William Stanley Lighted a Town and Powered an Industry

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Preface:

At a meeting of engineers in New York a half century ago, a paper was read which contained the following description of a historic event in the development of electrical technology:

> For the setting we have a small town among the snow-clad New England Hills. There a young man, in fragile health, is attacking single-handed the control of a mysterious form of energy, incalculable in its characteristics, and potentially so deadly that great experts among his contemporaries condemned attempts to use it. With rare courage he laid his plans, with little therapy or precedent to guide him; with persistent experimental skill he deduced the needed knowledge when mathematics failed; with resourcefulness that even lead him to local photographers to requisition their stock of tin-type plates (for the magnetic circuit of his transformer), successfully met the lack of suitable materials, and with intensive devotion and sustained effort, despite poor health, he brought his undertaking, in an almost unbelievably short time, to triumphant success.

This triumphant success occurred in Great Barrington, Massachusetts, in 1886, and the young man in fragile health was William Stanley. A century ago he demonstrated the feasibility of transforming to a higher level the generated alternating current voltage, for transmission at a distance, and reducing it at the consumer end to a usable level.

One hears or reads on occasion that Stanley "invented" the transformer. Although he was a pioneer in the design of this apparatus essential for alternating current transmission and use, that is not his claim to fame. Others were also working on this problem in the early days of electricity, and Stanley himself gave these men credit in talks he gave to engineering groups. In the words of his biographer, Laurence A. Hawkins, "The Great Barrington installation was the first attempt ever made to transmit high voltage alternating current by the principles employed today." It was not just the use of the transformer that made this event unique, but the demonstration of a practical system that was reliable enough for commercial application.

That this landmark technological event should have occurred in the Berkshires is entirely fortuitous. William Stanley, who was born in Brooklyn in 1858, was working on his inventions in Pittsburgh. But when his health began to fail in 1885, he was advised to get away from the Pittsburgh climate. He came to the Berkshires because he was not unfamiliar with this area.

An ancestor, also named William Stanley, had moved from Connecticut to Great Barrington in 1836. His son, "our" William Stanley's grandfather, owned the Berkshire House in that town for some years and Stanley's grandfather was born there. Although his father's business required the family to move to the New York City area, where the inventor William Stanley was born, there were visits to relatives in the Berkshires. It was only natural that these hills beckoned when he had to leave the less bucolic Pittsburgh atmosphere.

His health improved and he continued the electrical experiments which eventually led to the March 20, 1886, demonstration.

But enough. You'll learn about that landmark experiment and much more in this special, double-size issue of *Berkshire History*.

William Stanley Lighted a Town

The country was still mourning the death of former President Ulysses S. Grant, in the summer of 1885. In Great Barrington, Massachusetts, that September. Barnard's Orchestra played at a widely attended hop at Barrington House. Interest was growing in the pending trotting races at Barrington Fair. Oscar Beckwith was about to go on trial for the sensational killing that January of Simon Vandercook in a mountainside cabin in Alford. Industrialist John H.C. Church was recovering from a bad tumble from his bicycle, while fellow businessman Parley Russell was pleased with a new team of horses he had just purchased in Lenox.

William Stanley and his family quietly moved to town, staying first at the Turley place on South Main Street, then with Seth L. Sheldon on Castle Hill.

That fall of 1885, *Berkshire Courier* owner Clark W. Bryan was preparing his "Book of Berkshire" for publication. Albert Bodwell's photos of the Hopkins mansion under construction (it is now known as Searles Castle) were on display at J.A. Brewer's store. Hermit Crosby, a gunsmith who lived a solitary existence on the east side of the Housatonic River, fell ill.

And inventor Stanley leased the former rubber factory off Cottage Street for use as a laboratory. Within the next six months, his electrical experiments would light Main Street – and eventually power an industry, as his modifications to the alternating current transformer spawned a

huge business still active 100 years later, at General Electric's sprawling plant two towns to the north in Pittsfield.

The Inventor's Early Career

William Stanley Jr. was born in Brooklyn, New York, Nov. 22 (or 23, there seems to be some dispute), in 1858, the son of William and Elizabeth Adelaide Parsons Stanley. He was a descendent of John Stanley, an Englishman who joined the Massachusetts Bay Colony in 1634.

His grandparents, William and Clara Wadhams Stanley, had settled in Great Barrington in 1836, operating a general store and the newly constructed Berkshire House.

The inventor lived with his parents in Great Barrington for a few years. Then they returned south to Bridgeport, Connecticut, coming back for occasional vacations. His father, the only male in a family of eight children, was educated at Yale. He became a prominent New York City lawyer. An avid hunter and fisherman, he at one time owned a property called Pinecliff in Barrington. He retired to Great Barrington for the last two years of his life; he died in 1893. His wife was the daughter of a wealthy New York importer.

Young Stanley at an early age showed a mechanical aptitude, preferring toys of that character to ordinary playthings, and at age 10 he took apart and put together again a watch, which continued to keep good time. He learned about the locks and clocks in the family home, and he repaired household equipment when it was out of order.

He displayed little interest in school, though he did attend Williston Academy in Easthampton, Massachusetts, graduating in 1877. His father expected that the young man would study law at college, and Stanley duly entered Yale in 1879. But he was dissatisfied with academic life and left before Christmas vacation. He sent a brief note to his parents: "Have had enough of this, am going to New York." He would comment years later, "I am afraid there is a good deal of stuff taught in school that clogs instead of clears the brain."

He spent a brief stint with Charles T. Chester, a manufacturer of telegraph apparatus; then, learning of an opening in the nickel plating business, he sought from his father a loan of $2,00 with which to buy an interest in a firm owned by George Wiley. At last recognizing that he would never make a lawyer of his son, the elder Stanley lent the money. William developed so much business for the nickel-plating shop that its facilities were overwhelmed, whereupon he devised novel methods for expediting the process. The first year they did very well, and William's share pf the profits was $4,000, which enabled him to repay his father.

Work at the shop was too routine for the tastes of an adventurous and innovative young man, and in 1880 Stanley went to work as an assistant to inventor Hiram Maxim, a member of an inventive family, who at the time was manufacturing electric lamps and small direct current generators in New York City. Stanley's income dropped to 50 cents a day, but he was happy in confronting new challenges.

Maxim (later Sir Hiram for having invented the machine gun, smokeless powder and a delayed-action fuse in England) described the young Stanley as "very tall and thin, but what he lacked in bulk he made up in activity. He was boiling over with enthusiasm. Nothing went fast enough for him. I believe he preferred that each week should contain about 10 days and that the days should be about 48 hours long. Whatever was given to him to do he laid himself out to do in the most thorough manner. He would spare no trouble or expense to accomplish the task which was given him to do, after laying out his own money in order to obtain material which he thought might be better than what was available in the works."

That whirlwind of activity aroused jealousy in the plant on the part of those who were less devoted to their work and when, after working late one night, he neglected to turn off some electrical equipment, the place burned down and the manager fired him. But Maxim so appreciated the young man's qualities that he reinstated him. In less than a year Maxim made Stanley his first assistant in charge of what we would now call R&D: research and development.

In 1879 Thomas A. Edison invented his incandescent lamp, which was powered by direct current generators or batteries. This invention was to launch an enormous industry, Edison's and those of Maxim and others

THOMAS ALVA EDISON (1847-1931) founded the first industrial laboratory at Menlo Park, N.J. in 1876. His Edison Electric Company evolved into General Electric when it merged with Thomas-Houston Company (at the same time giving up the "battle of the currents": until then Edison made strictly direct current goods, while Thomas-Houston was a major alternating current producer). The inventor had wide interests, working with Ford and Firestone on rubber products, developing the printing telegraph, the mimeograph, the phonograph and microphone, the carbon telegraph transmitter, the incandescent lamp and alkaline storage battery.

Maxim was "electrician and general wizard" of the United States Electric Light Company, which had two plants on 26th Street, about a block apart. The firm sought to demonstrate the feasibility of illuminating commercial business with its system of generators and a distribution network, to attract investors, and it proposed using Maxim's incandescent lamps.

Caswell, Massey & Company, a drugstore on Broadway near 24th Street, agreed to have six lamps installed, and Stanley had a wire stretched from the generating plant across the rooftops to the

Fifth Avenue Hotel, on whose first floor the drugstore was located, and utilized the city gas pipes for the return circuit.

