

BURTON KINRAIDE IN JAMAICA-PLAIN
(MASS., V. ST. A.).

Selbstunterbrecher.

BURTON KINRAIDE IN JAMAICA-PLAIN
(MASS., V. ST. A.).

Selbstunterbrecher.

Fig. 1.



Fig. 2.

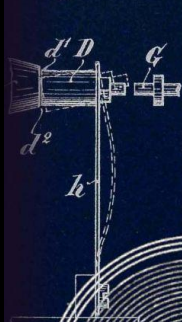


Fig. 3.

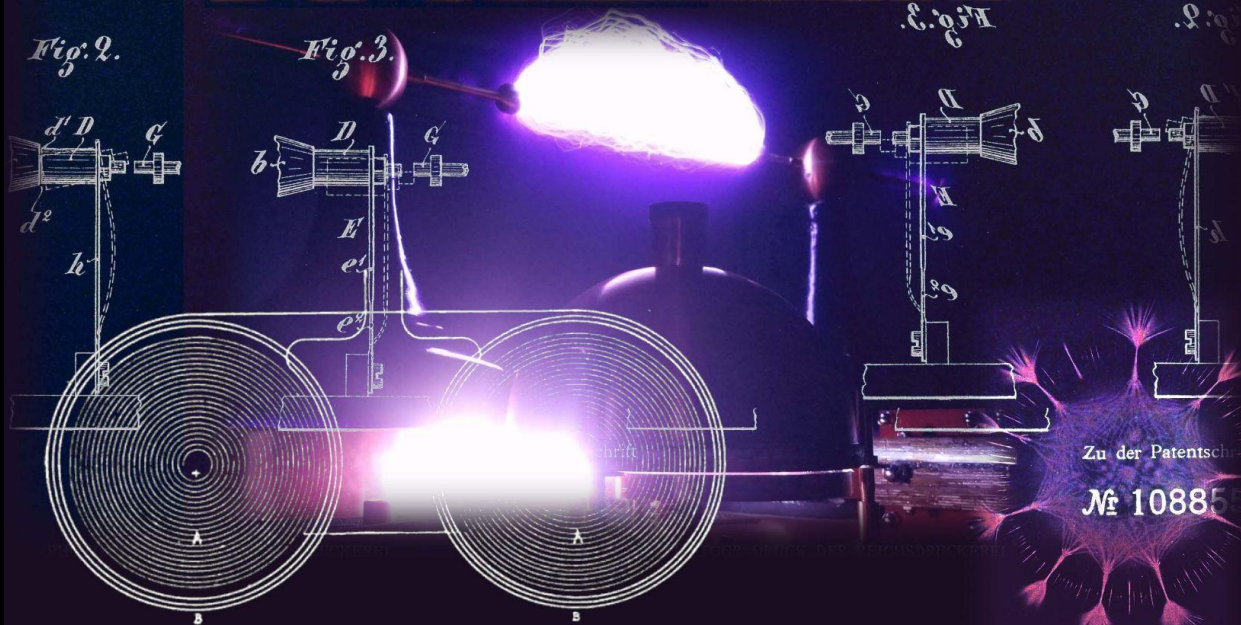
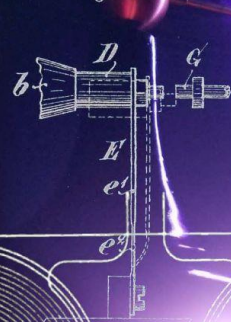


Fig. 5. Shows the arrangement of two coils side by side: A.A., secondary.
B, B, primary.

Zu der Patentschrift
Nr. 108855

**Compiled for Reference only.
Dedicated to the Kinraide family for all their help over the decades.**

**Also dedicated to my museum colleagues:
Frank Jones, John Grzywacz, Daniel Cuscela, Kelly McJilton, Bruce Rosenbaum
Graham Foulkes, John Jenkins, Chad Shapiro, Robert Campbell, Andy Wright, Litak Tirak**

**To the memories of William C. Wysock, James Hardesty,
Leland I. Anderson, Harry Goldman, William Terbo, Paolo Brenni**



Thomas Burton Kinraide: Photo scanned by Dottie Welch. All items are from the author's collection except where noted. Nikola Tesla letters were from the Nikola Tesla Museum in Belgrade. The Problem Of Increasing Energy was scanned by Curtis Philips. Century Magazine letters are from the New York Public Library.



Our story begins in the late 1890s, and for this compilation is ignoring the Keely Motor press releases. Those will be released in a separate volume, as they are the subject of a complete book on their own.

This compilation contains a selection of news articles pertaining to Thomas Burton Kinraide. The early articles pertain to his electrical research, electrical photography, coil development, development of the non-phosphorescent fluoroscope screens, Kinraide Coils, etc. Kinraide was the originator of the X-Ray Intensifier Screen with his first patent "Method of Converting X-Rays to Light for Photographic Purposes", Pancake-style flat-disc coils embedded in beeswax and rosin that became an industry standard for high frequency coils for decades, the first "quenched spark gap" that later revolutionized the wireless telegraphy field, and, unknowingly in his electrical photography work, the replication of Sprite Lightning on a laboratory scale.

This compilation also contains letters to and from Nikola Tesla, and excerpts of the large file Tesla kept on Kinraide. It also contains correspondence with Tesla's close friend Robert Underwood Johnson, who published an article about Kinraide in Century Magazine with the help of Anabel Parker. Johnson also arranged for the two to meet in person in New York. The article was published in Spanish (Arededor Del Mundo) as well as in Danish (Kringsjaa).

The later part of this compilation contains (often front-page) news of his very public separation from his wife Ethel (and mistress, Rachel - Ethel's mother). It was considered the most sensational separation in Massachusetts history in 1920.

This compilation is far from complete; however - it paints an interesting story of a man from the sensation of newspaper articles and the media, combined with scientific papers of the time. Spelling typos of Kinraid in period texts were left as original.



Electrical Review - New York - Jan 20, 1897

Discovery of a Non-Phosphorescent, Highly Fluorescent Crystal.

Until quite recently, the scientific world, and particularly those who have devoted time and study to the nature and theories of Roentgen rays, has accepted as a conclusion that fluorescent crystals could not be otherwise than phosphorescent. After a long series of experiments, carried on in the Spring Park Laboratory, Jamaica Plain, Mass., by Mr. T. B. Kinraid, a combination of chemical elements was found which is much greater in fluorescent power than calcium tungstate or any of the other salts, and is absolutely non-phosphorescent. So fully is the attribute of phosphorescence eliminated that when the screen, composed of fluorescent crystals, is exposed to the rays of the tube, the effect is instantaneous, showing the most vague shadows, which cannot be traced when Calcium tungstate is used. This discovery is likely to prove of great value in the practical application of X-Rays, and particularly in medical diagnosis its good qualities will be realized, because perfect control of the rays is possible, and no afterglow remains on the screen.

A representative of the Electrical Review was permitted by Mr. Kinraid to witness a demonstration of the results accomplished with this new non-phosphorescent crystal in the experimental room of the Spring Park Laboratory

Electrical Review - New York - Wednesday, February 03, 1897
A Proposed Experiment to Demonstrate that X-Rays Are Material.

In line with the theories advanced by Tesla, that Roentgen rays are particles of matter, Mr. T. B. Kinraid, whose researches and experiments relative to fluorescent salts have been of general interest to the scientific world, outlines a proposed test by which he demonstrates Tesla's theory.

In an interview with a representative of this journal, Mr. Kinraid said: "I want to take several methods, when I can make sure that I have the necessary time, to develop the following experiments, which I believe will show conclusively the nature of the unknown rays."

The test as outlined by Mr. Kinraid is substantially as follows: Two metal disks, one and one and a half inches in diameter, are to be made of a metal that is sonorous but has the power to intercept X-Rays. These disks are to be accurately and perfectly gauged, so that there shall be no chance for variation in their condition during the life of the experiment by being subjected to a long period of grading.

Each of these disks is to be supported on its center by a small stem which will permit it to have perfectly free vibration, and mounted on these disks are to be very delicate hammers, so that these hammers may start the vibration of the disks. The resonators are then to be connected by a tube, and from that tube a second tube will be connected, so that it can be taken to the ear. A difference in the vibration frequency must be arranged so that the difference can be reckoned per second.

One of the disks and its resonator will be enclosed in a thick metallic case, preventing any of the rays from passing through, and the other disk will be subjected to the amplified energy of a powerful Crookes tube, so as to concentrate all the energy possible on it.

Mr. Kinraid believes that if the X-Rays have any of the qualities of matter as we know it, they will produce certain phenomena in the metallic plate, and if they are physical matter, they will increase the vibration of the disk exposed to the rays and also the frequency of the other disk.

This variation will be instantly detected by the ear at the table, and the variation in the frequency of the two disks may be recorded.

Electrical Review - New York - March 24, 1897
An Improved High-Frequency Coil.

To one who has investigated the various methods of exciting X-Ray tubes, the early difficulties encountered in making an efficient tube seem not so surprising. The only instrument then available for excitation being the induction coil, it was then, as it is now, an extremely delicate undertaking to secure and maintain the right degree of vacuum.

Both manufacturers and manipulators of the induction coil agree that the correct exhaustion is the all-important consideration. This difficulty, being apparently insurmountable, led the laboratory department of the L. E. Knott Apparatus Company of Boston to continue its investigations in order to further perfect the high-frequency coil. It was early shown that with this instrument the question of vacuum was not of such great importance as had been supposed, the rapidity of discharge being sufficient to produce good X-Ray power with any reasonable degree of exhaustion.

During these investigations, a new and simple method of discharging the condenser with uniformity and rapidity was developed. The early coils of Hertz, Tesla, and others employed numerous devices to produce this effect, some of which were quite complicated. With these devices, "tuning" or changing the capacitance of the condenser to meet the varying current conditions was a difficult undertaking. Fortunately, this new device rendered this entirely unnecessary, as it was found by the L. E. Knott Company that the rapidity and power of discharge could be easily regulated by simply closing or opening the spark gap. It is believed that this device is what has made the high-frequency Tesla coil one of the most successful X-Ray generators and a practical instrument for hospital and surgical use. Since this coil may be operated by an alternating current, it has been assumed by some that a sharp definition was not to be obtained. The results of many well-known investigators, among whom are Mr. O. B. Shallenberger of Rochester, PA, and Dr. F. F. Strong of Boston, prove beyond question the error of this belief. In fact, considered from the standpoint of penetrating power, clear definition, ease, and convenience of operation, the high-frequency coil commends itself to all practical workers.

A New Form of X-Ray Apparatus.

At the Spring Park Laboratory, Jamaica Plain, MA, Mr. T. B. Kinraide has completed a somewhat radically new form of X-Ray apparatus, which will permit a new method of supplying the current. The improvement principally is in the method of constructing the coil. The apparatus consists of an induction coil, in appearance like an ordinary coil, and a rotary device, which may be mounted on the shaft of a hand-powered dynamo supplying current for operating the coil. The apparatus is designed to be portable, such as one or two men could carry, and might be used by surgeons, in hospitals, or for military use. When operated by two men, it is said to provide more power than any X-Ray apparatus yet made. The machine may be used with any voltage, and a key feature is the precise control of the discharge, which is of very high potential, through a tube. This discharge can be varied from the most powerful, passing through bone and flesh, or reduced until the flesh is merely opaque. With the vacuum in the tube being extremely high, perfect definition is obtained.

FLUOROSCOPES AND SCREENS



of the recently discovered Fluorescent Crystals are being used by a large number of physicians, hospitals and experimenters, in place of tungstate of calcium and other salts, as they accomplish the result of showing each image undimmed by previous exposure or phosphorescence, make clear the most vague shadows which can not be traced when calcium of tungstate is used, and are absolutely instantaneous in effect.

A leading scientist says: "I find the Fluoroscopes and Screens of this Crystal an improvement over all others that I have used."

MADE ONLY BY THE

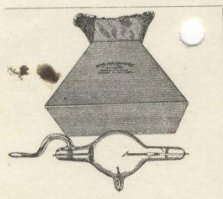
Spring Park Laboratory,

JAMAICA PLAIN, MASS.

Also, Complete X-Ray Apparatus, Scientific and Electrical Instruments.

The New Non-Phosphorescent Crystals, Positively SUPERIOR TO CALCIUM TUNGSTATE.

198



Spring Park Laboratory,

Manufacturers of

Scientific and Electrical Instruments,

* X-RAY + OUTFITS *

* Fine Chemicals. Calcium Tungstate Crystals all Sizes. *

Fluoroscopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,
X-Ray Photograph plate holder for Plate or Bromide Paper.

