the Club, he developed the loop compass and radio direction finder as the primary and major defensive tool against the otherwise utterly successful submarine warfare of the German navy. Shortly after his entrance into the field of broadcast receivers in 1923, he developed the principle of negative feed back as well as of automatic volume control.

Later came his epoch-making work in developing on purely mathematical basis the theory of the vertical antenna and its low-angle radiation, the soundness of which continues to be attested to by the radiating system of substantially every broadcasting station in the world today.

Later his work in acoustics, ranging widely from new microphone calibration techniques, the invention of the throat microphone as standiardized by the U. S. Army Air Corps, the development of especially high fidelity reproduction, and so forth.

His many, many inventions and developments which together comprise far too long a catalog to be here detailed, mark accomplishments made primarily as an individual and all-too-often unsupported experimenter, who, persisting always against odds that would, themselves and alone, have defeated someone of less stamina and enthusiasm, won out to the ends that contributed so mightily to making radio communication and radio broadcasting the important instrumentality it is today."

Ballantine Laboratories, located just off Fanny road, Boonton, has continued to function in the manufacture and development of precision electronic measuring instruments and special types of Geiger-Muller tubes used in cosmic ray research and certain industrial applications. The Ballantine electronic voltmeter, because of its sensitivity, accuracy and stability, is probably the best known and the most widely used of all electronic voltmeters. The present officers of the company are: Henry Ladner, president; Frank R. Zayac, vice president; Virginia O. Ladner, treasurer. The chief engineer who has been with the laboratories for many years is another local resident, Edmund Osterland.

Ferris Instrument Co.

As mentioned earlier in this article, much specialized test equipment was needed for research work. One of the men who was responsible for the design of the signal generators and many other instruments used was a member of the Seabury staff, Malcolm Ferris. After several years with the RFL organization, Mr. Ferris set up his own business as a consulting engineer and in September 1932 formed the Ferris Instrument Company located on Boonton avenue. The Ferris line of test equipment quickly found acceptance by industry, schools and governmental agencies. Mr. Ferris operated the company until his death in December 1937, after which it was continued by his widow, Mrs. Ellen Ferris, and other members of the organization. In September 1942 the company moved into larger quarters on Cornelia street which it now occupies.

The Ferris organization is now operated by Harold E. Barnes.

Boonton Radio Corp.

By 1934 the Seabury interests had liquidated a good portion of their holdings and in that year William D. Loughlin, one of the industry's pioneers, previously mentioned in this account, purchased the original RFL building located along the Lackawanna Railroad tracks at Boonton and established the Boonton Radio Corporation.

This new concern concentrated its engineering skill toward the creation of new measuring equipment, then so badly needed by the radio industry. For example, manufacturers were confronted with the costly annoyance of making coils that would pass all requirements when tested in their own laboratories only to be rejected by the purchaser because he had entirely different test instruments. Approved standards were necessary and the Boonton Radio Corporation engineers were determined to build them.

In November 1934, Mr. Loughlin presented at the Institute of Radio Engineers' Fall meeting in Rochester, N. Y., the company's first "Q-Meter." This instrument was immediately accepted as a standard by industry and research laboratories. The "Q-Meter" in an approved form is still being produced by BRC in large quantities and is the best known instrument of its type in use today.

Other new equipment followed including the "QX-Checker," similar to the "Q-Meter" but designed as a production testing instrument that could be operated by factory personnel, and still give laboratory accuracy. A radio interference measuring instrument was developed and produced for the Government and BRC pioneered the development of the beat-frequency signal generator.

Major Edwin H. Armstrong had introduced his system of frequency modulated transmitters and receivers which attracted the attention of engineers throughout the world. One of these was Mr. Loughlin who, predicting the demand for FM test equipment, directed his laboratory group in the design and production of an FM signal generator that was first presented in 1940 at the Institute of Radio Engineers' meeting in Boston. The concern had again made a timely development as a modified version of this instrument is still being manufactured by BRC.

In 1940 with the war clouds darkening, but our country still not in actual combat with Germany or Japan, large numbers of planes were being flown to Canada for the installation of armament and radio equipment before they were piloted to the British Isles. To provide the ferry pilots, who took the planes to Canada, with radio, so vital to safe navigation, Boonton Radio Corporation produced a compact, lightweight receiver and power supply. This unit, developed by RFL, required no special installation and had only to be carried by the pilot for use in each plane he had to deliver. The receiver was later used by the Navy in its N3N-3 training planes.

Like the others, Boonton Radio Corporation's efforts during the war period were devoted to the production of instruments for the Armed Services and other manufacturers making electronic equipment. The production of micro-wave signal generators for the development and maintenance of airborne radar equipment represented the company's principal output for wartime use.

In cooperation with the extensive program of the CAA and Department of Commerce to equip our airways with the most modern electronic navigational equipment, the Boonton Radio Corporation in 1947 introduced a crystal monitored signal generator and a glide slope test set which are both widely used for testing omni-range radio equipment and other airborne navigational instruments. Various airlines are now installing this new equipment and it will eventually be available to private flyers; thus this Boonton laboratory has made an important contribution to the safety of air travel.

Within the past two years a large addition has been built on the BRC plant and the original structure has been modernized in every detail.