In remarks before an American Institute of Electrical Engineers dinner in Pittsfield in 1911. Stanley said: "I remember that it fell to my lot to arrange the machinery for applying the service. For this purpose a 'No. 20' machine was employed having a rated capacity (in the company's literature) of one hundred Maxim lamps, and a Maxim automatic exciter was used to maintain a constant electromotive force (volts) upon the wire.

"Strange to say, this crude installation really gave excellent results; the lamps burned brilliantly, creating a fine public impression and thereby caused an additional demand for the company's stock, and both the directors and 'staff' were happy."

As Alexandre Dumas once observed, "Nothing succeeds like success," and following upon the successful drugstore demonstration, the Union League Club, the Equitable Life Assurance Society and the Post Office installed the system, discarding the conventional, but dim, illumination by gas.

Although Stanley could not foresee the part he would play in the future in overcoming deficiencies in that direct current system, he recognized at the time the limitations inherent in that system. It required very large conductors to minimize voltage drop as the distance increased from generator to lamps. The voltage drop increased over greater distances severely circumscribed the utility of the system.

When Maxim departed for England and the United States Electric purchased the Weston Arc Light Company, Stanley became an assistant to Edward Weston in Newark, New Jersey. Stanley found it difficult working with another intense and inventive man – so much like himself – that he soon resigned.

EDWARD WESTON (1850-1936). Born in England, in 1875 established a plating firm in Newark, N.J. He worked for the U.S. Electric Lighting Company until 1888, when he formed his own Weston Electric Instrument Company, to produce measuring instruments. He introduced a number of improvements in nickel plating methods and also invented electric dynamo equipment.

Stanley joined Swan Electric Lamp Company in Boston in 1882, where he worked on incandescent light bulbs. The firm's founder, Sir Joesph Swan, had perfected an incandescent bulb said to be comparable to Edison's.

SIR JOSEPH SWAN (1828-1914) was a British physicist and chemist whose inventions included improvements in dry plate photography and an incandescent lamp. While in the employ of the Swan Electric Company, Stanley patented a number of incandescent lamp improvements.

From 1883 to '84 Stanley worked at a private laboratory in Englewood, New Jersey, where his parents, experimenting on storage batteries. The patents he received during this interval were later acquired by the Westinghouse of Electric & Manufacturing Company. One of them adapted machinery to the exhaustion of air from incandescent lamps, thereby eliminating the old, inefficient hand method.

On December 22, 1884, Stanley married Lila Courtney Wetmore. She was the daughter of Jacob S. Wetmore of Englewood, New Jersey, a member of the firm of Richard Irvin & Company, American agents for the Bank of Scotland. They eventually had a family of six sons and three daughters. Stanley a few years before had met H.H. Westinghouse, brother of the industrialist. When George Westinghouse decided to expand into electrical manufacture in 1884, Stanley was hired to work in Pittsburgh.

There was considerable electrical research going on at this time, both in America and abroad, by Edison, Charles F. Brush, Elihu Thomson, John Hopkinson, Weston, etc.

ELIHU THOMSON (1853-1937) was born in England but grew up in Philadelphia, Penn. His early electrical work was in arc lights, but he eventually covered the spectrum of direct current, alternating and polyphaser systems. His Thomson-Houston Co. of Lynn, Mass., merged with Edison General Electric in 1892 to form General Electric.

Stanley and Westinghouse entered into a contract in March 1884 in which Stanley was to be allowed to devote his attention to those lines of investigation which interested him, and Westinghouse in his turn agreed to exploit such inventions as might result, giving the inventor some financial benefit from their manufacture.

In 1885, no fewer than 10 patents were granted to Stanley in his name, and one with E.P. Thomson, most of them pertaining to the incandescent lamp and its appurtenances. True to his word, Westinghouse had Stanley install a lamp manufacturing facility at the Pittsburgh plant of the Union Switch and Signal Company to exploit those patented inventions.

GEORGE WESTINGHOUSE (1846-1914) worked in his early years in his father's agricultural machine shop. In 1869 he organized the Westinghouse Air Brake Company, the first of more than 30 firms which he was to head. His inventions ranged from the rotary engine (at age 15) to the railroad air brake. He acquired American rights to the Gaulard and Gibbs alternating current transformer patent in 1884 and, following Stanley's successful experiment, introduced the alternating current system of electrical distribution for light and power. Westinghouse registered in the neighborhood of 400 patents in his lifetime. In 1893 he purchased his Erskine Park Estate in Lenox, Massachusetts. At his death, he was worth an estimated $200 million.

Stanley and other electrical pioneers had an interest in alternating current as an alternative to direct current. Low voltage direct current, then the only electrical power in use, needed large conductors for transmission. Until the problem of transmission was solved, electricity was

impractical for installation any distance from a generating plant. Westinghouse was interested enough in alternating current to take an option on the Gaulard and Gibbs transformers developed in England.

In 1883, recalled Stanley, "Lucien Gaulard brought out in London his systems of operating induction coils in series, and this system of Gaulard's was far more of a system and was much more completely worked out than the general public imagined. It was not only a system by which the high potential currents of a generator could be used to deliver low potential currents on a local circuit, but it also contemplated an automatic regulation feature which then was and now is little understood."

He continued, "Gaulard proposed to place a series of 'inductoriums,' or, as we should say, open magnetic circuit transformers in a line connected to an alternating-current generator supplying a constant current and showed that if the 'inductoriums' or transformers were made open-circuited and had very high mutual induction between the primary and secondary coils , and if the alternating generator was constructed to give a constant current, each induction coil would give a constant potential on its secondary circuit through variations of resistance in that circuit, such as variations in the number of lamps turned on or off…

"In 1883 I attempted," said Stanley, "to devise a system of alternating current distribution that would be inherently self-regulating, but found that I knew too little of the subject to venture into it."

Westinghouse legal counsel Franklin L. Pope objected that high-voltage transmission of a-c would be dangerous (an ironic prediction, as we shall see).

FRANKLIN LEONARD POPE (1840-1895), a native of Great Barrington, took an early interest in telegraphy. He became a telegraph operator, and later was an artist for Scientific American. He investigated the possibility of running a telegraph line through British Columbia and Alaska to Russia, until the Atlantic cable was placed in 1866, obviating the need for such a line. He later developed, with Edison, the Pope & Edison one-wire telegraph printer. He authored a number of books.

Stanley never gave up on the Gaulard idea: he suggested to business friends that he undertake research, and did a few small, preliminary experiments.

"I became so satisfied of the value of the system and of great opportunities that its development would necessarily bring forth that I determined to build a plant of my own and demonstrate the correctness of my views," Stanley recalled years later.

"By the spring of 1885 my health gave out and there seemed to be a grave question as to my ability to withstand Pittsburgh and its work. My doctor began to advise me to go to the country. I was rather discouraged.

- B.D. and G.C.

The Great Experiment: from Newspaper Accounts 1885-1886

"I have a very personal affection for a transformer," William Stanley once said. "It is such a complete and simple solution for a difficult problem…"

That simple solution didn't come easily, however, as he worked virtually alone in his makeshift laboratory in the Berkshire hills that winter of 1886.

Following is an annotated history of Stanley's experiment as described week by week in the pages of the Great Barrington newspaper, *The Berkshire Courier*.

William Stanley Jr. of Pittsburgh, Pa., was in town a few days last week. He expects to spend the summer here, with his family.

- April 22, 1885

Stanley was frustrated with his employer's seeming blindness to what he felt was a sure solution to developing an alternating current transformer system. But he remained determined: "… I finally made up my mind to employ my own money for the construction of a plant which would demonstrate beyond peradventure the value of my work," he told his biographer, Harry Douglas.

He packed his family and a small induction coil (or transformer) and set off for Great Barrington in early July.

William Stanley Jr. has leased the 'Rubber Factory' for a term f years, and will occupy it at an early day. It is to be a laboratory for experimental work, in conjunction with Messrs. Westinghouse of Pittsburgh, Pa. A boiler and a 5-horse power engine will be at once set up, and some fine testing machinery, all of which will be under Mr. Stanley's direction. The building will be fixed up inside quite a little, and will make, when finished, a most excellent place for the proposed work. The town will also be a gainer, as besides Mr. Stanley making his residence here it will necessitate the coming of some experienced men who will also add to our population.

