EARLY HISTORY OF RIVERBANK ACOUSTICAL LABORATORIES

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The establishment of the Riverbank Acoustical Laboratories in Geneva, Illinois, had its origin in the interest of Colonel George Fabyan in an acoustic device purportedly described by Francis Bacon in a secret cipher embodied in the printed First Folio (1623) of the works of William Shakespeare, and the resulting acquaintance of Fabyan with Professor Wallace Sabine of Harvard University.

In connection with the 50th anniversary of the Riverbank Acoustical Laboratories, I was asked to make some comments on the origin and early history of that institution, at a meeting of the Chicago Acoustical and Audio Group. This is the basis of the present article. I do not know that any account of the origin of these laboratories has ever been written, and, therefore, this will be based altogether on my memory, in fact on my memory of verbal information pieced together from conversations of many years ago.

If this were presented in the style of some of the writers of popular articles, it might be said that this laboratory owes its origin to the activities of Francis Bacon, who lived back in the days of Queen Elizabeth I, around the year 1600. This might be stretching a point, but it is true that the sequence of events that resulted in the building of this laboratory did start with Francis Bacon, with Colonel George Fabyan of Riverbank as the connecting link.

Colonel Fabyan was born in Boston, with a solid New England background, coming from an old Bostonian family. His father, together with Cornelius Bliss, founded the textile firm of Bliss, Fabyan Company in the days of the predominance of New England in the textile industry. Incidentally, Cornelius Bliss was later the treasurer of the Republican party in the successful campaign of William McKinley for President of the United States in 1896. Colonel Fabyan left school at a rather early age and went out to the Middle West, but later

joined his father's firm and managed the Chicago office. He and Mrs. Fabyan moved out from Chicago to Geneva, Illinois, and established the 500-acre estate which they named Riverbank.

The story of Riverbank is tied in with the subject of codes and ciphers. I believe that Colonel Fabyan became interested in codes and ciphers in connection with the transmittal of information and prices in his business activities. He became acquainted with the cipher work of Mrs. Elizabeth Wells Gallup of Detroit, probably through a book that she had written on the cipher of Francis Bacon. This was an important link in the sequence of events leading to the building of the Riverbank laboratory. Mrs. Gallup was much interested in the literature of the Elizabethan period. She became acquainted with the writings of Francis Bacon, and was particularly intrigued with Bacon's description of a method of secret writing, which is plainly described in one of Bacon's books. The characteristic of Bacon's system is that a secret message may be encoded in any ordinary manuscript or letter without obvious evidence that any secret message is there. This is done by the use of two slightly different fonts of type or forms of letters, the differences being too small to be immediately obvious, and the encoding is done by the chosen sequences of use of the two forms of letters. Five letters of the plain text, with the two fonts of type used in suitable sequence, are required for the representation of one letter of the encoded message.

Having knowledge of Bacon's cipher system, Mrs. Gallup looked for evidence of its use in writings of his period. One possibility, perhaps somewhat obvious, was the printed works of William Shakespeare. I believe that the first edition of Shakespeare's plays was printed in 1623, and this has been reproduced photographically, so that the characteristics of the original printing are preserved and available for examination. This is the material on which Mrs. Gallup spent a great many years of her life. She felt that she was able to distinguish between and identify the individual letters belonging to each of the two sets of type which are necessary for the use of Bacon's cipher, and thus was able to decode the secret messages embodied in the apparently straightforward text.

Colonel Fabyan induced Mrs. Gallup to move to Riverbank. She lived in the house which is somewhat down the road to the south of the present laboratory, then called the Ingledew cottage and now the site of a publishing concern. In personal appearance, Mrs. Gallup strongly resembled Whistler's mother; she was perhaps 65 years of age when she came here, and somewhat over 70 when I first knew her.

Of course, the big interest is in the content of the messages that Mrs. Gallup produced. Perhaps the most startling of these is one which stated that

Francis Bacon was the illegitimate son of Queen Elizabeth, and was the rightful heir to the throne of England.

However, the item that is most pertinent to the present discourse is a technical one. This stated that if a circular cylinder were to be made, having piano strings stretched from end to end along the outside of the cylinder, and with these strings tuned to a major chord, then if these strings were vibrated and the cylinder were rotated at the same time, the cylinder would levitate—i.e., it would rise in the air without visible means of support.

This may sound fantastic, but it may be noted that Francis Bacon was the head of the Rosicrucian Society. This society, in Bacon's time, was a sort of underground organization devoted to what we would now call science, i.e., the investigation of natural phenomena by experimentation, which in those days was considered practically sinful and unlawful. It may also be noted that there were only seven licensed printers in England at the time, and Francis Bacon was the governmental official in control of them. So it was possible that he could have controlled the setting of the type in any publication in the way he wished.