38 SPRING PARK AVENUE,

T. B. KINRAIDE, Treas. and Manager.

Jamaica Plain, Feb. 24 - 1897

Mr Nikola Tesla;

Dear Sir,



We send you today a small sample Screen made from our Non Phosphorescent Crystals which we think is a great improvement on the Calcium Tungstate so much in use. We will send you a Fluoroscope (gratis) made from the same material if you will kindly let us know what size you prefer, as we should like you to give our Fluoroscopes a thorough trial.

We do this without in any way soliciting you to give us a testimonial regarding them; other than that you would naturally make regarding anything you found superior for any special use. If you find our Screens are better than most others in the market, naturally you would so refer to them and more we do not ask or expect.

Trusting you will let us send you one of our Fluoroscopes

We are, Very truly yours

Spring Park Laboratory,
T. B. Kinraide

MNT, CXVI,
K 116

198 A

The New Non-Phosphorescent Crystals, Positively SUPERIOR TO CALCIUM TUNGSTATE
Spring Park Laboratory,
Manufacturers of
Scientific and Electrical Instruments,
X-Ray Outfits
Fine Chemicals. Calcium Tungstate Crystals all Sizes.
Fluoroscopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,
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T. B. Kinraide, Treas. and Manager.
Jamaica Plain, Feb. 24 - 1897

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Trusting you will let us send you one our Fluoroscopes, We are, Very truly yours,
Spring Park Laboratory, Mr. T. B. Kinraide

189
New York, Feb. 25th, 1897.

#46 & 48 E. Houston Str.

Mr. T. B. Kinraid,

38 Spring Park Ave.,

Jamaica Plains, Mass.

My Dear Sir:-

Your letter of Feb. 24th has been received.

I am naturally interested in every advance and am ready to acknowledge the merit of those to whom, in my honest opinion, it is due. But it has been my principle not to make any public statements for commercial use, even of my very best friends. If, however, you have any screens which you think are better than the old ones, kindly send me one and let me pay for it as every other of your customers does. Only on such condition could I possibly accept one.

I shall be much obliged for any attention you will devote to the matter.

Yours very truly,



MNT, CXVI,
K 116

199 A

New York, Feb. 25th, 1897.
#46 & 48 E. Houston Str.

Mr. T. B. Kinraid,
38 Spring Park Ave.,
Jamaica Plain, Mass.

My Dear Sir: -

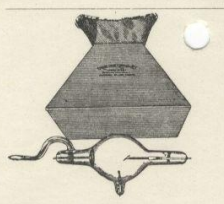
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I shall be much obliged for any attention you will devote to the matter.
Yours very truly,

The New Non-Phosphorescent Crystals, Positively SUPERIOR TO CALCIUM TUNGSTATE.

200



Spring Park Laboratory,

—Manufacturers of—

Scientific :: and :: Electrical :: Instruments,

* X-RAY + OUTFITS *

* Fine Chemicals. Calcium Tungstate Crystals all Sizes. *

Fluorescopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,

X-Ray Photograph plate holder for Plate or Bromide Paper.

38 SPRING PARK AVENUE,

T. B. KINRAIDE, Treas. and Manager.

Jamaica Plain, March 15 - 1897

Mr Nikola Tesla

46 Huntington St.

Boston Mass.



Dear Sir:

We forward you today one of our Non Phosphorescent Fluoroscope which we think upon trial you will find much superior to the Calcium Tungstate Crystals in general use as there is no phosphorescence to obscure or dim the image and the definition of the object is so much more clear and sharp.

We appreciate your attitude when you say that you never make any public statements for commercial use, even for your best friends. We did not expect or ask you to anything of the kind and fear we but poorly express ourselves if our communication was open to that interpretation.

However, we send you the Fluoroscope which you can submit to test and comparison with any others. We should be glad to give to you as a token of our appreciation of the original work you have done; but if you insist on paying for it only do so after you find that it is something you want.

Very truly yours,
Spring Park Laboratory
Dr. J. B. Kinraide

MNT, CXVI,
K 116

200 A

The New Non-Phosphorescent Crystals, Positively SUPERIOR TO CALCIUM TUNGSTATE
Spring Park Laboratory,
Manufacturers of
Scientific and Electrical Instruments,
X-Ray Outfits
Fine Chemicals. Calcium Tungstate Crystals all Sizes.
Fluoroscopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,
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Very truly yours,
Spring Park Laboratory
Mr. T. B. Kinraide
K

201

New York, March 21st, 1897.
 #46 & 48 E. Houston Str.

Spring Park Laboratory,

#38 Park Avenue,

Jamaica Plain, Mass.

Gentlemen:-

Your favor of March 15th has been received. Your Roentgen screen has also reached me and I have found it satisfactory. I do not like to comment upon its merits in comparison with others and wish only to say that I will retain it. Kindly mail me the bill at your earliest convenience.

In examining with the screen I have noted that you have utilized some suggestions. I am not saying this in any critical spirit, on the contrary, I am glad that you have done so and you are welcome to any advantage which may result to you therefrom.

Should you have any new phosphorescent material I wish you would send me some for trial.

Believe me to be,

Yours very truly,

MNT, CXVI,
 K 116

201 A

New York, March 21st, 1897
#46 & 48 E. Houston Str.

Spring Park Laboratory,
#38 Park Avenue,
Jamaica Plain, Mass.

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In examining the screen I have noted that you have utilized some suggestions. I am not saying this in any critical spirit, on the contrary, I am glad you have done so and you are welcome to any advantage which may result to you therefrom.

Should you have any new phosphorescent material I wish you will send me some for trial.

Believe me to be,
Yours very truly,

202

New York, June 6th, 1897.

#46 & 48 E. Houston Str.

Spring Park Laboratory,

Jamaica Plain, Mass.

Gentlemen:-

I have up to this moment received no bill for the fluoroscope forwarded to me some time ago. As I cannot possibly retain it unless you allow me to pay for it as any other customer would, I would beg you to forward me the bill with the least possible delay.

I have been satisfied with its performance and, although there are at present better screens in the market, I am using it still.

Yours very truly,

240
365

MUSEUM
NIKOLA TESLA

MNT, CXVI,
K 116

202 A

Spring Park Laboratory,
Jamaica Plain, Mass.

New York, June 6th, 1897.
#46 & 48 E. Houston Str.

Gentlemen: -

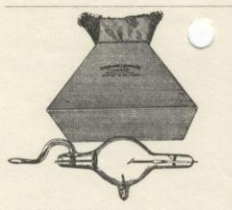
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203



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* X-RAY + OUTFITS *

—Fine Chemicals. Calcium Tungstate Crystals all Sizes.—

Fluoroscopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,

X-Ray Photograph plate holder for Plate or Bromide Paper.

38 SPRING PARK AVENUE,

T. B. KINRAIDE, Treas. and Manager.

Mr N. Tesla
46 Houston St

Jamaica Plain, June 7- 1897

New York N.Y.

Dear Sir



Enclosed find bill for the Fluoroscope as per your request. We are getting out a new Fluoroscope, with detachable screen of a new and improved salt, mounted in Mahogany and we were waiting to have them finished intending to send you one and allow you to choose which you would prefer to keep before bill you however, the exchange can be made at any time?

Very Truly Yours,
Spring Park Laboratory

MNT, CXVI,
K 116

203 A

The New Non-Phosphorescent Crystals, Positively SUPERIOR TO CALCIUM TUNGSTATE
Spring Park Laboratory,
Manufacturers of
Scientific and Electrical Instruments,
X-Ray Outfits
Fine Chemicals. Calcium Tungstate Crystals all Sizes.
Fluoroscopes, Fluorescent Screens, Photographic Screens, Crookes Tubes,
X-Ray Photograph plate holder for Plate or Bromide Paper.
38 SPRING PARK AVENUE,
T. B. Kinraide, Treas. and Manager.
Jamaica Plain, June 7 - 1897

Mr. N. Tesla
46 Houston St.
New York, N.Y.

Dear Sir

Enclosed find bill for the fluoroscope as per your request. We are getting out a new fluoroscope, with detachable screen of a new and improved salt, mounted in Mahogany, and we are waiting to have them finished intending to send you one and allow you to choose which you would prefer to keep before bill you. However, the exchange can be made at any time?

Very truly yours,
Spring Park Laboratory
K

204

New York, June 16th, 1897.

#46 & 48 E. Houston Str.

Spring Park Laboratory,

38 Spring Park Ave.,

Jamaica Plain, Mass.

Gentlemen:-

Your favor of June 7th has reached me in due course,
and I have forwarded a check for the amount of my bill.

I hope you will excuse this late acknowledgement of your
letter and believe me that I was perfectly satisfied with the per-
formance of the screen, although I have since obtained a much more
sensitive one made of a platinum salt exactly the same as Prof.
Roentgen and other European scientists have used from the beginning.
We have tumbled rather late to the advantages of the barium plati-
num cyanide. This is probably due to the fact that up to recently
no pure salt of this kind was obtainable here.

Yours very truly,

353
365
MUZEJ
NIKOLE TESLE

MNT, CXVI,
K 116

204 A

No. 615,652.

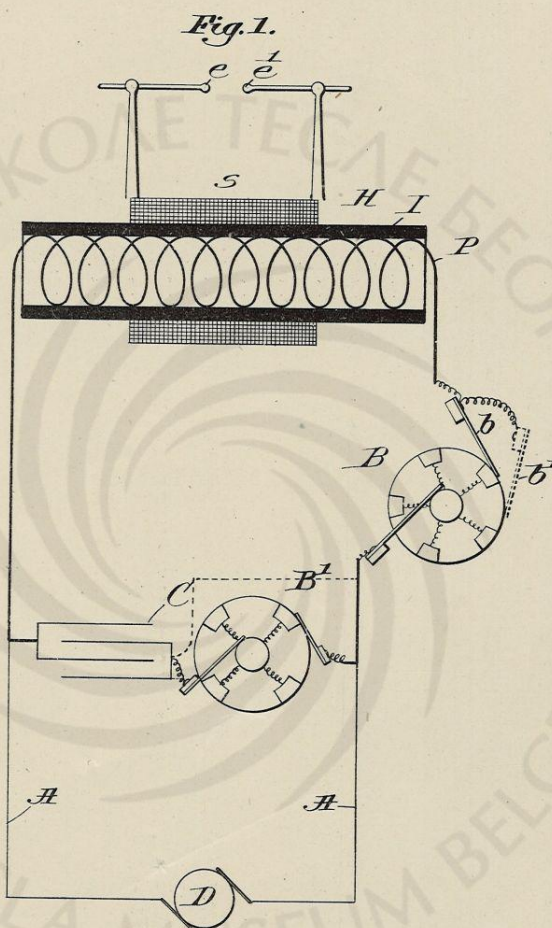
Patented Dec. 6, 1898.

T. B. KINRAIDE.
HIGH FREQUENCY APPARATUS.

(Application filed May 13, 1897.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses:

Fred S. Grunha.
Thomas J. Hammond.

Inventor:

Thomas B. Kinraide.
by Leroy S. Gregory atty.

No. 615,652.

Patented Dec. 6, 1898.

T. B. KINRAIDE.
HIGH FREQUENCY APPARATUS.

(Application filed May 13, 1897.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 2.

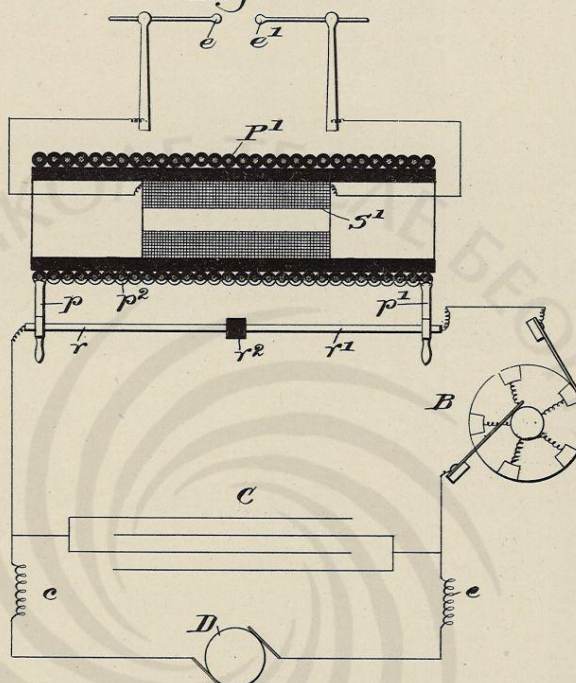
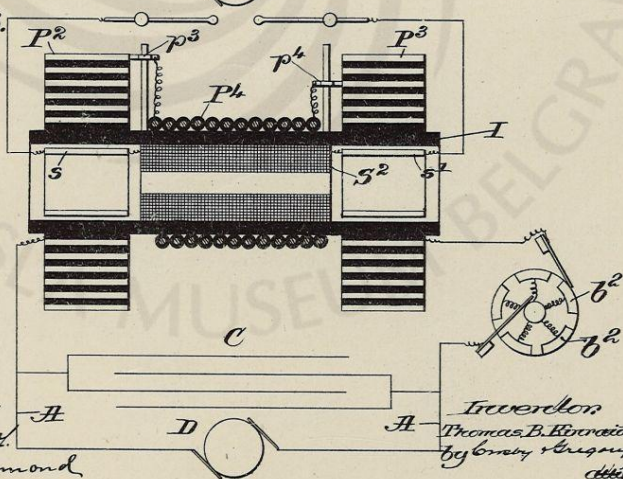


Fig. 3.



witnesses:
Fred A. Grunberg
Thomas Drummond

Inventor
Thomas B. Kinraide
by Emory & Company
attys.