-Nov. 4, 1885

The rubber factory had been established on the east bank of the Housatonic River near Cottage Street by Horace H. Day in 1847. There had previously been a sawmill and gristmill on the same water privilege. Day manufactured vulcanized rubber footwear and waterproof cloth and clothing. The Berkshire Woolen Company, with a privilege just upstream, complained that Day's dam was infringing on its privilege. Day's dam was torn down, then rebuilt, and the matter ended up in court. Day was forced to lower his dam by 11 inches, and the loss in water power forced him to close his mill. It was still idle when Stanley leased it for his experiments.

William Stanley Jr. has purchased of Billy H. Hatch his place (on West Avenue), in this village, and will refit it for his own occupancy.

-Jan. 20, 1886

A Westinghouse Automatic engine, of 25 horse power, was received here on Friday, and will be used by William Stanley Jr., the electrician, in the laboratory he is fitting up in the building known as the rubber mill.

-Jan. 27, 1886

While direct current was the prevailing electrical system of the time, it was flawed; its inherent low voltage made it impossible to send an effective current over any distance greater than a mile, and even then the transmitting wires had to be huge.

As Stanley himself said, "It was the common saying of the day that, if one should attempt to light Fifth Avenue from Fourteenth Street to Fifty-Ninth Street, the conductors (d.c.) required would be as large as a man's leg."

He also observed, "The Edison direct current system was very strongly entrenched throughout the country, both because of the great prestige of Mr. Edison and because of the strong financial interests that were believed to be behind him. The Edison Company entirely failed to appreciate the distribution value of the alternating current system, and prophesied its speedy downfall."

Stanley recognized a flaw in the British Gaulard system – the need to place the transformers in parallel, rather than series, to maintain constant potential. His notebook entry for September 18, 1883 shows his solution.

"I realized that if we could make a transformer that would regulate the energy transformed by slight variations of its induced counter electromotive force in the same manner that a shunt-wound motor regulated for energy transferred by variation of its rotational counter electromotive force," Stanley wrote in *The Journal of the Franklin Institute* in June 1912, "the problem would be beautifully solved. I saw this analogy faintly at first, but soon with strong and clear conviction. I was very much excited by it… I told Mrs. Stanley, and, although she did not understand a word of it, she saw it too."

Reminiscing in the February 15, 1902 issue of *Electrical Review*, Stanley said "It is to be remembered that at this time, that is, in 1885, there were no alternating current machines built in America. The only transformers or induction coils that I knew of were three of four or more of the Gaulard type that had been imported from England.."

The introduction of the electric light is soon to be an accomplished fact. Mr. William Stanley Jr., the electrician, has placed globes for incandescent lights in R.I Taylor's store, and as soon as the wires are ready the lights will be used. The store of C.H Lillie is to be similarly embellished, and soon we will be a city with all the fixings.

-Feb. 17, 1886

From the laboratory 4,000 feet of No. 6 Underwriters wire was strung along conductors and fastened to elm trees along Main measuring of the voltage drop in the system under a variety of load conditions. Lamps of 16, 50 and 250 candlepower were installed in the subscribing stores and hotels. A half dozen transformers housed in wooden boxes were placed in the basements of the various buildings.

Messrs. William Stanley Jr. and L.L. Jenkins left town, this morning, for a trip South, probably making quite an extended journey.

-Feb. 24, 1886

Coincidentally that winter, a conventional Edison direct current generator was being put into operation at the Hopkins mansion.

A BRILLIANT SPECTACLE During the last few evenings the Hopkins premises have been brilliantly illuminated upon the balconies and piazzas of the homestead, while the interior of the new home was brilliantly lighted, as were the surrounding grounds. The plant is located in the basement of the new house. A fire engine is also located there, connected with Lake Mansfield, and stands ready to promptly extinguish any fires that may break out upon the works.

-March 10, 1886

William Stanley Jr., who has been taking a trip South, returned, on Monday, much benefitted.

-March 10, 1886

The wires to be used in lighting the electric lights in R.I Taylor's and C.H Lillie's stores, were strung last Saturday.

March 10, 1886

R.W Pope, in remarks printed in the "Great Barrington, Mass., Town Diary 1676-1911," observed the drawbacks of direct current transmission: "The area which could be served from a central station was then limited to about 16 square miles. European engineers were grappling with the same problem. A British patent issued to Gaulard and Gibbs had directed attention to the use of the alternating current and the well known induction coil. The proposed plan was not practical, but embodied the theory to be subsequently worked out. This was the mission, of Mr. Stanley…"

Stanley, developing his own version of the transformer, then known as a converter, nicknamed the device "the exhorter." As described by *The New York Herald Tribune* in March 15, 1936, the device "consisted of two stationary coils insulated from each other but coupled by an iron core. This simple piece of apparatus makes possible the easy changing of an alternating current voltage. In direct-current work, a motor and a dynamo are required t perform this function …"

The Stanley transformer was powered by a boiler, steam engine and alternating current generator in the old factory building. An unexpected hitch came in the grumpiness of the Westinghouse steam engine. As Stanley later observed, "I have frequently met, in a long and stormy life, serious and obstinate difficulties, but I have never encountered any mechanism, of any kind whatsoever, that possessed so profound a genius for going wrong as this engine."

One of the first stores to be wired for the experiment belonged to Stanley's cousin, R.I Taylor. Another 25 or so subscribers soon signed up.

Last evening the interior and exterior of R.I Taylor's store was lighted by three 150 candle power electric lights of the Stanley system. Two of the lights in the store made it as light as noon-day. A large number of business men were present to witness the effect, and were unanimous in their praise thereof.

-March 17, 1886

Stanley energized his system on or about March 6 and put it to practical public test on March 20.

THE ELECTIC LIGHTS Last Saturday evening an opportunity was afforded those who desire to witness the illuminations by the Stanley and Edison systems of electric lights. Two of the Stanley lights. Each of 150 candle power, were placed in C.H Lillie's drug store, with a thoroughly satisfactory result. A sixteen candle power light had been placed in Dr. F.P Whittlesey's office, and proved conclusively that a light of this size would be sufficient for any ordinary sized room. R.I Taylor's store had undergone a grand transformation. The cases and shelving had been altered to obtain additional room, the ceiling and sidewalls painted a very delicate blue tint, and new show cases are to be added as soon as received, everything was so fresh as paint could make it, while three 150 candle-power Stanley lights, one being outside the door and two in the interior, added the finishing touches. These lights are so powerful, and so perfectly white, that green and blue can be readily distinguished, though they cannot by gas light. A lesser candle power would have the same effect as gas or kerosene light. H.A Brewer's store was lighted by eighteen 16 candle power Edison lights, making 288 candle power in all. Dividing up the power into so many lights failed to show how strong it would be if concentrated into two or three single lights, so that a comparison of the two systems was difficult, although the majority of those who viewed the results, seemed to favor the Stanley lights. With two such enterprising parties as Messrs, Stanley and Bodwell (H.N. Bodwell, superintendent of works at Hopkins mansion) interested there seems to be little doubt but that, in the near future, the stores and houses, and perhaps the streets of our village will be generally and thoroughly illuminated.

- March 24, 1886

"We made a gala night of it," Stanley said later. "The streets and stores were crowded with people, the big 150-candlepower lamps were running at about double their candlepower, and my townsmen, though very skeptical as to the dangers to be encountered when going near the lights, rejoiced with me."

Great Barrington historian Charles J. Taylor wrote: "The little plant in Great Barrington worked. It did more. It gave evidence to the incredulous that to William Stanley was due a system of distribution capable of indefinitely extending limits over which electricity could be publicly served

through very small conductors. That night Mr. Stanley himself threw the switch in the little rubber factory and sent the village light by means of two number eight wires fastened by insulators to trees…"

Observed Laurence A. Hawkins in his "William Stanley (1858-1916) – His Life and Work," "The Great Barrington installation was *the first attempt ever made to transmit high voltage alternating current by the principles employed today*…"

Stanley himself, recalling the experiment for the American Institute of Electrical Engineers' dinner in Pittsfield in 1911, explained: "As there were no alternating-current machines at hand, I borrowed a Siemens machine of Mr. George Westinghouse that he had imported from England, and constructed about a dozen transformers… each of which was wound to reduce the 500 volt main-line potential to 100 volts in the secondary circuit. This work took me most of the winter of 1885 and it was until along in the spring of 1886 that the generator was set up and connected, the transformers were completed, tested and erected in some of the stores of the village of Great Barrington where they were put into service on a regular commercial basis.