At any rate, Colonel Fabyan became interested in this suggested cylindrical device and decided to have one built. In connection with his business, he regularly commuted from Geneva to Chicago on the Chicago and Northwestern Railroad, and across the street from the Chicago railroad station there was, I believe, a woodworking plant of the Plamondon Company. He went to them to discuss the making of the cylindrical device. Colonel Fabyan arranged with one of the men there, Bert Eisenhour, to come out to Geneva on Saturdays and Sundays to work on the project, and eventually Eisenhour left Plamondon's to spend full time at Riverbank.

The cylinder with associated piano strings was made and may still be seen at Riverbank. I do not know just how they planned to make the strings vibrate, but there is a clue in the fact that Colonel Fabyan purchased a musical instrument called a Choralcelo, and eventually had three of these on the premises. This instrument is fundamentally a piano, and can be played as a piano. However, there was a suitably actuated electromagnet associated with each of the piano strings so that the string could be kept in vibration to give a continuous volume of sound as long as the piano key was depressed, thus giving a resemblance to an organ tone. The alternating currents of the various frequencies for the electromagnets were furnished by an elaborate set of rotary generators with a proper commutator for each frequency. This embodied the fundamental principle of continuous vibration of a piano string, although the association of this apparatus with a rotating levitating cylinder of limited size is not obvious.

But Colonel Fabyan persisted. One of his brothers was a trustee or overseer of Harvard University, and Colonel Fabyan went to him and asked him who was the foremost acoustical expert in the country. His brother told him that this was undoubtedly Professor Wallace Sabine, professor of physics at Harvard. So Colonel Fabyan sought out and became acquainted with Professor Sabine. I do not know what opinion Professor Sabine expressed regarding the cylinder experiment, but Colonel Fabyan became interested in the work that Professor Sabine was doing in Cambridge. This was the pioneer work on architectural acoustics, Professor Sabine being the real pioneer in this field. He was studying the phenomenon of reverberation, its causes and control. This work was being conducted in the Sanders theater, by producing a musical note and measuring with a stop watch the time it took for the sound to die down to its minimum audibility. The variable introduced in a series of observations was the number of seat cushions which he placed in the theater seats. Thus it might be said that the first unit of acoustical absorption was the absorption of one seat cushion of the Sanders Theater. I recall that not many years ago the Acoustical Society had a meeting in Cambridge, and there were on view a few of these Sanders Theater seat cushions that had been salvaged when these original cushions had been discarded by the theater.

Professor Sabine was able to make his tests only when everything was quiet and, as he said, this was after the street cars stopped running at midnight and before the milkmen started in the morning with their carts rattling over the cobble stones. So the Colonel said to Professor Sabine: "I'll build you a place out in Illinois on the prairie where there just isn't any noise." This seemed like a good idea, and they proceeded with the plans. I believe that the original idea was simply to build the room that is now the reverberation sound chamber, making it with hard walls to have as extended a reverberation time as possible. Out of this developed the laboratory with three stories and a basement. This was just before and during the participation of the United States in the first World War. I recall that some years later it was decided that insurance should be taken out on the laboratory building. The insurance agent came out to look the building over, and asked for a copy of the plans of the building. It then came to light that there were not and never had been any such plans. The building had just been built on a day-by-day basis on the cooperative judgment of Colonel Fabyan and Eisenhour, with the guidance of Professor Sabine as to the features which would be necessary for his work on architectural acoustics. The laboratory was completed in 1918, as the war was coming to a close. During the war, Professor Sabine was engaged in governmental war work, much of the time in France. He had an ailment for which an operation had been advised, but he kept postponing this operation until the war was over. Then he did have the operation, from which he did not recover. Thus he personally never did have an opportunity to make

use of the facilities of the laboratory which had been built specifically for him and for his work on architectural acoustics.

Colonel Fabyan then set about to find someone who could carry on at this laboratory the work pioneered by Professor Sabine for which the laboratory had been built. He went to Cambridge and talked with the people at Harvard who were acquainted with Professor Sabine's activities. He concluded that the person who seemed to know most about the experimental details was the janitor of the Harvard physics building. In looking over the notebook records, he came across the name of Paul Sabine as having assisted Professor Sabine for some time. Dr. Paul Sabine, a relative of Professor Wallace Sabine, had received his PhD degree in physics from Harvard, and had gone to teach in the physics department of the Case School of Applied Science in Cleveland. So Colonel Fabyan looked him up and, as a result, Dr. Paul Sabine came to Riverbank to take up the work for which the laboratory had been built.