No. 623,316.

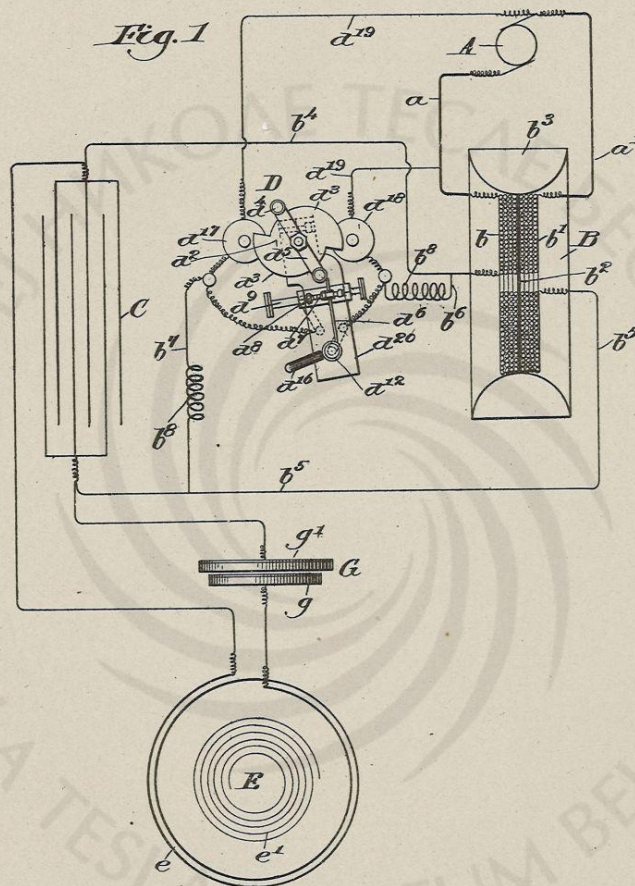
Patented Apr. 18, 1899.

T. B. KINRAIDE.
INDUCTION APPARATUS.

(Application filed May 5, 1898.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses:

Al. Hammond
Frederick S. Gummel

Inventor:

Thomas B. Kinraide
by Leroy Gregory
Attys

THE MORRIS PETERS CO., WASHINGTON, D. C.

No. 623,316.

Patented Apr. 18, 1899.

T. B. KINRAIDE.
INDUCTION APPARATUS.

(Application filed May 5, 1898.)

(No Model.)

3 Sheets—Sheet 2.

Fig. 2.

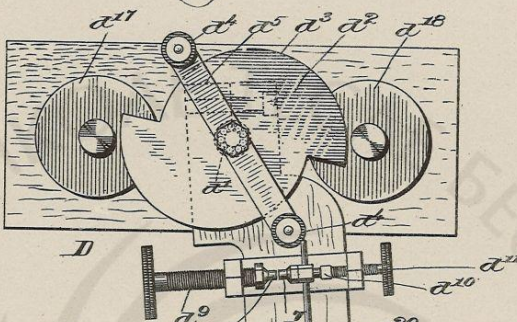


Fig. 4.

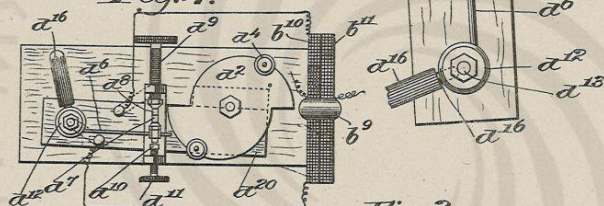
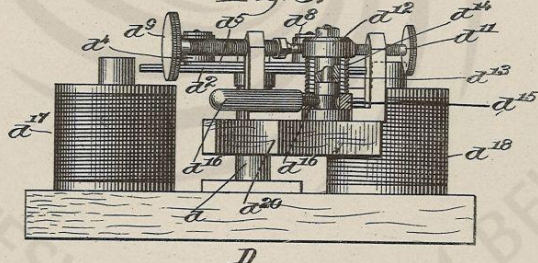


Fig. 3.



Witnesses:

A. C. Harmon

Fred L. Grunhof

Inventor:

Thomas B. Kinraide

by Henry Gregory

attys.

THE NORRIS PETERS CO., WASHINGTON, D. C.

No. 623,316.

T. B. KINRAIDE.
INDUCTION APPARATUS.
(Application filed May 5, 1898.)

Patented Apr. 18, 1899.

(No Model.)

3 Sheets—Sheet 3.

Fig. 5.

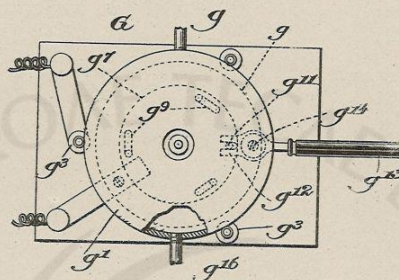
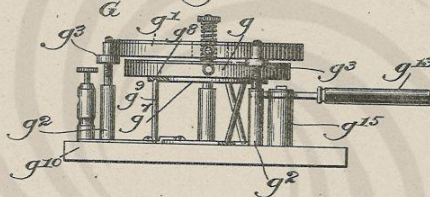


Fig. 6.



Witnesses:

A. C. Harmon.

Fred A. Grunhof.

Inventor:

Thomas B. Kinraide.

by Henry & Gregory
attys

THE MORRIS PETERS CO., WASHINGTON, D. C.

MNT, CCXXI,
K 221

7 A

FREDERICK F. STRONG, M. D.,
ELECTRO-THERAPEUTICS,
AND PATHOLOGICAL EXAMINATIONS.
BOSTON, MASS.

176 Huntington Ave. Sept 27.1898.

Mr Nikola Tesla,-
New York City.



My Dear Sir,-

I trust you will pardon the liberty I take in writing to you, but I am very anxious to have your opinion in regard to certain matters. For the past three years I have been engaged in a clinical study of the Tesla High-frequency currents in their application to the treatment of disease. Apostoli and D'Arsonval have done some work in this line with very remarkable results, especially in rheumatic conditions. Their current was derived from a Tesla coil excited by the discharge of a static machine with suitable condensers. They employed a current capable of giving a spark of from 1 to 2 cm in air. My researches have differed, in that I have employed an apparatus of my own design, consisting of a large transformer, condenser in oil, and Tesla coil, the spark gap being a revolving metal plate studded with wings which move past a stationary ball. I employ a 104 v alt incandescent current, and obtain a spark about 6 in long from my Tesla coil.

I have recently seen a machine of a novel character, and have made one like it. It is the best "x ray machine" I ever saw, and I am anxious to know whether it would have a similar therapeutic effect to the machine that I have been using. A patent has been applied for on the

MNT, CLIII,
K 153

85 A

apparatus, and I should be glad to have your opinion as to whether there
 is anything patentable about it. It consists of a small spark coil
 wound with a pound or two of No 20 wire: this is in two sections: the
 extreme ends of the sections are connected directly to the 110 v
 direct incandescent current, while the two inner ends of the sections
 are attached to an interrupting device consisting of an excentric
 iron disc which is made to revolve by the magnetism of the core of
 the coil. This disc bears two studs which come in contact with a short
 bar, which, when at rest, is held in contact with a post provided with a
 platinum terminal. This contact is broken every time a stud hits the end
 of the bar. The coil ends are connected, one to the spring bar, and one
 to the post. The current is broken in such a manner that the iron disc
 revolves rapidly ^{or} the principal of a simple motor. A mica condenser is
 connected around the break to absorb the current generated by the
 self-induction of the coil. This condenser is provided with a dischar-
 ging circuit consisting of a Tesla primary formed by 5 layers of copper
 foil 1 inch in width: the coil being 1 foot in diameter. A spark gap is
 included in the circuit consisting of two copper plates a short dis-
 tance apart. The Tesla secondary consists of a disc 1 foot in diam. and
 a quarter of an inch thick, and is formed of a pound of no. 36 wound
 and embedded in paraffin. The spark coil draws half an ampere and
 the Tesla coil gives sparks six inches long. To me the idea was entirely
 new, and I should be glad to know if it is patentable. The current in
 the Tesla coil is uni-directional, and the sparks are synchronous with
 the breaks of the spark coil circuit. The current is harmless: one can

draw six inch sparks from the positive pole without injury, while scarcely any spark can be drawn from the negative terminal. The makers claim that it gives an oscillating high-frequency current, but it seems to me that the frequency is the same as the number of breaks in the spark coil circuit. Passing the hand in front of a Crookes tube excited by the machine gives a succession of images, as is the case with an ordinary Ruhmkorff, and this suggests to me that the frequency is low. Will you kindly give me your opinion on the following points.

What has been your experience in regard to the curative power of high-frequency currents?

What are the requirements of such a current, in order to be of value medically?

Would the above ^{described} machine give therapeutic results similar to those given by an alternating machine, such as the one I have described as having used for medical purposes?

Is the apparatus just described a true high-frequency coil or am I right in supposing the frequency to be low? (the voltage of the current used to charge the condenser is only 3000)

If you can find time to answer these questions you will confer a great favor upon me, and aid me greatly in my researches. I trust I may have the honor of meeting you personally at some future time. Trusting that you will pardon me for my freedom in asking for information and trusting that I may hear from you soon, I remain

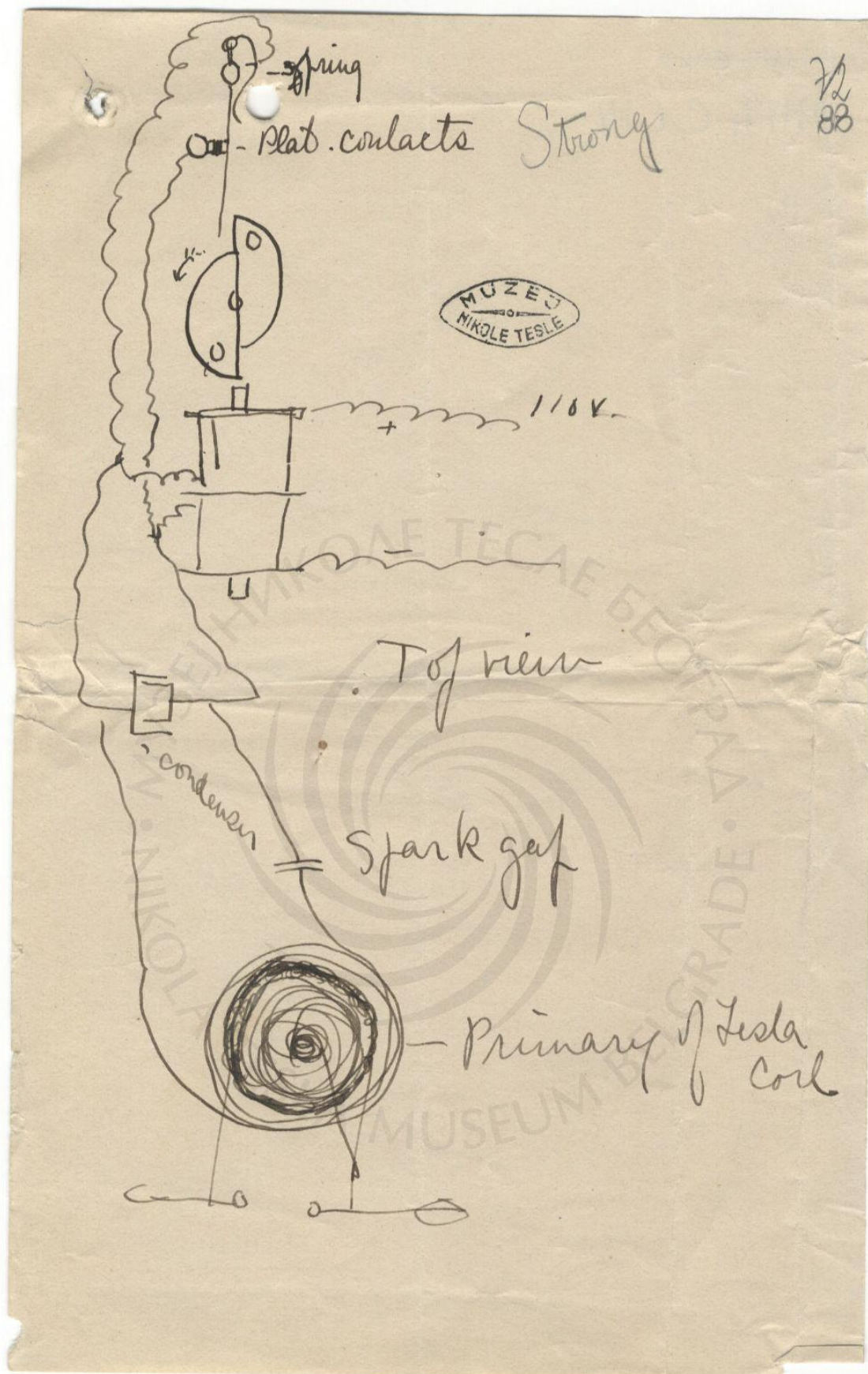
Very respectfully,

Frederick F. Strong

#176 Huntington Ave Boston

MNT, CLIII,
K 153

87 A



FREDERICK F. STRONG, M. D.,
ELECTRO-THERAPEUTICS,
AND PATHOLOGICAL EXAMINATIONS.
BOSTON, MASS.