Boonton Radio Corporation's products are recognized throughout the world for their superior quality which is the cumulative result of expert care from the drafting boards to the final test departments and the company's policy of building only those instruments which have been pioneered in their own laboratories.

Officers of the BRC besides president William D. Loughlin include Dr. George A. Downsbrough, vice president and general manager who joined the organization in 1942, and James R. Estler, secretary-treasurer.

Radio Frequency Labs.

By now most of the RFL activities had been absorbed by Aircraft Radio Corporation and Seabury & Sons Inc., but in 1937 RFL built a new laboratory and hanger on the airport opposite the ARC plant and engaged in the further development and production of aircraft radio communication and navigation equipment, as well as radio-controlled, pilotless aircraft. Late in 1941 an agreement was made with Boonton Radio Corporation to manufacture RFL aircraft receivers for the Navy. During the war RFL also aided in the design and manufacture of electrical testing and proving equipment for the Weston Electrical Instru-

ment Company and the Eclipse-Pioneer Division of Bendix. At the cessation of hostilities the firm's engineering talent turned to new commercial equipment and government developmental contracts.

Several of these products are now on the market and include a portable magnet charger, "Sealnuts," an r. f. probe, a metal detector, insulation testers, instrument calibrator stands, a radiation integrator and a small, light-weight radio telegraph terminal unit. RFL products and engineering services are today sold all over the world. Its founder Richard W. Seabury is now chairman of the board with Richard W. Seabury jr as president and Edwin S. Seabury as executive vice president. Other RFL officers include Robert H. Denton, vice president; Everett A. Gilbert, vice president, engineering; Elliott L. Richmond, treasurer; Berton E. Holley, secretary; John Solomon, assistant secretary and assistant treasurer.

Measurements Corporation

Still another important member of Boonton's electronic group is Measurements Corporation, research and manufacturing engineers of a world-famous line of electronic measuring equipment. The story of the formation of this company must too be evolved from the former association of its founders with other local laboratories. These founders, Jerry B. Minter and John M. van Beuren, both still active in Measurements Corporation, were employed by the Ferris Instrument Corporation until early in 1939 when they left that organization to form their own company, Microvolts Inc.

On April 10, 1940, the Microvolt name was dropped and the new concern became Measurements Corporation as it is known today. New quarters were secured in a local building that had formerly been used as a doll factory and it was here that the first "Laboratory Standards" of Measurements Corporation were produced.

Laboratories, manufacturers and governmental agencies began to specify Measurements equipment in their requisitions because of its excellent quality, so before long the new company outgrew its plant facilities. A tract of land on Intervale road, Parsippany, near Boonton, was purchased and a long frame building, known as Unit One, was constructed. Here signal generators, field strength meters, vacuum tube voltmeters and other precision electronic instruments were developed and manufactured in increasingly large numbers.

In 1941 a pioneer in the radio industry, Harry W. Houck, acquired an interest in Measurements Corporation. Mr. Houck had been associated with various branches of the industry since 1910 and had gained prominence for his collaboration with Major Armstrong in the development of the superheterodyne receiver and for his patents on the battery eliminator, vacuum tubes and varied electronic circuits.

During the war every engineering facility was directed to the production of critical equipment and it became necessary to expand into an abandoned school on Harrison street, an idle automobile showroom on Main street and a silk mill on Monroe street, all in Boonton. Measurements' personnel increased to several hundred workers and the company can be justly proud of the contribution it made to the war effort in vital equipment so necessary for the maintenance of communication services, radar and the development of highly secret electronic devices.

After V-J Day the Monroe street plant remained as the headquarters of Measurements Corporation and all activities were concentrated in the production of FM and television signal generators as well as test equipment for micro-wave relays, airplane navigational systems, mobile radio and countless other electronic applications.

In the Fall of 1948 ground was broken adjacent to Unit One for a modern plant, the new home of Measurements.

The new building is now completed with over 25,000 square feet of floor space utilized for laboratories and production departments. Radiant heating, air conditioning and expertly engineered lighting, plus the finest tools, equipment and instruments assure every modern convenience for the comfort of Measurements' personnel and the efficient production of the company's line of "Laboratory Standards". Measurement Corporation has been the first to develop and commercially produce many important instruments including the first signal generator with built-in tuning motor; a field strength meter usable above 20 megacycles; a signal generator for testing high frequency receivers; the first UHF signal generator with a self-contained pulse modulator; an FM signal generator covering the present band; the first wide-range grid-dip meter and the first commercial wide-band, wide-range television signal generator.

The officers of Measurements Corporation are John M. van Beuren, chairman of the board and chief research engineer; Harry W. Houck, president and general manager; Jerry B. Minter, vice-president and chief engineer.

The area's electronic industries are as important to Boonton and nearby communities as their instruments are to the electronic art. With a total personnel of over 500 skilled workers, the annual payroll represents a very sizeable portion of the industry's volume of sales totalling many millions of dollars yearly.

(NOTE: Besides the individuals mentioned in the foregoing article there were many others who took an important part in the formation and growth of Boonton's electronic industries. Many of these people today hold important positions with these concerns. As a complete listing of every one would literally resemble a local city directory, space limitations permitted the naming of but a few principals.—E. M. W.)