"Crude as the apparatus was," he continued, "with all its faults of design and construction, it operated in a marvelously beautiful manner, and thoroughly satisfied me that I had a system of distribution which was capable of indefinitely extending the limits over which electricity could be publicly served."

William Stanley Jr. left town on Monday on a business trip to Pittsburg, Pa.

March 25, 1886

MORE LIGHT ON THE SUBJECT C.J. Burget's grocery store is to be lighted by Stanley incandescent lights. A large 150 candle power light will be placed in the center of the store, and one 25 candle power light in each window. A.S. Fassett's store is to be lighted by Edison 16 candle power lights, while the Miller House office is being brightened and lightened with new wall and ceiling paper, and the introduction of four 16 candle power Edison lights, an additional light is to be placed on the front stoop. The Stanley lights will also be located in the following places: The post office, Morgan's News Room, E.E. Church's billiard parlors, J.A. Raifstanger's, C.G. Jerome's and N.C Williams' barber shop, Dr. H.A Atherton's, Dr. Samuel Camp's and Dr. F.P. Whittlesey's offices, Dr. W.P Small's office and residence, C.A Dewey's store, the Berkshire House, Samuel Sanford's and H.A. Bristol's markets, F.P. Perry & Co.'s and G.W. Briggs' shoe stores, Collins & Wheeler's office, Willard's pharmacy, L.B. Brusie's restaurant, Wier & Leonard's stove store, E.E. Barnes' grocery, Tobey's jewelry store, Mrs. Costa's residence, Dr. W.H Park's rooms in the Mahaiwe building and probably in G.W Mellen's store and Hon. Justin Dewey's and C.N Gilbert's residences. The Stanley lights have also been placed in R.I. Taylor's and C.H. Lillie's stores, while the Edison lights are already in J.A Brewer's, H.J. Mignery's and F.T. Whiting & Son's stores and Dewey & Wright's office. Taking it all together the town bids fair to be the most thoroughly electrified one in this portion of the state.

-March 31, 1886

The light from the Stanley laboratory was shut down on Monday evening, between seven and eight o'clock, on account of a hot journal in the new two hundred light Dynamo that had just been put in.

-April 7, 1886

THE ELECTRIC LIGHT The wires for the lighting of electricity have been placed, since last chronicled, in the City store and the Miller House, which use the Edison system, and the stores of C.J. Burget, M.E. Tobey and George W. Briggs and F.P. Perry & Co., on the Stanley system. The first two mentioned were lighted on Saturday night, as was also C.J Burget's, the others will be started up shortly, with a number of other takes on this side of the stret, the connection being made at once. The electric light business seems to be the most active, just at present, of any in town.

-April 7, 1886

In that same issue, Stanley wrote the newspaper's editor pointing out that a report from the *Journal of the Franklin Institute* which found the Stanley system to be of greater average efficiency than those of Edison, Woodhouse & Rawson, White and Weston.

Last Saturday night the stores of M.E. Tobey and G.W. Briggs, and the barber shop of N.C. Williams were lighted by the Stanley electric lights. It was common talk that the light from the system, on this occasion, was the finest ever seen.

-April 14, 1886

Messrs. W.C. Kerr and W.W. Church of the firm of Westinghouse, Church, Kerr & Co., of New York, arrived in town, on Monday evening, and spent Tuesday in looking over the laboratory of William Stanley Jr.

-April 28, 1886

The Stanley Electric Light System has been put in the following stores and they are each night lighted in fine shape. F.P. Perry & Co., C.W. Norton & Co., C.A. Dewy, Collins & Wheeler's office, and C.G. Jerome's barber shop. Wires have been put in Morgan's News Room, and the Post Office, R.H. Moore's store and E.E. Church's billiard saloon and J.A. Raifstanger's barber shop and all will be shortly connected and lighted.

-April 28, 1886

Once Westinghouse witnessed the Stanley system in operation, he lost little time putting it into large-scale test and production. Noted Stanley in 1911, "The results of this visit soon took form in the development of the Westinghouse Electric Company which installed the first alternating-current station in this country, after the Great Barrington plant, in Buffalo in the fall of the same year."

The electric light from the Stanley system was turned on last night at Morgan's News Room, the Post Office, R.H. Moore's, E.E. Church's and J.A. Raifstanger's. All of these places being very much better lighted than they have ever been before.

-May 5, 1886

William Stanley Jr. is having the house recently purchased by him of Billy H. Hatch painted and otherwise improved, preparatory to his occupying it.

-May 12, 1886

The office of Dr. W.W. Rice is now illuminated by the Stanley electric light.

-May 12, 1886

A slight fire occurred on Saturday night, between the post office and R.H. Moore's, caused by the electric light wires getting crossed, and the insulator worn off, so that the wires touched. It was immediately discovered and what little fire there was extinguished and the defect remedied.

-May 12, 1886

Stanley observed in 1911, "As I look back on the plant now I tremble for the safety of the inhabitants of Great Barrington while these experiments were being tried. We did not have oiled insulation or oiled cloth in those days, but separated our primary and secondary units with shellaced paper and various other substances of an equally fragile nature; but all went well with the system, no accidents occurred and no dangers, other than a small fire, were reported until an attendant dropped a screwdriver into the armature of the Siemens machine and entirely ruined it."

William Stanley Jr. is soon to erect a barn on his newly purchased place.

-May 12, 1886

The Stanley system of electric lighting is being put in the Berkshire house, by Mr. Tichnor.

-May 19, 1886

The Stanley electric light system met with quite a serious break, Wednesday evening, by the armature of their large dynamo breaking, which has prevented them from lighting up until now, and it will probably be several days before they will be in running order again.

-June 23, 1886

ELECTRICAL J.A. Brewer is re-arranging the electric lights in his store, more particularly those in his windows which, when re-organized, will make a very handsome effect. Wires have been carried across the street from Mr. Brewer's building to the Miller House, which will soon light its dining room and parlor by electricity. These are all lighted by the Edison system, which is giving great satisfaction. The wires from the same system are being strung in A.L Hubbell's clothing store, and soon he will discard gas, at $4.80, and light up by the great modern and convenient light.

-June 30, 1886

Also coincidental with Stanley's Great Barrington endeavor, a trio of Hungarian scientists, Deri, Blathy and Zipernowski of the Ganz Company, developed a system of parallel connected tranformers and demonstrated its practicality.

Stanley in later years freely admitted that, if he hadn't undertaken his experiment, "we would still have had the system from Budapest without essential modification."

With this system prematurely shut down, his experiment a success, the inventor made fine use of is time, as the following news item indicates.

R.I. Taylor and William Stanley Jr. expect to start, next week, on a fishing trip to Tadousac, Canada, at the mouth of the Saguenay River.

-July 7,1886

The power plant at Searles Castle continued to serve customers until late 1887. And the Great Barrington Electric Light Co. was formed in 1888. Great Barrington had entered the modern electric age.

STANLEY AND WESTINGHOUSE

There was far more to William Stanley's relationship with George Westinghouse than has been recorded in the history books. Letters in the inventor's files show he felt he was repeatedly deceived and cheated by the industrialist.

Westinghouse's biographers usually credit him with directing and supporting Stanley's transformer research. As one gushing American Society of Mechanical Engineers commemorative booklet in 1937 put it, "…in less than three weeks from the time he first saw a transformer, he (Westinghouse) made an outstanding contribution as an inventor…"

Stanley in a letter to Charles F. Scott in 1915, a year before his death, revealed a contrary view.