176 Huntington Ave. Sept 27.1898.

Mr Nikola Tesla, -
New York City.

My Dear Sir,-

I trust you will pardon the liberty I take in writing to you, but I am very anxious to have your opinion in regard to certain matters. For the past three years I have been engaged in a clinical study of the Tesla High-frequency currents in their application to the treatment of disease. Apostoli and D'Arsonval have done some work in this line with very remarkable results, especially in rheumatic conditions. Their current was derived from a Tesla coil excited by the discharge of a static machine with suitable condensers. They employed a current capable of giving a spark of from 1 to 2 cm in air. My researches have differed, in that I have employed an apparatus of my own design, consisting of a large transformer, condenser in oil, and Tesla coil, the spark gap being a revolving metal plate studded with wings which move past a stationary ball. I employ a 104 v alt incandescent current, and obtain a spark about 6 in long from my Tesla coil.

I have recently seen a machine of a novel character, and have made one like it. It is the best "X-Ray machine" I ever say, and I am anxious to know whether it would have a similar therapeutic effect to the machine that I have been using. A patent has been applied for on the apparatus, and I should be glad to have your opinion as to whether there is anything patentable about it. It consists of a small spark coil wound with a pound or two of No 20 wire: this is in two sections: the extreme ends of the sections are connected directly to the 110 v direct incandescent current, while the two inner ends of the sections are attached to an Interrupting device consisting of an eccentric iron disc which is made to revolve by the magnetism of the core of the coil. This disc bears two studs which come in contact with a short bar, which, when at rest, is held in contact with a post provided with a platinum terminal. This contact is broken every time a stud hits the end of the bar. The coil ends are connected, one to the spring bar, and one to the post. The current is broken in such a manner that the iron disc revolves rapidly on the principal of a simple motor. A mica condenser is connected around the break to absorb the current generated by the self-induction of the coil. This condenser is provided with a discharging circuit consisting of a Tesla primary formed by 5 layers of copper foil 1 inch in width: the coil being 1 foot in diameter. A spark gap is included in the circuit consisting of two copper plates a short distance apart.

The Tesla secondary consists of a disc 1 foot in diam, and a quarter of an inch thick, and is formed of a pound of no.36 wound and embedded in paraffin. The spark coil draws half an ampere and the Tesla coil gives sparks six inches long. To me the idea was entirely new, and I should be glad to know if it is patentable. The current in the Tesla coil is uni-directional, and the sparks are synchronous with the breaks of the spark coil circuit. The current is harmless: one can draw six inch sparks from the positive pole without injury, while scarcely any spark can be drawn from the negative terminal. The makers claim that it gives an oscillating high-frequency current, but it

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Very respectfully,
Frederick F. Strong

#176 Huntington Ave Boston

New York, Oct. 4th, 1898.

#46 & 48 E. Houston Str.

Mr. Frederick F. Strong, M. D.,
176 Huntington Ave.,
Boston, Mass.

Dear Sir:-



Your favor of Sep. 27th has been duly received and contents noted.

I do not see any patentable feature in the arrangement shown in your sketch. There is a self-induction coil provided to charge a condenser, and the latter discharges through the primary of an induction coil, a scheme which is now well known. As to the mechanical details of the break, they are likewise not novel.

The coil would be very much improved by doing away with the spark gap, in which there is necessarily a certain amount of energy consumed.

I cannot give you an idea of the frequency, as I do not know the capacity of the condenser and the self-induction of the primary coil, through which it discharges. It might be from, say, twenty to two or three hundred thousand per second. What you see there when moving the hand in the light of a vacuum tube, are the fundamental interruptions of the break, but each of these may again consist of a great number of superimposed and quick vibrations. It is evident, however, that since there is a spark gap in the path of

MNT, CLIII,
K 153

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the condenser current, these vibrations die out very quickly and their effect is very small.



Although I have experimented a great deal with high frequency currents, I could tell you little as to their effect upon the body from the standpoint of the physician. In a paper which I have forwarded to the recent meeting of the Electro-Therapeutic Society I have dwelt on the subject, and you might find in what I have said one or two items of interest.

The currents obtained from the machine you refer to are very sudden, and I should say that they would be less suitable for certain electro-therapeutic uses than a machine giving sinusoidal currents; at least, it is generally believed that the latter currents are preferable for medical purposes. I do not know exactly how that idea originated, but I think it is very likely that it followed from the observation early made, that a greater amount of energy can be passed through the body of a patient when the currents are harmonically varying than when they are sudden.

In connection with the subject it may interest you to know that I am just bringing out instruments of a greatly improved design which will, in all probability, fill a much needed want. I hope that soon you will be able to procure such an instrument, if you so desire, and I have no doubt that you will be satisfied with its performance.

Yours very truly,

MNT, CLIII,
K 153

90 A

New York, Oct. 4th, 1898.
#46 & 48 E. Houston Str.

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176 Huntington Ave.,
Boston, Mass.

Dear Sir: -

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Yours very truly,

3

April 17, 1902.

Mr. T.B. Kinraide,

Jamaica Plain, Mass.

My dear Mr. Kinraide:

I regret that I was called off the other day when you were here and did not have a chance to see you before you left. If you will tell me about what you need in the way of a Crookes' tube I will look over some which I have, and see if there is anything which would suit your purposes. The double focus tubes which are ordinarily made will stand potentials up to four, or five inches or more. They are made for the standard high frequency sets which we have been furnishing for sometime past and you probably know what they are.

I wish again to thank you for the favor of the copies of the enlargements of the spark photographs.

Very truly yours,

Ed. C. J.

**Letter from Elihu Thomson, from the American Philosophical Society
TWENTIETH TRIENNIAL EXHIBITION OF THE MASSACHUSETTS CHARITABLE
MECHANIC ASSOCIATION, BOSTON, OCTOBER 10 TO DECEMBER 3. 1898.-1V.**

SPRING PARK LABORATORY

38 Spring Park avenue, Jamaica Plain, Mass.

The products of this laboratory are here shown for the first time to the public, and the Kinraide induction coils, transformers and high potential ozone generators are attracting a great deal of attention. A number of negatives of very curious spark effects are exhibited and their study may lead to some very interesting conclusions. In this same space Messrs. Kirmayer & Oelling. 17 Blomfield street, Boston, Mass., are exhibiting their X-Ray supplies, such as Crookes tubes, static machines, fluoroscopes. Ruhmkorff coils and chemicals.

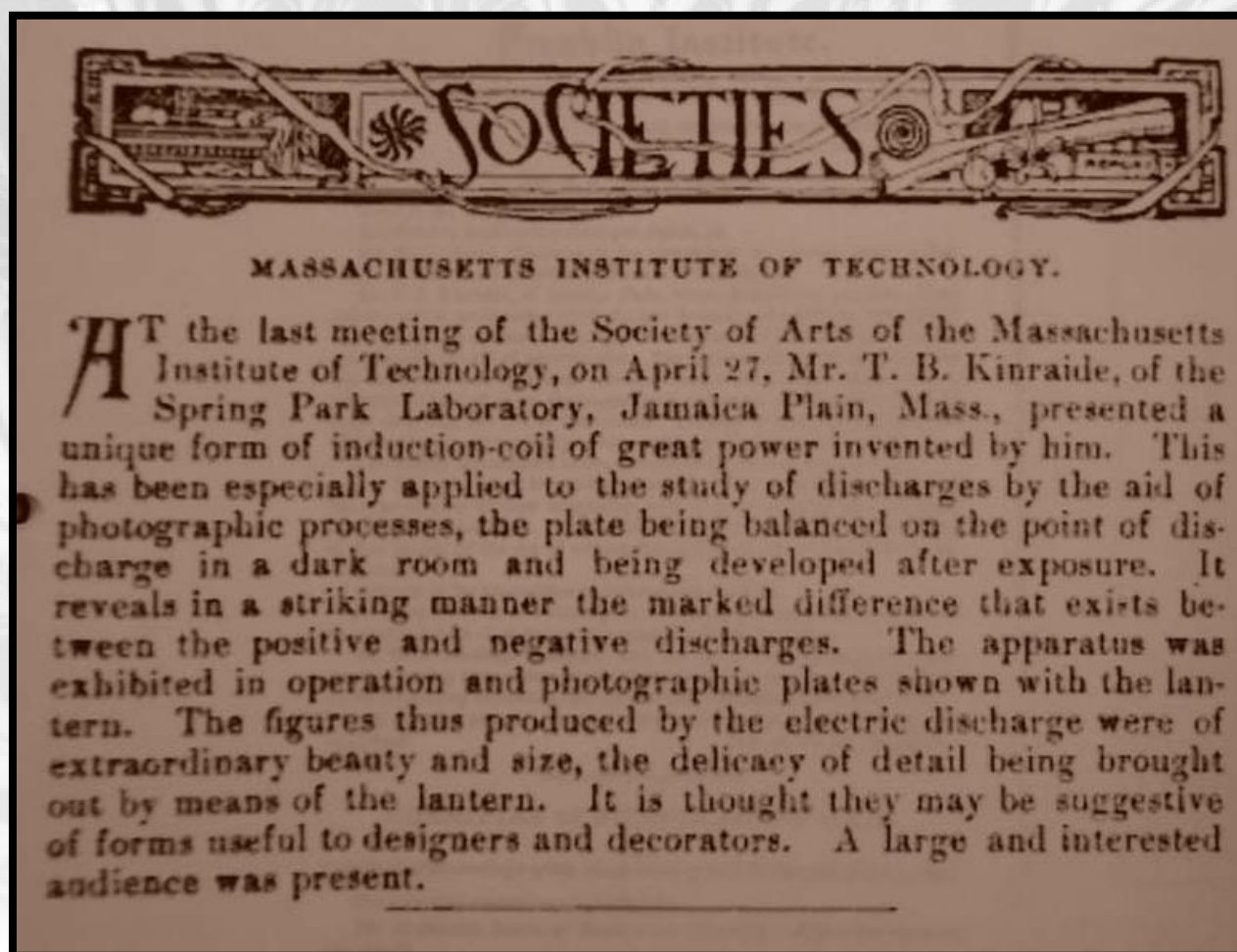
PHOTOGRAPHS OF ELECTRICITY

Shown by T. B. Kinraide in Illustration of His Latest Invention

A large audience heard Thomas B. Kinraide's lecture before the Society of Arts at the Massachusetts Institute of Technology last evening. It was Mr. Kinraide's first appearance as a lecturer since his name had become prominently known to the general public in connection with the Keely motor. His subject was "Arborescent Electricity." Mr. Kinraide's machine and the results he has accomplished have already been described. He told his audience how, after four years of labor, he had solved the problem of photographing electricity by his method, thereby aiding materially in measuring and establishing its force. Several plates were reflected on a screen by the light of a magic lantern. The lecturer went through every part of the work of taking the picture and explained that he believed he had a perfect representation of the Aurora, or northern lights. In answer to a question, he explained that he had not been able to measure the voltage of the electricity.

Mr. T. B. Kinraide, of the Spring Park Laboratory, Jamaica Plain, was then introduced and read a paper on "A New Form of Induction Coil." This unique form of induction coil of great power has been especially applied to the study of discharges by means of photographic processes, the plate being balanced on top of the discharging globe in a dark room, and being developed after exposure to the light of the discharge. This process reveals in a striking manner the marked difference that exists between the positive and negative discharges. The apparatus was exhibited in operation, and photographic plates were shown by the lantern. The figures produced were of extraordinary beauty, and the delicacy of detail was brought out very clearly by the lantern.