The contributions of Paul Sabine and of his successors, Luther Ramer, Ralph Huntley, Franklin Tyzzer, and William Siekman have established a solid reputation for the Riverbank Acoustical Laboratories in the field of architectural acoustics. In 1947 the management of the laboratory was taken over by the Illinois Institute of Technology Research Institute, IITRI, and, with expanded facilities, it is a continuing important testing laboratory for acoustic properties of materials and structures.

In addition to the work on architectural acoustics, there were other activities at Riverbank. Bert Eisenhour, in line with his natural gift for painstaking accuracy, developed methods of producing what were the finest tuning forks made. Floyd Firestone spent some time at Riverbank investigating echoes in auditoriums by the use of small models and electric spark techniques. Franklin Tyzzer came to the laboratory in 1924 and later, with IITRI, headed the work there and planned important expansions of its facilities. I came to Riverbank a year after the arrival of Paul Sabine, and for some years investigated various aspects of human hearing, part of the time in collaboration with Dr. A. G. Pohlman, who was Professor of Physiology at St. Louis University Medical School, and who spent his summer vacations at Riverbank for a number of years. This work included an early determination of human minimum audibility in absolute units, quantitative work on bone conduction audibility, the refutation of the erroneous belief that some people actually "hear better in a noise," the identification of what is now known as "recruitment" in the hearing of some people, etc.

Shortly after I came to Riverbank, there was a meeting there of the Acoustical Committee of the National Research Council, which had been set up by the United States government during the first World War. This is mentioned

because these committee members were representative of the limited number of individuals in the country who were actively interested in the field of acoustics in 1920. In addition to Paul Sabine, the members of the committee were, as I recall: Arthur Foley of the University of Indiana, Dayton C. Miller of the Case School of Applied Science, George W. Stewart of the University of Iowa, Floyd Watson of the University of Illinois, and Arthur Gordon Webster of Clark University, who is credited with originating the concept of acoustical impedance.

Although not related to acoustics, a by-product of Colonel Fabyan's interest in codes and ciphers proved to be of long-range importance. After Mrs. Gallup came to Riverbank, there was built up a small group to aid in trying to expand the work on the Baconian cipher. Also, with the idea of improving the products of the rather extensive farm which was operated on the Riverbank estate, Colonel Fabyan hired a young man, William Friedman, a graduate of Cornell University Agricultural School in plant genetics, to come to Riverbank for agricultural research. Friedman soon became involved in the work on codes and ciphers, for which he seemed to have a natural aptitude. When the United States entered the first World War, Riverbank had about the only organized group that was working on ciphers, and the government sent to them a number of messages for possible decipherment. The Riverbank group was quite successful with these. One was a test message in a new cipher which the British War Department considered using on the Western Front. Within a few hours after receiving this test message, a cablegram was sent to London, encoded in their own cipher and facetiously reading: "This message is absolutely undecipherable." This cipher was abandoned for military use. In 1921, Friedman left Riverbank to go with the U.S. Signal Corps, and he continued in government service as a cryptanalyst until his retirement in 1955. He was the leader of the U.S. Army task force that cracked the very difficult Japanese PURPLE code in August 1941, an achievement which enabled the United States officials to read the official Japanese private messages, including those during the United States-Japanese diplomatic negotiations which were in progress at the time of Pearl Harbor. Among his awards for his contributions was the Medal of Merit, the highest civilian award which is given by the United States government.

Colonel Fabyan was a colorful character, and the activities on the Riverbank estate were varied. Here lived and worked a gifted Italian sculptor who produced works in concrete for decorative purposes, such as the eagle which adorns the tower on the laboratory. Colonel Fabyan had been attached to the United States delegation which participated in the Portsmouth peace treaty which ended the Russian-Japanese war, and as a gesture of appreciation for this, the personal gardener of the Emperor of Japan was sent over here and supervised the construction of a small Japanese garden near the villa, the residence of Colonel and Mrs. Fabyan.

Colonel Fabyan decided to build a garage for Eisenhour's Stutz Bearcat automobile, using some 16 ft I-beams that had lain outside the laboratory for some time, the garage to be 16 ft x 32 ft. The framework went up quickly, and he then thought that it would be a good idea to extend the project. The result is the five-story cement block-house adjacent to the laboratory, constructed in 16 ft modules. This structure was finally limited by the possibility that it might slide off into the adjacent cornfield because of the limited footings which had been put in when the plans were more modest.

Such were some of the elements of the background from which developed the Riverbank Acoustical Laboratories.

"I try not to be too dogmatic."