"…It was with the greatest difficulty that I finally succeeded in placing a clear understanding (of how to improve the Gaulard and Gibbs patent) before Mr. Westinghouse and Mr. Pope. Mr. Westinghouse declined to furnish me the money to build and try out this system…"

LUCIEN GAULARD (1859-1888) was a Paris-born manufacturer of explosives. When he moved to London, he worked as an electrician. He invented a thermoelectric generator and with partner JOHN D. GIBBS devised an alternating current transformer system in 1884. It and subsequent transformer systems drew inspiration from the 1831 discovery by MICHAEL FARADAY (1791-1867) of the principle of electrical induction.

Thomas P. Hughes in "Networks of Power" concludes that Westinghouse was, in fact, in favor of developing an alternating current system, "but not Stanley's approach to it." Westinghouse executive H.M Byllesby in a 1922 letter averred that "no one in the organization, excepting Mr. Westinghouse himself and dear old Frank Pope… had any real expectation of anything coming out of the alternating current system."

Under Stanley's revised December 1884 contract with Westinghouse, Westinghouse set what Stanley described as "onerous conditions" while "he derived all the benefits accrued from the work."

Westinghouse agreed to purchase $25,000 worth of Stanley's company securities for $12,500 and pay same at $1,000 per month. He would also pay Stanley for services the sum of $4,000 a year, $1,000 less than his previous salary. He would also contribute $200 each month toward general laboratory expenses.

In return, Stanley was to offer any first rights to any invention to Westinghouse.

Stanley soon proved the merits of his system. But when credit for the device began to fall on Westinghouse, he complained. At the urging of his lawyer father, he secured a new contract in 1890 which called for Stanley's name to appear on the products "for the reason that I and my father objected to his stealing the credit for our work…"

Stanley made an even more serious charge in his 1915 letter. "As soon as Pope had persuaded Westinghouse of the value of this system," he said, "Mr. Westinghouse instructed him to take the information which I had given him and secretly draw up a new patent specification…" According to Stanley, Pope approached several European electrical inventors, looking for one to assume the transformer system as his own."

*MAX DERI (1854-1938), OTTO GITUS BLATHY (1860-1939) and CHARLES ZIPERNOWSKI (1853-1942), Hungarians working for the Ganz Company, devised a system of parallel-connected transformers and demonstrated its practicality in 1884-85. They recognized, as did Stanley, the disadvantages of the series-connection in the Gaulard system. Italian SEBASTIAN ZIANI de FERRANTI (1864-1930) in 1886 also saw the need for the parallel connection; he was chief engineer for Sir Coutts Lindsay and Company. The only alternating current generator available to these early investigators, including Stanley, was one developed by WERNER VON SIEMENS *1816-1892), a German inventor.*

"Mr. Pope proceeded to Paris and saw Marcel Deprey, Hospitalier and the others," Stanley charged. "In England he visited Dr. John Hopkinson, Gaulard and Gibbs, Ranklin Kennedy and a number of other engineers, all of whom he invited to claim authorship of this specification. He was received by these various parties in various ways. Hospitalier indignantly repudiated him; Marcel Deprey was eager to sign, but did not convince Pope that he would be a good author, Dr. John Hopkinson turned him out of the place, Rankin Kennedy claimed part of the invention, while Gaulard and Gibbs, delighted to get the money, eagerly signed for the sum of $16,000."

Stanley learned of the deception, but not before a patent was secured. Stanley and his father, both Westinghouse stockholders, thwarted an attempt by Westinghouse to pay himself $3,000,000 in stock for acquiring the foreign patent – "this caused a rupture between us which was never healed."

To establish the value of his patent, Westinghouse brought suit against the Sun Corporation of Woburn, Massachusetts, in 1888. Stanley had injudiciously told Sun owner Marmaduke M. Slattery of his system, and Slattery had crudely copied it. Westinghouse, according to Harold C. Passer in "The Electrical Manufacturers 1875-1900," had in 1887 successfully used the Gaulard and Gibbs patent to secure a royalty agreement with the Thomson-Houston Company. The Sun suit,

however, was decided against Westinghouse, and a patent was issued to Slattery. The decision found that Westinghouse's patent was strictly for an electrical system in series, not in parallel as Stanley had developed and Sun had apparently copied.

As by court testimony Westinghouse was using a system identical to that of the Slattery patent, Westinghouse was in trouble. He sought Slattery's aid.

Stanley, who had retained his notes on his 1885 work, was confident he would have little difficulty establishing his claim. He said he "worried" Westinghouse officials for a while before agreeing to sign a patent application.

Stanley said he took his father's advice, finding it "better to help out a rascal if your friends were with him than to try to punish him. So I agreed to go in and fight the Slattery patent…"

With the stipulation that he could make the invention himself if he chose, Stanley assigned his patent claim to Westinghouse without any remuneration whatever.

(The matter was far from over. In 1902 Westinghouse brought suit with an amended Gaulard and Gibbs patent against the Stanley Electric Manufacturing Company, charging infringement. A court decision found that Westinghouse could not simply drop a previous disclaimer which said the system was only for series connection.)

Some of Stanley's charges in his patent situation have not been corroborated. Stanley's son Harold in a 1953 letter to his brother George admitted he "didn't know anything except rumors about the trouble between Father and Westinghouse" and that he found only technical information contained in the Slattery court testimony.

Stanley remained at odds with the manufacturer for years, even while continuing work as a consultant to the firm. In a letter to Pope in June 1888, he complained that O.B Shallenberger, who had succeeded him as chief engineer at Westinghouse, had filed a patent application "after the agreement between us that neither applicant should file an application without conference being held."

A few weeks later, he complained to Westinghouse by letter that P.B Smith had applied for patents "for my method of treating carbons… by applying an automatically decreasing potential to the filament in proportion to the decrease of its resistance."

Why did Stanley stay with Westinghouse as long as he did? Probably because he enjoyed working for a large firm with its resources and guarantee of manufacture. Also, he hoped to collect what was due him financially. Fellow Westinghouse inventor Tesla was said to said to have been offered large sums of for his polyphaser motor patents but never received it at all.

NIKOLA TESLA (1856-1943), Hungarian-born inventor, came to the United States in 1884. He devised a system of arc lighting in 1886, the Tesla motor and system of alternating current power transmission two years later, the Tesla coil or transformer in 1891 and a system of transmitting electricity without wires in 1897-1905.

Stanley, poor at managing his own business affairs, had a strong ally in his father, William Stanley (1828-1893), a member of the New York firm of Stanley, Clarke & Smith.

The inventor, earning a yearly salary of $10,000 a year in 1889, proposed trading all his electrical inventions for $24,000 cash, with the plea, "I can't help thinking that what I did for the alternating system was what practically introduced it…"

Striking off on his own, Stanley established a manufacturing company in Pittsfield which enjoyed quick success. It produced the largest transformer ever built to that time, in 1893, and shipped it to a Pittsburgh customer – right in Westinghouse territory. It must have given Stanley some satisfaction.

There's some irony in the 1895 death of Stanley's sometimes nemesis, Pope. Pope died in his Great Barrington home, zapped by 2,000 volts of electricity while tinkering on a transformer in the basement. Stanley and fellow inventor Weston, taking part in the inquest, testified that he died, not from the electricity, but from striking his head while falling.

Westinghouse in 1890 challenged Stanley's second manufacturing firm, the Stanley Instrument Company, maker of watt-hour meters, with patent infringement. The decision – discussed in another chapter – closed the Stanley firm's doors.

The inventor aired his thoughts on the American patent system in 1903, in an article for *Electrical World and Engineer* in which he said, in part, that "testimony should only be given by qualified experts satisfactory to the court."

Years later, son Harold Stanley alleged that Westinghouse once approached the inventor's estate gardener in Great Barrington and attempted to bribe him to take certain patent papers form the library. He refused, but that night the house was broken into and the patents taken.

This, according to Edison biographer Hugh Russel Fraser, "Throws a corroborative light on Edison's claim that Westinghouse burglarized the Menlo Park laboratory."

Commented Stanley biographer Hawkins in a 1952 letter to George Stanley, "He (William Stanley) naturally resented the omission from the publicity accompanying Westinghouse's exploitation of the a-c system of any mention of his achievement in creating that system. He resented what he reasonably believed were misinterpretations and distortions of the people involved in the patent litigation which forced the Stanley Instrument Company out of business. He had plenty of ground for feeling he had ben shabbily treated."