A vote of thanks was tendered to the lecturer for his very interesting and instructive paper. The meeting then adjourned. ARTHUR T. HOPKINS, Secretary



INSTITUTE OF TECHNOLOGY

At the last meeting of the Society of Arts of the Massachusetts Institute of Technology on April 27th, Mr. T. B. Kinraide of the Spring Park Laboratory, Jamaica Plain, Mass., presented a unique form of induction coil of great power, invented by him. This has been specially applied to the study of discharges by means of photographic processes, the plate being balanced on the point of discharge in a dark room, and being developed after exposure. It reveals in a striking manner the difference that exists between the positive and the negative discharges. The apparatus was exhibited in operation, and photographic plates shown with the lantern. The images thus produced by the electric discharge were of extraordinary beauty and size, the delicacy of detail being brought out by means of the lantern. He thought they may be suggestive of forms useful to designers and decorators. A large and interested audience was present.

**The Electrical Engineer - London - July 07, 1899
Franklin Institute.**

We note from a program sent in that Mr. T. B. Kinraide was to have read a paper, entitled "The Application of Photography to the Study of the Structure of Electrical Discharges," before the above institute on Wednesday, the 21st. As this is an interesting subject, we hope to refer to it more fully later.

American Roentgen Ray Society Meeting, 1902:

The afternoon session opened at 2 p.m.

An address was read by the President outlining briefly the organization of the Society, with some account by Prof. Roentgen, and the advantage X-Rays have given physicians in diagnosing and treating X-Rays.

Dr. W. A. Florentine, of Saginaw, Michigan, read a paper entitled "A Review of Cases of X-Ray Burns."

Dr. Girdwood opened the discussion, which ensued, by stating that before discussing the question of X-Ray burns, it should be ascertained exactly what X-Rays were. He said that his friend, Dr. Rutherford, of McGill University, had told him that these rays, the X-Rays, were actually vibratory movements and that the vibrations or waves of those movements were smaller than the supposed size of any known atom. If that were true, we would save ourselves from abandoning atomic theory. That the ordinary-sized atoms which chemists are able to contemplate would act as a large sieve to these minute rays. That the Roentgen vibrations, according to Dr. Rutherford, are far smaller and far more frequent than the vibrations of sound and light. Thus, it was not surprising that the skin, which was most exposed, suffered the most from these rays. Dr. Girdwood expressed his approval of the speaker's plan of treatment; stated that he had always maintained a fairly high vacuum, always twelve inches from the patient and had covered the skin with a piece of gold foil. Never had an X-Ray burn or anything approaching it. That in Montreal the worst cases have been from static machines, despite the machine's claims that it does not and could not produce X-Ray burns.

Dr. Bleyer stated that he had discovered years ago that X-Ray burns were a secondary effect. That the X-Ray was applied to the surface of the skin when it was surgically unclean, and the burns did not appear at once, but a few days after the application of the X-Ray, the skin began to show certain conditions. These, when examined, proved to consist of particles of matter. Treating these burns, so to speak, consisted of sterilizing the wound itself

Dr. Kinraide, of Boston, gave his experiences in photography, stating that he had experienced all the effects of a bad X-Ray burn without any X-Ray apparatus whatsoever. He said he had also had several X-Ray burns and found the best treatment to be a strong solution of baking soda. He took two porcelain jars with a hot saturated solution of baking soda and simply placed his hands in them and kept them there until the solution cooled. If the burn was not a bad one, Vaseline or anything else that would keep the skin soft would be sufficient.

Dr. Florentine stated that in 1,500 exposures he had never had an X-Ray burn; that his paper was entirely based on the experience of the best-known X-Ray workers of today

Dr. Kinraide, in reply to a question from one of the physicians present, stated that nitrous acid was produced by the discharge; that he had to make special provisions to absorb this acid in some cases; that the burns were not entirely due to the X-Ray; the peculiar brown color observed was identical to stains produced by nitrous sold.

Dr. Cunningham stated that he had experienced severe inflammation of the face and eyes; he frequently had to ventilate the room to get rid of nitric acid. That Professor Thomson's experiments, as well as others, showed that when the skin was near an X-Ray tube, currents were present, and when a properly grounded screen was placed across it, the currents disappeared. No X-Ray burns were ever seen as long as screens were used. I agreed with Dr. Kinraide regarding treatment with bicarbonate of soda; in addition, a small amount of cocaine was used.

Dr. Monell and Dr. Kinraide discussed the matter of the effects of the acid being so long delayed, whereas if you apply an acid to the skin, it acts very quickly.

The President stated that the discussion of this paper was of much interest and that probably a committee would be appointed for the purpose of investigating this and reporting to the next meeting on how to get rid of it altogether, including chemistry in their report

A paper by Dr. William Rollins of Boston, "X-Ray Apparatus for Physicians in the Country." Due to Dr. Rollins' absence, this paper was read by the manufacturer of the machines described therein.

Dr. Waite said that the paper seemed to be devoted exclusively to the operation of certain apparatus.

The President stated that discussions of this paper must be confined to the direct purpose of the meeting.

Dr. _____ asked if anyone had had an X-Ray tube explode. He stated he had never had this experience, but had feared it and wished to know if there was any such danger.

Dr. _____ replied that he had had that experience at the beginning of his work, but thought it was due to his carelessness.

Mr. Westbury remarked that in handling something like 5,000 tubes, he had never had one explode unless it was damaged in some way

Dr. Clapp, of Boston, said that he had one explode in his hand without any apparent cause.

Dr. Custer did not think that tubes explode; condensation rather than explosion. Dr. Kassabian stated that he had two tubes inside for four years, one of them exploded while working, and couldn't see any fault in it.

The President asked if it was giving radiation at the time.

Dr. Kassabian replied affirmatively.

Dr. _____ said that he had some tubes collapse at the slightest pressure, but never had one explode while in use. While the current is passing through it, of course, if you touch a tube, it may go into a million places. The very slightest pressure will do it under certain conditions with a thin tube; tubes used to be much thinner than now. They do not explode; they collapse. I had noticed it when they were in use. A physician in St. Louis had one in his hand, and it collapsed and filled his eyes. That was when tubes were made very thin. In those cases, there was pressure of some kind.

Dr. Monell had had no accidents to speak of with any tube at all. Never had a tube explode. The only punctures taking place under his observation were during handling by a student.

Dr. Girdwood had never had but two accidents, one due to a finger being put on it, and the other punctured by a spark passing over it.

Dr. _____ asked if it might not be due to the fact that tubes were not properly annealed.

Dr. _____ stated that Dr. Jeffrey, of Buffalo, handled the same tube for six months. Last June, as he took it from the box, it went into a million pieces. He said, "I am through showing x-ray tubes."

Dr. Grover stated that all this goes to prove that tubes do not explode but collapse, and the collapse is always due to some cause. He had several tubes collapse, and in almost every case, the collapse was due to his own carelessness in overheating the tube.

Dr. Kinraide, of Boston, stated that the tubes were put through the most severe conditions possible in their manufacture. That if they could stand that, they ought to be able to stand

almost anything, and if they do burst, it is from no one's fault practically.



DELETERIOUS EFFECTS OF X-RAYS ON THE HUMAN BODY.

FURTHER EVIDENCE THAT REPEATED EXPOSURE TO THE RAYS PRODUCES A SUNBURN EFFECT.

To the Editor of ELECTRICAL Review:

This week's issue of the ELECTRICAL REVIEW, just received, contains an article on the "Deleterious Effects of X-Rays on the Human Body." Mr. Hawks's conclusions as to the cause of his trouble are without doubt correct. Mr. K., who attends the testing of the tubes during and after the ex-hausting process at our work rooms, complained a few weeks ago of a peculiar itching and burning in his left hand, and thought that it was caused by poisoning with chemicals. The skin assumed a dark red color; it became hard and glossy, and finally began to peel off. There was a sort of dead feeling in the fingernails, "as if pounded with a hammer." The trouble could neither be traced to chemicals nor to any other known source, and we finally concluded it must be the effect of the rays. A burning of the eyes has also been noticed, not to such an extent, however, as described by Mr. Hawks. Within a week past the same phenomenon has appeared on my hand. The skin has turned brown and hard, and during last night a blister about three-eighths of an inch in diameter was raised on the little finger. Further developments will be carefully watched and noted.

The above effects have only been noticed since we began the manufacture of the "Bowdoin College" type of tubes in quantity. This being a very powerful tube undoubtedly increases the deleterious effects upon the system. Yours very truly,

G. A. FREI

Boston, August 13

(Note: G. A. Frei was one of the earliest X-Ray tube manufacturers in Boston that

originally manufactured light bulbs. They started making Crookes tubes and selling fluoroscopes, likely Kinraide's earliest designs. Frank H. Swett & his brother-in-law Lewis took over that company and began selling Stanley Static Machines and Kinraide inventions. Mr. K above could well be Mr. Kinraide...)

Skin to Lakeside Hospital; Consulting Dermatologist to charity Hospital, St. Alexis Hospital, and the City Hospital, Cleveland; Member of the American Dermatological Association, and the Dermatological Society of Great Britain and Ireland. Illustrated by 12 Colored Plates, 28 Half tone Plates from life, and two Engravings, Philadelphia, F. A. Davis Company, Publisher, 1901.

For the young practitioner of medicine and for the older, whose experience has been interrupted from constant clinical experience with the infectious exanthemata, this book is especially needed. At the outset there is a brief history of the original source of these diseases, covering nearly 30 pages. It is a most interesting account, dating from the earliest period in all nations of the earth.

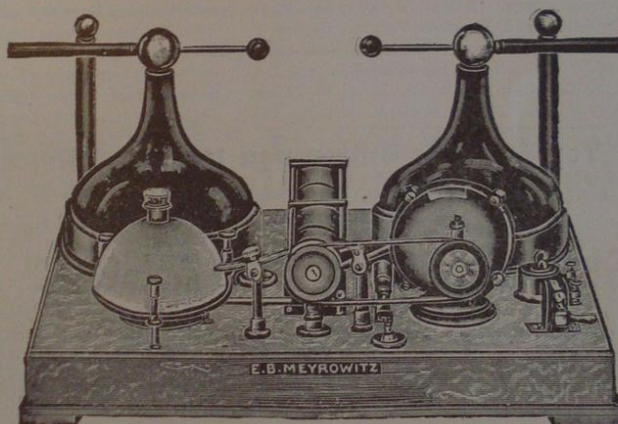
Definitions, Varieties, Symptomatology, Etiology, Diagnosis, Prognosis and Treatment are each subdivided into distinct head-lines giving a variety of catch-attention that betrays an essential

feature. The subjects are illustrated with colored and half tone plates in constant evidence of description. The book is richly printed and substantially bound, covering about 400 pages. Infectious diseases are lessening in the civilized races, and the type is somewhat modified, probably due to sanitation, disinfection and isolation, making diagnosis the more difficult. The writer only recently saw a case that had been diagnosed smallpox, and was confirmed by two older practitioners. The patient was quarantined and his residence displayed a red flag. The patient defied the authorities and his doctors and sought additional advice. The case was a simple form of impetigo. A perusal of this book would have negated variola at the beginning.

An International System of Electro-Therapeutics, by numerous associated authors. Edited by Horatio R. Bigelow, M. D. *Second Edition* edited by G. Belton Massey, M. D., Ex-President and Fellow of the American Electro-Therapeutic As-

The Kinraide High-Frequency Coil.

The best
apparatus
for use
with the
direct or
alternating
current.



SEND FOR
DESCRIPTIVE
CIRCULAR.

E. B. Meyrowitz,

Maker of Ophthalmological Apparatus, Complete Standard Electro-Therapeutic Equipments, X-Ray Apparatus and High Grade Eye, Ear, Nose and Throat Instruments.

104 East Twenty-third Street,
125 West Forty-second Street, } NEW YORK,
650 Madison Avenue.

604 Nicollet Avenue, Minneapolis.
360 St. Peter Street, St. Paul.
3 rue Scribe, Paris, France.

X-RAY TUBES.

Perfect Glass, Reinforced Seals. They Can Always be Repaired.

X-Ray Tubes re-exhausted and repaired. Also Atomizers, Nebulizers for heavy fluids, and Inhalers
Glass apparatus of all kinds. Correspondence Solicited.

STUNTZ & ARMSTRONG, - - Owenaboro, Ky.

Results Attained Will Attract the Attention of Scientists the World Over.



PLATE II.—The fern-like rays are negative. The feathery, cloudy rays show the unvarying appearance assumed by the positive discharge. This is what Mr. Kinrade calls an electrograph. No camera

in the same fashion. It is very large and high studded. A brilliant fire of colors glows in the grain, and in the sunlight can be seen in this fantastic room, but at the touch of a button it can be flooded with brilliant light.