STANLEY IN PITTSFIELD AND THE GROWTH OF GE

Having successfully demonstrated the practical use of alternating-current transmission, inventor William Stanley remained with George Westinghouse's electrical company as it began to manufacture alternating current equipment. He resigned as chief engineer in 1888, during a slack fiscal time with the firm, but continued as a consultant until 1890.

Meanwhile, he pursued new interests in the Berkshires.

Edward Boltwood in his history of Pittsfield explains that the Edison incandescent electric lamp was introduced to the city in 1885. An electric light company was organized and subscribers signed up.

Two years later, in 1887, the Pittsfield Illuminating Company was formed, with Stanley as president. Its power plant was in the Robbins & Gamwell shop on West Street. This venture soon merged with the Pittsfield Electric Light Company (incorporated in 1883) and became the Pittsfield Electric Company, William A. Whittlesey treasurer. That firm had a brick office building on Renne Avenue.

Inventor Stanley was soon hard at work in Stanley Laboratory, on the second floor of the Renne Avenue building. The laboratory would serve as consultant to the soon-formed manufacturing company.

Working with Cummings C. Chesney beginning in 1890 and John F. Kelly, who joined in 1892, he developed the SKC transformer (taking its initials from the three men).

Experiments were conducted in alternating current transmission on "Colt's lot," at the intersection of Colt Road and Wendell Avenue. Wires were strung to test the alternating current motor to transmit power.

Stanley joined with William W. Gamwell (1850-1913), William R. Plunkett and Whittlesey to find financial backing for the Stanley Manufacturing Company. It had an initial capitalization of $25,000. Charles Atwater (1853-1898) was first president.

The company began operation in January 1892 from a factory on Clapp Avenue. The first units were shipped in April. Chesney was works' engineer, John H. Kelman shop superintendent, Henry Hine sales manager.

In 1891 the company built the first 100-light transformer used in the country; and it became the first to build transformers of 10,000 volts and higher. The 4,000 kilowatt transformer made in '93 for a Pittsburgh customer was the largest of its kind in the world.

Stanley is quoted in Hawkins' biography regarding the success of the SKC system as follows: "I honestly think we did pretty well. While the other fellows were writing articles to prove that efficient transformers must be limited in size, we were building them larger and larger, and constantly increasing their efficiency.

"I believe we turned out the first commercial condensers for the alternating current in Pittsfield. We used them to furnish the magnetizing current for our motors.

"I had already designed at Great Barrington what is known as an "induction alternator" but it was vastly improved in Pittsburgh by Messrs. Chesney, Kelly and myself, and became an important factor in our success…"

CUMMINGS C. CHESNEY (1863-1947) joined William Stanley's laboratory force in 188, fresh out of college. He went on to work with the U.S Electric Lighting Company in Newark, New Jersey, in 1889-90. He was one of the incorporators of the Stanley Electric Manufacturing Company in Pittsfield in 1890, serving as first vice president and chief engineer. He continued in this capacity when, in 1904, the firm became the Stanley G.I. Electric Manufacturing Company. He was manager of the Pittsfield General Electric works from 1906-27. He was awarded the Edison Medal in 1933. A pioneer in electrical improvements including the first polyphase electrical power transmission. He also designed alternating current generators for high voltage use.

The company soon was also making switchboards, motors and generators. It grew quickly, and moved into the new quarters on Renne Avenue in 1893, employing 300 hands.

The Stanley Laboratory was absorbed into the manufacturing company in 1895.

Electical Engineer took a tour of the Stanley plant, publishing a description in its February 27, 1895 issue. This is a brief excerpt dealing with the first gallery above the main floor: "At the end of the gallery is the punching department, where the armature and inductor plates of the alternating machines are punched out of sheet iron, the punching department being quipped with the latest Ferracute, Bliss and Eaton punch presses. Beyond this is the tool room, equipped with Pratt & Whitney shapers and planers, Garvin, Barinerd, and Becker milling machines… and around on the east side are the Pratt & Whitney and Jones & Lamson bolt and screw cutting machines and other special machinery for small work by Sloane & Chase…"

While working in Pittsfield, Stanley lived with his family in a home on Dawes Avenue. The property was subsequently owned by Max Butler.

John Forrest Kelly (1859-1922) was a chemist in the Edison laboratory in 1879, then worked for Western Electric Company from 1879 to '82 and Parker Electric Lighting Company until '84. He was an electrician in the Westinghouse Electric Company's Newark shops until 1892, when he joined the Stanley Laboratory in Pittsfield. He served as a consulting engineer to the Stanley Electric Manufacturing Company in Pittsfield and the Stanley Instrument Company in Great Barrington until 1905, then helped the Telelectric Piano Company in 1905, serving as president until '10. He experimented in electrical transmission, distribution, and measuring procedures and equipment; with Chesney and Stanley, he developed the SKC transformer.

In December 1893, Stanley through his laboratory set up a polyphase power transmission system at the power station at the Stockbridge Furnace, on the Housatonic River, going to the Monument Mills textile factory in Housatonic and on into Great Barrington, for a total of eight miles. The system remained in use until 1912. Supervising the project was Franklin Pope.

Boltwood observed that the Stanley firm, unlike some older electrical companies, was not burdened by the expense of years of experimental work. Its engineers were yound and talented and able to rapidly expand.

"But the rapid expansion of its business, although very profitable, compelled the carrying of a larger and larger amount of raw material and of the material in process of manufacture. The money market at the time was stringent. The financial managers of the company were not seldom embarrassed by lack of capital…"

Capital gradually increased, to $500,000 in 1896.

Desperate for new capital, the Stanley Morningside factory was sold in 1899 to Ferdinand W. Roebling, of the John A. Roebling Sons Company of Trenton, New Jersey.

There was great uncertainty in Pittsfield whether the firm would stay. Nevertheless, more buildings were put up in Morningside, including one 90 by 500 feet. Employment rose to 1,200.

Roebling sold to General Electric Company in 1903. That company had been formed in 1892 by the merger of the Edison General Electric Company of Schenectady, New York, and the Thomson-Houston Company of Lynn, Massachusetts, a firm established by electrical inventor Elihu Thomson.

JOHN H. KELMAN, first plant superintendent for the Stanley factory in Pittsfield, numbered among his inventions the use of oiled cambric cloth for transformers. He also invented the vacuum system if impregnation for electrical insulation. Kelman met Stanley while both worked for Westinghouse. He came to Pittsfield at the same time Kelly and Chesney did.

The Stanley company was merged with the General Incandescent Arc Light Company and called the Stanley G.I Electric Manufacturing Company. The Stanley name was maintained until 907 (and is still visible on one building in the GE complex today).

The GE plant grew like Topsy; all transmission product production was moved here. In 1912, some $425,000 was spent on building construction. Floor area was increased to 1,600,000 square feet. In 1915, there were 22 factory and 22 out buildings. Output in 1915 was, according to Boltwood, "transformers aggregating 4,800,000 horse power, 300,000 electric flat irons, 168,000 electric fans, and 24,000 small motors…" The plant employed 6,000 people – a sixth of the city's population.

Chief officers of the GE operation were W. Murray Crane, president, Gamwell, treasurer, and Chesney, a vice president and supervising engineer.

(For a more complete history of General Electric in Pittsfield, see the "Morningside Becomes Electric" chapter of Willison's history of Pittsfield and the "GE Jubilee" publication of *The Berkshire Eagle*. For a detailed overview of the electrical industry of the era, see Harold C. Passer's "The Electrical Manufacturers 1875-1900" and Thomas P. Hughes' "Networks of Power: Electrification in Western Society 1880-1930.")

Stanley remained a GE consultant for a few years, with a shop on West Street.

Then in 1898, he removed to Great Barrington to undertake a new enterprise.

THE WATT-HOUR METER

William Stanley's sales success with his Pittsfield electrical factory didn't translate into immediate financial success. There were cash flow problems and he was forced to sell his stock to secure new capital.

In 1895, he returned to Great Barrington to establish a new factory. It was called the Stanley Instrument Company and it manufactured and sold electric watt-hour meters designed by Stanley and Frederick Darlington.