This is, perhaps, the fancy of a man of science. It is certainly a most interesting room. Here Mr. Kinnable takes the wonderful photographs, which are sure to make him famous. Here, too, he has a

His experiments endanger his life.

[illegible]

terms of the city speak in most critical terms of the remarkable achievements of Mr. Kirshale.

From the Institute of Technology, Mr. Kirshale's photographs of the electric spark are certainly the most remarkable ever obtained. He has a very amount of inventive genius, and is an exceptionally skillful mechanic. I consider his X-ray apparatus the most complete. Some of his work in acoustics, too, has gone beyond that done by any other investigator. I am told that his X-ray machine is the same that has just been made, since the form of induction is certainly very interesting. About its application to wireless telegraphy I do not know, because I have not investigated it. Mr. Kirshale is an exceedingly modest

[illegible]

Boston Sunday Post March 18, 1900

**World-Astounding Electrical Discoveries
Made by Thomas B. Kinraide of Jamaica Plain.**

Remarkable Discoveries in X-Rays and Wireless Telegraphy

Every Day of His Work Endangers His Life

Results Attained Will Attract the Attention of Scientists the World Over.

There is a man in Jamaica Plain, who is danger of becoming one of the most famous scientists in the world. His neighbors don't know it; the great public hasn't the least suspicion of it. Only a few brother scientists have found him out. Some of the marvelous results of his years of patient experimenting are told the public for the first time in today's Post:

Science, unlike most things else, makes famous in a single day such of her devotees as she designs to grant a place in the roll of her chosen ones. Long years of patient effort, working in the dark, of seeking after elusive knowledge, may be futile. Many a man knows that to his sorrow, but they may end in a sudden dazzling burst of radiance that shall leave a halo round a man's head for the rest of his natural life and as long as human knowledge shall be sought after.

The conclusive grasp of some law in nature that no one before has ever been able to fathom raises a man in a day, as soon as it becomes known, from a humble ordinary citizen to a position of admittedly absolute power in his particular field of investigation. Edison, Harvey, Faraday, Herschel, Marconi, became famous in a day. The world took no note during their years of patient research. It recked not of sleepless nights, of repeated failures, of heroic perseverance. But when of a morning it woke and heard the news of the marvelous results obtained, then the world bowed its head in admiration of the man whose name the day before it had never heard.

To the famous trio of names so notably associated with the development of electrical appliances, Edison, Tesla, Marconi, it seems that a fourth should be added, and one happily that of a Boston man. Thomas B. Kinraide of Jamaica Plain. Mr. Kinraide himself is not seeking the honor. On the contrary, he shrinks in an exceptional degree from the public notoriety; but if the predictions of those who ought to know come true, Mr. Kinraide's achievements cannot fail to make him famous the world over.

Mr. Kinraide is a young man, but he has succeeded in doing several things that nobody else has ever done. For one thing, he has succeeded in photographing positive and negative electricity, and has discovered that each has its individual and unwavering form. He has invented a new and powerful form of transmitter to be used in wireless telegraphy, from which he has obtained unprecedented results. He has invented a new form of induction coil and has shown its

practical value by its use in his apparatus for X-Ray photography, which is the most valuable ever set up. Besides all this, he has conducted experiments, along other scientific lines, and has made a set of instruments that will measure over 100,000 sound vibrations per second.

It seems incredible that a man who has already accomplished so much should be so little known, but the reason for it has several causes. One of these is that Mr. Kinraide is an exceedingly modest and quiet man; another is that he has always had ample means at his command, so that he has not been obliged to work from a commercial standpoint, while still a third reason is that his experiments have always been carried on in his own house and comparatively few people have known anything about them.

HOW HE MADE ELECTRICITY TAKE ITS OWN PICTURE.

Mr. Kinraide is not the first man who has succeeded in photographing electricity, but he is the first man who has been able to secure separate pictures of the positive and the negative, and thus to determine the shape of each. His experiments along this line - in making electricity photograph itself - electrographing, as he calls it, began about four years ago. The results are not only of the greatest scientific value - they are marvellously beautiful as well.

In this work no camera is used. The electric fluid is made to print its own picture on ordinary sensitive plates. And the picture it prints are wonders of graceful designing. Negative electricity has invariably the exquisite fern-shaped appearance shown in the half-tone reproduction on this page. Mr. Kinraide describes this as filiciform, that being the latin word meaning fern-shaped. Positive electricity has a well-defined feathery appearance, which is more readily noticed when the pictures are enlarged.

Strictly speaking, the positive is formless compared with the complicated form of the negative. Its appearance is that of a cloud, plume-like, very similar to the car tails of the long-leaved meadow flag. This plume, varying from six to ten inches in length, is supported upon a delicate stem from one to three inches long, the plume a pale violet color, the stem the vivid white of the electric spark.

Thus far Mr. Kinraide has failed to persuade this form to appear upon the sensitive plate. It is in no way affected by the plate's presence, completely ignoring it, except to fog the plate where it passes through it. Only by using the negative electricity in controlling it has he succeeded in photographing modifications of this form.

The half-tone reproduction on this page marked "negative electricity in its pure form, uninfluenced," is one of the valuable series of pictures of the negative current. The first plate in the series shows just one frond or fern leaf starting from the centre. The second shows two or three, and the succeeding plates show each a great number of fronds until the perfect number seen in the plate here is found.

In the printing of each plate the current is broken but once, but the delicacy of the apparatus permits the amount of the discharge to be regulated. This graceful and beautiful fern shape is, Mr. Kinraide believes, the natural form of negative electricity whenever it is discharged into the air and is uninfluenced. To the ordinary man it is a surprise to be told that electricity has any defined shape. But that it has, Mr. Kinraide's pictures unquestionably prove.

In a recent lecture before a body of scientists at the Massachusetts Institute of Technology Mr. Kinraide, in referring to this, said:

"I trust that I will not be too severely condemned for having become infatuated with the beauty that this work has presented to me. No words that I can use can express the grace and splendor that these forms reveal. To me, it has been a revelation of a world beautiful, hidden hitherto and unknown.

"These beautiful shapes are the true symbols of electricity, and in time to come I sincerely trust that when we see electricity symbolized it will be a figure holding these fronds or the fronds themselves.

"I cannot but feel that the artist will welcome these photographs as studies that cannot be found elsewhere

"We have all experienced a feeling of awe when dealing with this peculiar force, but have not hitherto seen it in such a way as to be moved to admiration. Now that the opportunity is presented to you to see this force embodied in its true form, incarnated as it were, and revealed to your eyes, you will not only know it better, but will give to it the sincere appreciation that most certainly is its due."

In securing these electrographs the electrical current is made to discharge from a sphere. Sometimes it happens that the sphere attracts to itself electricity from the air. Then there are inward discharges. This creates the most interesting phenomena of all. The Post plate numbered 3, which is a section of a large plate, shows the formation of the inward discharge. It is seen to be both positive and negative. The light, triangular spot has the base of the triangle the outshooting of the characteristic fern-like negative electricity. From its direction it can be seen that this is shooting in towards the sphere. At the apex of the triangle is the plumous positive. Somehow the two merge or are united in the triangular space.

Wherever these triangles are found there is the same arrangement, the negative emerging from the base, the positive from the apex.

This particular form of electrical phenomena has never before been seen - that is, the juncture of the positive and negative electricities base to base. This junction has always been in the apparatus in which the electrical discharge was developed, only the outer fern-like negative and plumous positive having been visible.

This alone contains a world of revelation, which Mr. Kinraide believes it is the key which will unlock many of the mysteries hitherto associated with electricity.

It will have particular value in the ultimate conclusion at which Mr. Kinraide hopes to be able to arrive as a result of his electrographing. As yet he has not finished his experimenting in the line, and he is not willing to commit himself to any statement as to what the plates already secured show in regard to the nature of electricity. He does admit, however, that the theory which is forming in his mind, and which these pictures are, one after another, confirming him in, is one that has never been put forward. It is quite different from the theories so far accepted by scientific men in regard to the nature of this wonderful force.

It is not desired in saying this to claim that Mr. Kinraide has a preconceived theory and that he is proving it. It is more correct to say that a theory has been forming in his mind during the years he has been carrying on this line of investigation, and that the various phenomena as they develop all tend to make this theory grow stronger. It has now settled almost into a conviction, but Mr. Kinraide is unwilling yet to formulate it for public utterance.

The theory of the nature of electricity as now accepted by the most reputable scientists, is that it is either a single fluid or a dual one. The supporters of the former claim that so-called negative electricity is but the withdrawal or absence of the positive or real electricity. Mr. Kinraide is convinced that his photographing experiments are to settle this much debated question once and for all. He believes that they will even do more than this, that they will give scientists such a clear knowledge of the nature and character of this mighty force that the study of electrical development on all lines will be rendered vastly more intelligible. In this way his work, which might seem at first glance the pastime or hobby of a man at leisure, will have a distinctly practical and commercial character, and prove of inestimable value to the public at large.

FAILURES BEFORE SUCCESS.

It could not be expected that these remarkable electrographs would be secured until after repeated attempts. "These beautiful and perfect plates do not tell the story of my many failures," said Mr. Kinraide, "but I have a stack of spoiled negatives big enough to make a greenhouse. Disappointing failures in securing photographs were not, however, my only ones. I had to first construct my apparatus. After I had discovered the secret of the flat-disc coil I was for weeks at the mercy of the condenser. When I had made that satisfactory I found that the ordinary oil insulation used in high voltage apparatus would not stand the enormous strain. Then I had to work for a long time before I hit upon just this combination of rosin and beeswax that I now use. Then I had to learn the process of developing my plates, as I could not wait to have them sent out to a photographer."

This electrographing apparatus is entirely unique. There is not another like it in the world. It controls a higher voltage for the quantity that any other instrument so far made, this being rendered possible by the new flat disc coil which is Mr. Kinraide's most valuable invention. This consists of No. 34 wire wound concentrically in about 1000 turns and making a disc about 12

inches in diameter. This form of coil will, Mr. Kinraide is confident, supplant the Rumkorff coil splinters to atoms.

The beautifully polished brass sphere from which the current discharges surmounts the apparatus. Upon it the sensitive plate is carefully balanced. When the current is broken the sphere becomes a ball of intensified light. The negative electricity shoots out its graceful, quivering fronds in pale, delicate violet, while the heavier plumous positive glows with a more brilliant intensity, still violet in tinge. Sometimes these gorgeous displays shoot out into the air a length of two or three feet. Sometimes they are much shorter. The length depends somewhat upon the size of the sphere used.

Mr. Kinraide has used spheres from one to eight inches in diameter. He has secured the best results from the five and six-inch spheres. With the large ones he uses the largest plates, 18x22 inches. A record is kept of the exact conditions under which every plate is secured. This record is quite as valuable as the plates, and furnishes a key, as it were, to the various phenomena photographed on them. It gives Mr. Kinraide the materials for an exhaustive treatise. And this he will probably issue at no very distant day. In the meantime, he makes no secret of his work, and in the lecture above referred to, he explained quite fully the construction and working of his apparatus.

HIS X-RAY APPARATUS.

Mr. Kinraide has applied the principle of the flat-disc coil to an X-Ray appliance with remarkably satisfactory results. Several of his X-Ray instruments are in use in this city, one in the Massachusetts General Hospital and one in the Children's Hospital. In both these institutions the operators and physicians speak most enthusiastically of the results obtained. Several prominent physicians of the city are also using them in their private practice. They are valuable not only in radiographing instruments, but on account of their extreme voltage control, as ozone generators.

The electricity by which these machines are operated is the direct or alternating current of the commercial electricity of the city. A machine for alternating current has been completed this week in Mr. Kinraide's laboratory for the Troy (NY) Hospital. Mr. Kinraide will personally set it up there, and start it in operation.

The X-Ray picture of Mr. Kinraide's hand in the plate numbered 4 was taken by one of these instruments. The exposure lasted less than one second. The definition with and without a screen is shown. No such perfect definition has ever been secured in the same length of time. The plate was an ordinary standard plate and no especial pains was taken in developing it. If an especially prepared X-Ray plate had been used it is probably that a much clearer definition would have been secured.

A NEW APPLIANCE FOR WIRELESS TELEGRAPHY.

Probably the most extensive commercial benefits resulting from Mr. Kinraide's experimenting will be in the line of wireless telegraphy. His new coil is destined to revolutionize the apparatus now used for making experiments in this department of electrical science. He has already demonstrated this to his entire satisfaction, and as soon as he is able to discontinue his electrographing work he intends to devote himself exhaustively to perfecting his wireless telegraphy devices. He expects to begin work along this line during the coming summer.

Already he has transmitted signals over short distances with surprising results. His experiments so far have been with the telegraphing device used with wires in lecture halls. With this appliance, yet without even a perpendicular or a ground wire, he has sent signals with perfect ease from the cellar of his house to the cupola, four floors above. This, perhaps, seems simple, but when it is remembered that the house is filled with a network of charged wires in voltages from 20 to 550, with dynamos in constant motion and with storage batteries innumerable, it can be seen that for an electrical impulse to be sent through the various floors and to escape the powerful attractions surrounding it and be recorded by the receiving apparatus is full of significance. As yet, Mr. Kinraide has not used code signals, but he proposes to do so in his forthcoming experiments.

He has had equal success in transmitting electrical impulses from his laboratory to a house at perhaps a quarter of a mile distant. Here, again, neither perpendicular nor ground wire was used, and yet every impulse sent was recorded. This is greater success than that obtained under the recent trials at Blue Hill Observatory, which were carried on under the auspices of the Smithsonian Institution.

All these three instruments made by Mr. Kinraide, the electrographing machine, the X-Ray apparatus, and the perfected wireless telegraphy appliance, owe their remarkable efficiency to the arrangement of the secondary induction coil. This simple invention seems destined to revolutionize one department - and that a most important one - of high voltage electricity. Just how great its value will ultimately become no one is yet able to foresee.

A WONDERFUL LABORATORY.

The inventor of these wonderfully delicate and sensitive machines is not yet 36 years of age. He is not a large man, yet built with the figure of an athlete. It would be difficult to find anywhere a quieter person. He has the blackest of hair and eyes. There is a reserve power about him that commands respect and as soon as he begins to speak one listens involuntarily.

A Post reporter found Mr. Kinraide in his laboratory one day this week. Mr. Kinraide could not be induced to talk about himself, although with cordial courtesy he was willing to talk about the great science in which is so much interested. He allowed the reporter to visit his laboratory and to see the wonderful photographs he has made.

This laboratory is one the most perfectly equipped in the country. Every appliance that could possibly be needed is at hand. It is the workshop of a man of science rather than an artisan. The utmost nearness and order prevail, and not a speck of dust is to be discovered. Mr. Kinraide has in his employ several skilled mechanics. His master workman is one of the cleverest of men in the country in his line of work. There is a constant buzz of turning wheels, as the dynamos are in constant motion. As before noted, these are run by city power. There is one for the 550V commercial volt and one each for the 220, the 110 and the 20-volt current. Besides this direct current Mr. Kinraide makes use of large storage batteries to furnish him with the intermediate voltages, so that he can use a voltage from zero up to an indefinite number.

To look at the outside of this remarkable laboratory one would never suspect its character. "Ravenscroft", which is the name of the house, looks like the residence of a wealthy man. There is no hint that it is the workshop of a great electrician. But as one steps on to the broad piazza and pulls the bell his ear catches at once the buzzing sound within. Then he knows that there is something besides an afternoon tea going on inside. The whole lower floor of the house at the left of the front entrance is given up to the laboratories, the house being specially designed for this purpose. At the right, in front, is Mr. Kinraide's private office, but leading from the small tiled hallway between in a second hall opening into the residential part of the house.

Up from this inner hall leads the broad stairwell to the wide parlors above.

Mr. Kinraide's "dark room" where he makes his photographs, is in the cellar. It is the most interesting room possible to imagine. Access to it is by means of a dark stairwell leading from the office. This stairway is panelled in beautiful polished oak and softly carpeted. The room itself is fitted in the same fashion. It is very large and high studded. A brilliant fire of coals glows in the grate. No ray of sunlight can penetrate this fantastic room but at the touch of a button it can be flooded with brilliant light.

This is, perhaps, the fancy of a man of science. It is certainly a most interesting room. Here Mr. Kinraide takes the wonderful electrographs which are sure to make him famous. Here, too, he has a lantern for throwing on a screen and studying the plates photographed.

Mr. Kinraide, thus fortunately environed, can work with tranquility along the line of his chosen profession, not caring whether the world pays attention to him or no. He does not even advertise the X-Ray machine which he has made, and which is so valuable. "There is no need in doing so," he says. "If a person is in search of an apparatus for X-Ray work he will make inquiries and not be satisfied until he finds the best there is. Naturally a man's investigations would lead him to Boston, which seems to be a centre for this work."

HIS EXPERIMENTS ENDANGER HIS LIFE.

One would not expect from the quiet manner in which Mr. Kinraide talks about his electrical experiments that very much of his work is carried on under the most dangerous conditions. But as a matter of fact he has several times barely escaped electrocuting himself. He frequently receives electrical discharges and his hands show the marks in their seared flesh.

"The nervous strain under which this work is carried on," he said, "is something practically impossible for anyone to realize. After receiving two or three discharges I am unable to work for a considerable time. Then the fascination of the work comes on me again; I simply cannot stop. It is something that takes possession of one and impels him to go on."

Under the constant recognition of this ever imminent danger to which is subject, a curious and highly interesting muscular contraction has developed in Mr. Kinraide's arms. This contraction, wholly involuntarily, is controlled undoubtedly by the nerves of the sympathetic system. It has been the means of saving Mr. Kinraide's life on more than one occasion. It is an instinctive movement which leads him to draw away his arms from the instrument he is working with during the two or three seconds before the force of current, which he recognizes is coming, reaches him. It is a movement which takes place more quickly than it can be controlled by thought.

This would form an interesting study for the psychologist and neurologist. Upon it Mr. Kinraide depends for his safety.

It is perhaps unnecessary to say that Mr. Kinraide is both a man of limitless patience and of great mechanical ability. Had he not been the former, he would never have devoted himself so constantly to his work as to secure the results he has secured; had he not been the latter, he could have never constructed the appliances that have enabled him to reach the front rank among electrical investigators.

Some of the most widely known scientists of this city speak, in most cordial terms of the remarkable achievements of Mr. Kinraide.

Professor Cross of the Massachusetts Institute of Technology says: "Mr. Kinraide's photographs of the electric spark are certainly the most remarkable ever obtained. He has any amount of inventive genius, and is an exceptionally skilled mechanic. I consider his X-Ray screen the best made. Some of his work in acoustics, too, is beyond that done by any other investigator. I am told that his X-Ray machine is the best that has yet been made. His new form of induction coil is certainly very interesting. About its application to wireless telegraphy I do not know, because I have not investigated it. Mr. Kinraide is an exceedingly modest man. His lecture given here before the Society of Arts could not have been more modestly given."

Dr. C. L. Norton spoke of Mr. Kinraide as "an earnest and capable experimenter and a man of dignified standing among the professional scientists of Boston.". He also referred to the various lines of investigation in which Mr. Kinraide had done deeper than any other experimenter.

OTHER INVESTIGATIONS.

Before beginning this work in electricity, Mr. Kinraide has made some very interesting experiments in acoustics. He invented a series of tuning forks which are capable of measuring sound waves from those inaudible to the human ear to those which vibrate over 100,000 times per second. There are about fifty forks in the series. This invention has no practical commercial application, but is of great value in scientific investigation.

The forthcoming exhibit of Mr. Kinraide's photographs in the Old Corner Bookstore will show to the world for the first time the true forms of electricity. It will also show to the Boston public that one of Boston's citizens, hitherto comparatively unknown, is one of the leading electricians of the age. Mr. Kinraide's limitless patience has already met with its own reward in the marvelous results he has secured, but it has not been recognized as it will be when once the public is apprised of his achievements.

The remarkable series of photographs of electricity that are to be placed on exhibition during the coming week in the windows of the Old Corner Bookstore cannot fail to attract the attention of every passer-by. They have already called out unstinting admiration and have provoked the keenest professional interest on the part of the Boston scientists who have been privileged to see them. The general public will have the opportunity to see them probably on Wednesday of this week.

The exclusive story printed in last Sunday's Post told in a general way some facts shown by these truly marvelous pictures. The theory which has presented itself to Mr. Kinraide's mind as an outcome of his experiments in securing them is told here for the first time. It involves nothing less than a theory of the origin of the universe, suns, moons, stars, and planets.

By reference to the plate numbered III, it will be seen that one electrical phenomenon takes the form of a comet. This is a union of the two manifestations of electricity, the positive and the negative, base to base, and, as stated in last Sunday's Post, has never before been seen. Mr. Kinraide has experimented in securing this particular form and has found out under what conditions it can originate. Whenever he takes a notion, he can now go into his dark room and make a shower of these beautiful electrical comets.

From other experiments he has made, he knows that the feathery forms shooting out from the base of the triangular part of the comet are negative and that the nebulous tail is positive.

Mr. Kinraide claims that the conditions under which these comet forms are The products made in his laboratory are the same as those which must have existed millions of aeons ago, when what we may call the universe was in a state of chaos. That is, before the suns and stars were formed.

Of course, Mr. Kinraide reasons, under the same conditions similar results would follow. Then he explains what these results would be. In the first place, he assumes that before the worlds were formed, electricity was present everywhere in the cosmos. It was the only great physical force then operative. Primarily, it then existed in a state of equilibrium.

For some reason or other, the equilibrium was disturbed, and then electrical comets went swinging off into space. The negative, going ahead, would be followed in a headlong chase by its brother, the positive, trying to catch up with it. For how many billions of leagues this great race may have gone on, no one will attempt to say, nor for how many aeons it was kept up. On and on, the chase would sweep through space until something would stop it. But this is how Mr. Kinraide believes it would be stopped. He assumes that in the mad rush, the electrical comet would attract cosmic dust to itself in much the same way that any static electrical machine in a laboratory will quickly gather the motes in the air. As time went on, this accretion of dust would grow greater and greater. Polarization of the dust particles in the comet's path would ensue, and it would whirl along like a great sweeping machine, gathering into itself whatever came in its way.

In time, an enormous mass would be collected. Then the speed of the on-rushing Korce would be retarded, and the positive electricity would be able to overtake and unite with the negative.

Then the cosmic dust, free to follow its own devices, would assume its natural, spherical condition. Thus the worlds were formed.

This, at least, is Mr. Kinraide's theory, based on the marvelous results he has secured in his study of this mighty force. He says that every plate he secures has some new proof for him. He

does not claim that electricity was the life principle, but he believes it was the first great physical force out of which all things else have developed. Beautifully analogous to all things animate, it, though inanimate, has at least a two-part nature, a dual manifestation.

Mr. Kinraide takes a natural pride in his successful inventions, his X-Ray apparatus and his wireless telegraphy devices, both of which are of direct commercial value, but the wonderful vistas of grandeur opening out before him along the line of this theory of the building of the universe so far eclipse in their absorbing interest in all other phases of his study that to which he has given his deepest attention.

It seems perhaps far-fetched that from the study of protographic plates and of the conditions under which they were produced a man can base a theory of world building. But that is what Mr. Kinraide has done. Four years of closest study along this line have taught him wonderful facts, and the theory has worked itself out before his eyes, day by day, until it stands as clearly before him as any other law in nature. He appreciates the vastness of the ideas presented and watches their unfolding with deep reverence.

Mr. Kinraide has been interested in the study of electricity since boyhood. When he was only 10 years old, he began experimenting. Most of his work has been along the lines of independent investigation. He is still a young man, and the world may rightly look to him for other marvelous discoveries.

The Daily Times - Wednesday March 28, 1900

FORMER MONCTON BOY -

In Danger of Becoming Famous.

THOMAS BURTON KINRAIDE OF JAMAICA PLAIN

Has Made Some Remarkable Discoveries in X-Rays and Wireless Telegraphy

The Boston Sunday Post of March 18 devotes a whole page to plates and a description of electrical discoveries made by Thomas Burton Kinraide, of Jamaica Plain, formerly of Moncton. Mr. Kinraide is a son of the late Thomas Kinraide, who for many years ran a woodworking factory on Wesley Street in this town, and is a brother-in-law of Mr. James L. Stanley, foreman of The Times newsroom, and Mr. R. P. Ripley, of the I.C.R. "Bert," as he was "familiarily called here," began his experiments with electricity when a mere boy in a room in his father's house on Wesley Street, traveling to the States about twelve years ago, interested a wealthy gentleman, who, it is understood, furnished him with the means to pursue his work. The results attained, it is stated by the Post, "will attract the attention of scientists the world over." The article in the Post is given in part below:

There is a man in Jamaica Plain who is in danger of becoming one of the most famous scientists in the world. His neighbors don't know it; the general public hasn't the least suspicion of it. Only a few fellow scientists have discovered him. Some of the marvelous results of his years of patient experimentation are told to the public for the first time in today's Post.

Science, unlike most things else, makes famous in a single day such as of her devotees as she designs to grant a place in the roll of her chosen ones. Long years of patient effort, or working in the dark, of seeking after elusive knowledge, may be futile. Many a man knows that to his sorrow, but they may end in a sudden, dazzling burst of radiance that shall leave a halo around a man's head for the rest of his natural life and as long as human knowledge shall be sought after.