As the generation and distribution of alternating current became practical and more widely used, it became imperative to devise an accurate method of measuring the consumption of electrical power of that type. Meters for measuring direct current consumption were common, but the rapid reversal of electric potential (now standardized in the United States and elsewhere at 6 cycles per second) caused the moveable elements of the meter to vibrate with consequent severe erosion of even the hardest jewel bearings. Meters ran too slowly under the drag of poor bearings and failed to measure all the power consumed and would not even respond to small loads. Power companies were therefore deprived of their just revenues.

A writer in an industry magazine asserted in 1899 that "the actual loss attributed to this source alone frequently amounts to four, five or six percent of the energy delivered to the consumer…An instance of common occurrence is that of one lamp-burning perhaps 12 hours per day. Through a meter of, say, 50 lights capacity, its current, which would show no record, would amount to 360 lamp-hours per month, 4,320 lamp hours per year or (were the average daily use of the entire installation from one to one-half hour per day) from 24 to 48 per cent of the current recorded and charged for. It needs no mathematical demonstration to show that a meter which would record *freely* and *accurately* the current of any number of lamps, from a single 8-cp

(candlepower) to the maximum for which it is designed, would not only avoid such failures , but prove a most excellent investment as well."

Stanley first applied himself to the problem of overcoming this difficulty in 1892, but it was not until 1896 that he really got down to work upon the problem. He drew upon the talents of Darlington of Great Barrington (whose daughter, Helen D. McCandless, lives on Alford Road there), with whom he had earlier worked while in a consulting capacity for the Westinghouse interests.

Stanley ran through a wide variety of materials for use as bearings: the harder jewels, bronzes and even leathers but none availed to withstand the constant vibration of 120 alternations per second.

But this native ingenuity again came to the fore; he conceived of a rotating disc with a spindle to maintain its position, but with no bearings at all: the assembly was suspended in air by "magnetic flotation." Stanley and Darlington also devised the circuitry to effect the multiplication of volts by amperes (potential times current). They found that the Hungarian, Blathy had already devised the same circuitry, so they bought the patent. They applied themselves to the technical problems inherent in achieving a practical, frictionless suspension, such as is the heart of the watt-hour meter in common use today. The disc, which revolves with a speed proportional to the power used, drives a chain of gears that advance dial pointers.

The technical consideration of "power factor" intrudes here, as a characteristic of alternating current, but suffice it to say that the meter indicates the product of *effective* volts by *effective* amperes to give the true power in the circuit. Stanley and Darlington were awarded patent No. 606,795: Electric meter, on July 5, 1898. Other relevant patents along the way were No. 588,666 to Stanley and Darlington: Means for supporting rotating shaft, August 24, 1897: No. 590,777 to Stanley: Magnetic brake, September 28, 1897; No. 658,814 to Stanley and Herbert M. Smith: Means for delicately suspending moving parts, October 2, 1900; No. 720,979 to Stanley: Improvement in meters, February 17, 1903.

Once he developed his watt-meter, Stanley set out to interest the businessmen in Great Barrington in supporting its manufacture.

The Taylor-Maclean "History of Great Barrington" tells the story:

"The Stanley Instrument Company, in 1897, was organized with a capital of $75,000. The officers were as follows: Clerk, John S. Fuller; treasurer, John H.C. Church; directors, William Stanley, Charles C. Huntley, William H. Brown, Frederick Darlington, John L. Dodge, Parley A. Russell, John B. Beebe, Frank H. Wright. At a meeting of the directors, Frank H. Wright was elected president, William Stanley vice-president and engineer and Frederick Darlington manager… In the

spring a shop was built at the corner of Church and River Streets. Work at this shop started in summer of 1898. Among the specialties to be manufactured was an electric meter for which a patent had been granted in July 1898 to William Stanley and Frederick Darlington.

FREDERICK DARLINGTON (1867-1943) worked for Westinghouse, United Electric Light & Power and Brush Illuminating before joining Stanley in his scientific investigations in Great Barrington 1898-1903. He later rejoined Westinghouse from 1905-12. During World War 1, he was consulting engineer to the Sperling interests in the early development of the Alabama Power Company and was chief power administrator on the War Industries Board.

"In September of the following year (1899) the capital stock of the company was doubled and the erection of a brick building started, the company having outgrown its quarters. Extensive improvement at the shops of the company were made in 1902.

Reported *The Berkshire Courier* for September 27, 1899: "Meters have been sent to all parts of this and to many foreign countries, and have met the approval of expert electricians wherever they have been used. Electric light producers everywhere have quickly recognized their superiority and the present demand seems likely to be only a premonition of the greater one which will follow."

"In October, 1899," records the Taylor-Maclean history, "the Westinghouse Electric Manufacturing Co. brought suit against the Stanley Instrument Co. for infringement of patent on an alternating current meter. This was the beginning of many years of litigation, which finally ended fatefully for this new but prosperous company and struck a heavy blow to many local investors and to the large number of hands employed. While this litigation was pending, the company prospered, additional land was acquired, the shops enlarged. The demand for the Stanley meter was increasing and the future seemed bright. Meanwhile the litigation over the patent went on, the so-called 'patent pool' persistently following up the case for several years. Several decisions favorable to the local company were made, but the final decision was against the… In 1907 the Stanley shops were permanently closed and the Stanley Instrument Company was dissolved"

Among Stanley's papers deposited in the Schaffer Library at Union College in Schenectady is his own version of the situation:

"In 1887 the lamented [O.B.] Shallenberger and the writer independently devised the induction meter. Comparison of the dates of invention by the late Franklin L. Pope resulted in an award of priority to Shallenberger by about 10 days. Shallenberger, however, produced the ampere-hour meter, while the writer devised the watt-hour meter. [This is a significant distinction, as the former records merely the current flowing over an hour's time, while the latter records the *power* used over an hour – the quantity of power consumed, which is what the electric company sells.] The watt-hour meter was first manufactured and put into commercial use by Blathy in Budapest in 1889. Owing to pressure of other work and lack of funds – a chronic condition – I did not attempt to

build my watt-hour meter until 1899, before which time no induction watt-hour meters were made in this country.

"Having purchased the United States Blathy patents, Mr. Frederick Darlington and I brought out the magnetic suspension meter in 1900. Although we owned fundamental patents completely covering our device, suit was brought against us by the owner of the Tesla patents, who claimed the split-phase motor as his own invention in spite of the fact that it had been devised by Ferraro in 1885 and disclosed in 1887. We defeated the Tesla patents in several courts, but eventually it was upheld by Judge Archibald (afterward impeached by the U.S. Senate), and, a decision having been rendered against us, we were compelled to abandon the manufacture of our invention."

In a technical discussion beyond the scope of this booklet, Stanley explained their system for determining the product of "the e.m.f. (electromotive force, or voltage) of the circuit and… the current," which is the power.

Stanley and Darlington were always working on improvements, even during the prolonged litigation, and were granted another patent, No. 941,467. "The invention, however," he continued. "came too late. The 'plaintiff' had systematically undermined the credit for their opponents, exhausted their slender resources and threatened and coerced their customers. The invention was not put into commercial use."

General Electric Company in Somersworth, New Hampshire, is a manufacturer of the common induction-type watt-hour meter. As indicated on a second meter outside my home, the Duncan Electric Company in Lafayette, Indiana, is another producer of William Stanley's invention.

- G.C.

THE VACUUM BOTTLE

Great Barrington's disappointment at the closing of the Stanley factory was brief. Never idle, William Stanley would soon bounce back with his vacuum bottle.

This invention actually grew out of Stanley's experiments with electric ranges and insulation.

Development of the unbreakable Stanley bottle was announced in *The Courier's* July 8, 1915 number. Stanley, who had gone to work for General Electric as a consultant after his previous Great Barrington venture closed in 1907, had experimented on thermal conductivity properties of various materials.

"Eventually," Stanley reported, "we found a new (insulating) method, which is the foundation of the new invention. The physics of the subject is too complicated to discuss here. My son and I have applied this new method to the insulation of metal receptacles of various kinds…

"These bottles not only possess remarkable thermal properties, but as they are made of steel are practically indestructible. In order to produce them commercially, it has been necessary to devise and work out special tools and machinery for rapidly welding together the parts. This work has been successfully completed."

The first vacuum-insulated container was the Dewar flask invented by Sir James Dewar in 1885 as a means of keeping heat away from the liquid gases with which he was experimenting. He sold the concept under the trade name "Thermos," meaning hot.

Stanley's earlier experiences with nickel-plating and with evacuating air from light bulbs found new use here. His bottle required an innovative welding process and the creation of a small vacuum between two metal shells.

In cooperation with engineers at GE, he came up with an electro-welding and immersion process which rendered reliable, invisible, leak-proof welded se ms.

Stanley's product, patented in 1913, lacked the glass core common to the Thermos bottle. The inventor instead used metal. He envisioned, and his company was soon making, a wide variety of liquid and food containers under the Ferrostat, and later Supervac, label.

WILLIAM STANLEY had some 129 patents to his credit, both singly and with O.B. Shallenberger, J.F. Kelly, C.C. Chesney, H.M. Smith, F. Darlington and H.P. Ball. The first was No. 344,331 issued in 1881 for a circuit closer for incandescent lamps. The last was No. 1,161,748 issued in 1915 for an electric heat storage system. Other patents were induction coils, dynamo-electric machines, self-exciting alternating-current electric generators, electric fuse boxes, improvements in meters and electric heaters. For listings of the patents, seen the Douglas and Hawkins biographies.

Stanley secured backing for his last venture from William H. Walker, who had purchased his Brookside estate in 1907. Walker became president of the new firm, Stanley vice president. Walker eventually took entire control of the company, and after his death in 1917, it was acquired by Landers, Frary & Clark of New Britain, Connecticut, which made the bottles under the Universal trade name. The firm remained in Great Barrington until 1933.

The Great Barrington factory was well into production when the late Edward Holohan got out of high school in 1918. "I went into the Army for three months," he said, "then came back and went right into the Stanley Shop." That was spring 1919… I was there a little over 10 years. It was a nice place to work, an asset to the town. At least 150 people worked there.

"At the same time," he recalled, "they made the pint, quarter and two-quart sizes. Later they began to make the carafe."

The production of the vacuum-insulated containers required complicated and precise welding techniques. "They had to get the separate parts welded just so before putting them together," said Holohan, who started out in the shop putting the thread on the neck.

He described the various steps that went into manufacturing the bottles. Raw sheet metal was cleaned in acid to remove oxidation then went to a machine room where it was stamped and pressed into shells, bases, necks, etc. Inner and outer shells were formed and welded separately, then fitted together and bonded.

The space between the two shells, he said, was filled with charcoal, then evacuated with a pump and the base was welded on.

Each step was carefully monitored. "They had inspectors checking them," he said. "Every once and a while, a speck of dirt would get in the weld and make it leak."

Some parts went through a nickel-plating process. Inside chambers were coated with enamel. "They'd inspect them with a light and a mirror down inside," he said, "to see if there was any spot that might have been missed when enameled."

One of Holohan's jobs at the plant was overseeing the marking of doughnut-shaped lead rings which were used in soldering the necks of the bottles.

The late Louis DeTour recalled that those working at the factory "earned what was considered a good wage, probably $20 to $25 a week." DeTour played outfield for the Stanley baseball team.

During World War 1, the Army tested the bottles by tossing samples from soaring airplanes and running over them with heavy field equipment.

In 1923, the Commerce Department also reported that Arabian Sheiks used the bottles in the desert. "All the Better Caravans Include Great Barrington Equipment - American Bottles Considered Superior" bragged a local newspaper headline.

The Stanley Bottle is still manufactured today by Aladdin Industries of Nashville, Tenn.

- B.D

STANLEY'S ZEAL

William Stanley is widely depicted as a pleasant, generous man.

"Stanley had a winning personality," according to the Taylor-MacLean "History of Great Barrington." "He was a combination of Apollo and Mercury… He abounded in hospitality and was generous to a fault."

Noted Hawkins in his biography: "William Stanley had entered upon his career without having had the advantage of a scientific education. A technical problem was always a stimulating

challenge to him, however, and, as his work progressed, his efforts to master the *useful* application of the mathematical, physical and chemical arts became tireless…"

Said his fellow inventor Chesney: "Mr. Stanley was primarily an inventor who seemed at times to accomplish his results by inspiration, and many times I have seen him, baffled at night after a long day of experimentation, return the next morning to his task with a solution that had come to him during the night…"

Stanley was incurably curious. John L.E. Pell recalled one time being in New York with the inventor when they met Tesla in a hotel. The two men began talking about electricity, drawing schemes and diagrams on the tablecloth. They continued to talk until Pell fell asleep in the chair beside them. They were finally chased out of the grill at 3 a.m.

According to the inventor's son, William W. Stanley, "Father's love for the out-of-doors was inherited from his father, my grandfather, who was not only fond of fishing and shooting as sports… but was even more fond of things that went with them in the country in spring, summer and fall, with the changes between one week and the next, the dogs and the horses that were a part of the performance in his time and the companionship that went with it."

Wrote Douglas of the inventor: His "grace of manner, warm, frank nature and engaging personality rendered him a welcome visitor and general favorite in the clubs and assemblages of the Berkshire capital, where as a conversationalist and raconteur, he had an exceptional reputation…"

In considering his philosophy over the years, Stanley once said: "I have had many hours in which to think of life and the queer problems of humanity, and I have arrived at this view. There are three things one must possess- Love, Human Sympathy and the High Ideal of Childhood – for these are of divine origin. Whatever else one gains he holds only as a trustee for others, for they are of human origin. They cannot enter into the spirit of man."

Stanley in later years traveled extensively in Europe and was made a member of the English Society of Electrical Engineers, the British Society of Arts, and the French Society of Electrical Engineers.

The American Institute of Electrical Engineers held its convention in Great Barrington in 1902, largely through Stanley's efforts. And the AIEE, meeting in Pittsfield in 1911, made Stanley the guest of honor to mark the 25th anniversary of the development of the alternating current system. He received the Edison medal for his work on the transformer.

The inventor himself, writing for *Electrical Review,* observed: "It is remarkable how little of modern electricity we all knew in those days, the terms of inductance, mutual induction, self

induction, armature reaction, transformer, converter, single-phase, multi-phase, hysteresis and a number more were unknown…"

Among the inventor's many homes in Pittsfield and Great Barrington, Brookside was perhaps the fanciest. Once the estate of wealthy businessman David Leavitt, Brookside was purchased by Stanley at the turn of the century. The mansion was destroyed by a fire in 1904. He began new construction – of a fireproof building – but sold the property to William Walker before completing it. Today it is owned by Eisner Camp Institute for Living Judaism.

Stanley's last home in Great Barrington was Chestnutwood on Maple Avenue, where the Great Barrington Healthcare nursing home is today.

William Stanley died May 15, 1916 in Great Barrington. He was survived his wife (she died in 1939), five sons and three daughters.

Stanley has been honored frequently in recent years.

-In 1936, General Electric and the local chapter of the AIEE sponsored a 50th anniversary celebration of the inventor's transformer experiment.

-In 1946, exercises were held on the Great Barrington town hall lawn under the sponsorship of Westinghouse Electric.

-In 1960, the first in a series of founders days honoring the inventor was sponsored in Pittsfield by the Association of Business and Commerce of Central Berkshire County Inc.

- In 1974, the town of Great Barrington dedicated a park next to the Cottage Street bridge – not far from the site of the old rubber plant where he conducted early experiments – in Stanley's honor.

- And in 1986, a special centennial celebration is planned in Great Barrington and Pittsfield under the sponsorship of the Berkshire County Historical Society, the Great Barrington Historical Society, the Berkshire Museum, IEE and General Electric.

Among area institutions bearing his name are the Stanley Fund, which is used to purchase equipment at Fairview Hospital in Great Barrington; the Stanley Library (established in the 1910s, now defunct) at General Electric in Pittsfield; and the Stanley Club in Pittsfield (established in 1924 and occupying five sites, the most recent a renovated barn on Wendell Avenue).

Stanley was also depicted in a fictional work by his grandson, Winthrop Knowlton (whose brother Hugh resides in Egremont). In the 1983 novel "False Premises," a colorful description is given of "Clarence Starcliffe's" experiment in "Ellsworth Falls."

-B.D.