The conclusive grasp of some law in nature that no one before has ever been able to fathom raises a man in a day, as soon as it becomes known, from a humble, ordinary citizen to a position of admittedly absolute power in his particular field of investigation. Edison, Harvey, Faraday, Herschel, Marconi, became famous in a day. The world took no note during their years of patient research. It recked no sleepless nights, no repeated failures, no heroic perseverance. But when one morning it awoke and heard the news of marvelous results obtained, then the world bowed its head in admiration of the man whose name the day before it had never heard.

To the famous trio of names so notably associated with the development of electrical appliances, Edison, Tesla, Marconi, it seems that a fourth should be added, and this one,

happily, is that of a Boston man, Thomas B. Kinraide, of Jamaica Plain. Mr. Kinraide himself is not seeking the honor. On the contrary, he shrinks in an exceptional degree from public notoriety; but if the predictions of those who ought to know come true, Mr. Kinraide's achievements cannot fail to make him famous the world over.

Mr. Kinraide is a young man, but he has succeeded in doing several things that no one else has ever done. For one thing, he has succeeded in photographing positive and negative electricity, and has discovered that each has its individual and unvarying form. He has invented a new and powerful form of transmitter to be used in wireless telegraphy, from which he has obtained unprecedented results. He has invented a new form of induction coil and has shown its practical value by its use in his apparatus for X-Ray photography, which is the most valuable ever set up. Besides all this, he has conducted experiments along other scientific lines, and has made a set of instruments that will measure over 100,000 sound vibrations per second.

It seems incredible that a man who has already accomplished so much should be so little known. But the reason for it lies in several causes. One of these is that Mr. Kinraide is an exceedingly modest and equally quiet man; another is that he has always had ample means at his command, so that he has not been obliged to work from a commercial standpoint; while still a third reason is that his experiments have always been carried on in his own house and comparatively few people have known anything about them.

HIS EXPERIMENTS ENDANGER HIS LIFE.

One would not suspect from the quiet manner in which Mr. Kinraide talks about his electrical experiments that very much of his work is carried on under the most dangerous conditions. But as a matter of fact, he has several times barely escaped electrocuting himself. He frequently receives electrical discharges, and his hands show the marks in their seared flesh.

"The nervous strain under which this work is carried on," he said, "is something practically impossible for anyone to realize. After receiving two or three discharges, I am unable to work for a considerable time. Then the fascination of the work comes on me again; I simply cannot stop. It is something that takes possession of one and impels him to go on."

Under the constant awareness of the ever-imminent danger to which he is subjected, a curious and highly interesting muscular contraction has developed in Mr. Kinraide's arms. The contraction, wholly involuntary, is undoubtedly controlled by the nerves of the sympathetic nervous system. It has saved Mr. Kinraide's life on more than one occasion. It is an instinctive movement that leads him to draw his arms away from the instrument he is working with for two or three seconds before the force of the current, which he recognizes is coming, reaches him. It is a movement that takes place more quickly than it could be controlled by thought. This would form an interesting study for the psychologist and neurologist. Mr. Kinraide depends on it for his safety.

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Professor Cross of the Institute of Technology says: "Mr. Kinraide's photographs of the electric spark are certainly the most remarkable ever obtained. He possesses considerable inventive genius and is an exceptionally skillful mechanic. I consider his X-Ray screen the best made. Some of his work in acoustics, too, has surpassed that achieved by any other investigator. I am told that his X-Ray machine is the best that has yet been made. His new form of induction coil is certainly very interesting. I do not know about its application to wireless telegraphy because I have not investigated it. Mr. Kinraide is an exceptionally modest man. His lecture given here before the Society of Arts could not have been more modestly delivered."

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The Daily Times, Saturday June 05, 1900

A FORMER MONCTON BOY

**Makes Some Remarkable Discoveries
In X-Rays and Wireless Telegraphy.**

Results Will Attract the Attention of Scientists the World Over.

Every Day of His Work Endangers His Life, But It Has a Peculiar Charm for Him.

Boston Post Classifies Him With Edison, Tesla, and Marconi

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There is a man in Jamaica Plain who is in danger of becoming one of the most famous scientists in the world. His neighbors don't know it; the general public hasn't the least suspicion of it. Only a few fellow scientists have discovered him. Some of the marvelous results of his years of patient experimentation are being revealed to the public for the first time in today's Post.

Science, unlike most things, makes famous in a single day such as of her devotees as she designs to grant a place among her chosen ones. Long years of patient effort, or working in the dark, seeking after elusive knowledge, may be futile. Many a man knows that to his sorrow, but they may end in a sudden, dazzling burst of radiance that shall leave a halo around a man's head for the rest of his life and as long as human knowledge shall be sought after the conclusive grasp of some law in nature that no one before has ever been able to fathom raises a man in a day, as soon as it becomes known, from a humble, ordinary citizen to a position of admittedly absolute power in his particular field of investigation. Edison, Harvey, Faraday, Herschel, Marconi, became famous in a day. The world took no note during their years of patient research. It receded not of sleepless nights, of repeated failures, of heroic perseverance. But when, one morning, they saw and heard the news of marvelous results obtained, then the world bowed its head in admiration of the man whose name the day before it had never heard. To the famous trio of names so notably associated with the development of electrical appliances—Edison, Tesla, Marconi—it seems that a fourth should be added, and this one, happily, is that of a Boston man, Thomas B. Kinraide, of Jamaica Plain. Mr. Kinraide himself is not seeking the honor. On the contrary, he shrinks in an exceptional degree from public notoriety; but if the predictions of those who ought to know come true, Mr. Kinraide's achievements cannot fail to make him famous the world over.

The Mr. Kinraide referred to is a native of Moncton, son of the late Thomas B. Kinraide. The Post, describing Mr. Kinraide's experimental work, says: A series of photographs has been exhibited in Boston recently, which, in the field they cover, are unquestionably the most remarkable that have ever been captured. They are photographs of electrical discharges, and

they show facts about this mighty force that seem destined to revolutionize the scientific study of electricity and to give impetus to its hitherto undreamed commercial development.

These remarkable photographs—or more properly speaking, electrographs, for electricity was made to take its own picture on sensitive plates—are the work of Thomas B. Kinraide, of Jamaica Plain, Massachusetts. Some of the leading scientists of Boston, including eminent professors of the Massachusetts Institute of Technology and the Lawrence Scientific School, have already seen them and have pronounced them to be altogether the most remarkable pictures of electricity ever obtained. Mr. Kinraide is by no means the first man who has experimented along this line, but he is the first person who has succeeded in differentiating the forms of positive and negative electricity. If his plates showed no more than this, they would be remarkable, but they go even further and show the juncture of the positive and negative, which no one has ever seen before.

Mr. Kinraide has kept a careful record of the conditions under which each of these plates was secured. From the study of the plates and these conditions, he has gained a knowledge of electricity entirely different from that gained by the practical electrician, who knows the force only in its commercially applied manifestations. In other words, he has gone to the very heart of the matter and studied the nature of this mightiest of forces.

People have, for years, even before Ben Franklin flew his little kite into the clouds, been trying to make commercial use of this unknown force. They have studied how to apply it, though not in the least understanding the force itself. In a sense, every experimenter working in the field of electricity has been called a force.

Some have said it was a dual fluid, with manifestations denominated as positive and negative electricity. Another theory has been that it was a single fluid and that the phenomena commonly called negative electricity were simply the withdrawal of positive or real electricity.

Mr. Kinraide claims that his experiments in electrographing have settled this much-debated question once and for all. From the study of these actual pictures of pure electricity, he has been able to discover the true nature of electricity. His knowledge will, of course, when given to the world, make all experimenting with and studying electricity vastly more intelligent. Its effect on development of electricity for commercial uses can as yet be estimated. That it will, Mr. Kinraide feels assured of the incalculable benefit to the world.

Yet this is not all that Mr. Kinraide learns from the study of the marvelous photographs he has secured. Out of his theory of the nature of electricity, he has developed a theory of the building of the worlds, suns, moons, and planets. This is a theory which has never before been advanced. To the few scientists to whom Mr. Kinraide has disclosed this, it has been a most interesting revelation. It has been received with thoughtful and instant attention. Up to the present time, Mr. Kinraide has spoken of it only to his personal friends. Its first public expression is formulated in today's Post.

HOW HE MADE ELECTRICITY TAKES ITS OWN PICTURE

Four years ago, Mr. Kinraide began his attempts to make electricity photography its own. His first concern was to construct an apparatus that would give the most perfect and, at the same time, the most delicate control of electrical discharges. This was the work of months and came only after patient experimentation and heavy periods of discouragement. When he had finally perfected the apparatus, he found that the results he could secure went even beyond his highest hopes. He felt at once that they would be of the greatest scientific value. Moreover, he was filled with amazement at the marvelous beauty of the pictures he secured.

These electrical forms are wonders of graceful design. Negative electricity invariably has the exquisite fern-shaped appearance shown in the halftone reproduction on this page. Kinraide describes this as filiciform, that being the Latin word meaning fern-shaped. Positive electricity has a well-defined feathery appearance, which is more readily noticed when the pictures are enlarged. Strictly speaking, the positive is formless as compared with the complicated form of the negative. Its appearance is that of a cloud, plume-like, very similar to the cat tails of the long-leaved meadow flag. This plume, varying from six to ten inches in length, is supported upon a delicate stem from one to three inches long, the plume is a pale violet color, the stem the vivid white of the electric spark.

Thus far Mr. Kinraide has failed to persuade this form to appear upon the sensitive plate. It is in no way affected by the plate's presence, completely ignoring it, except to fog the plate where it passes through it. Only by using negative electricity in controlling it has he succeeded in photographing modifications of this form.

The halftone reproduction on this page marked "negative electricity in pure form, uninfluenced," is one of a valuable series of pictures of the negative current. The first plate in the series shows just one frond or fern leaf starting from the center. The second shows two or three, and the succeeding plates each show a greater number of fronds until the perfect number seen in the plate here is found. In the printing of each plate, the current is broken but only once, but the delicacy of the apparatus permits the amount of the discharge to be regulated. This graceful and beautiful fern-shape is, Mr. Kinraide believes, the natural form of negative electricity whenever it is discharged into the air and is uninfluenced. To the ordinary person, it is a surprise to be told that electricity has any defined shape. But that it has, Mr. Kinraide's pictures unquestionably prove.

In a recent lecture before a body of scientists at the Massachusetts Institute of Technology, Mr. Kinraide, in referring to this, said: "I trust that I will not be too severely condemned for having become infatuated with the beauty that this work has presented to me. No words that I can use can express the grace and splendor that these forms reveal. To me, it has been a revelation of a beautiful world, hidden above and unknown."

"These beautiful shapes are the true symbols of electricity, and in time to come, I sincerely trust that when we see electricity symbolized, it will be either a figure holding these fronds or the fronds themselves.

"I cannot but feel that the artist will welcome these photographs as studies that cannot be found elsewhere.

"We have all experienced a feeling of awe when dealing with this peculiar force, but have not hitherto seen it in such a way as to be moved to admiration.

Now that the opportunity is presented to you to see this force embodied in its true form, incarnate, as it was, and revealed to your eyes, you will not only know it better, but will give it the sincere appreciation that most certainly is its due. In securing these electrographs, the electric current is made to discharge from a sphere. Sometimes it happens that the sphere attracts electricity to itself from the air. Then there are inward discharges. This creates the most interesting phenomena of all. The Post plate numbered 3, which is a section of a large plate, shows the formation of the inward discharge. It is seen to be both positive and negative. The light, triangular spot has at the base of the triangle the outshooting of the characteristic fern-like negative electricity. From its direction, it can be seen that this is shooting in towards the sphere.

At the apex of the triangle is the positive plumous. Somehow the two merge or are united in the triangular space. Wherever these triangles are found, the arrangement is the same: the negative emerging from the base, the positive from the apex. This particular form of electrical phenomenon has never been seen before—that is, the junction of the positive and negative electricities base to base. This junction has always been hidden in the apparatus in which the electrical charge was developed; only the outer, fern-like negative and plumous positive had to be visible.

This alone contains a world of revelation, which Mr. Kinraide believes is the key that will unlock many of the mysteries hitherto associated with electricity.

It will have particular value in the ultimate conclusion that Mr. Kinraide hopes to reach as a result of his electrographing. It is one of the phenomena upon which he bases his theory as to the nature of electricity. It proves to him that electricity is a single unified force, having two aspects, positive and negative, neither of which is separate from the other. It possesses polarity, but neither aspect can manifest itself singly. Whenever one aspect is visible, the other is always present.

Mr. Kinraide had no preconceived theory as to the nature of electricity when he began his picture-taking. The theory which he now entertains has formed its own in his mind during the years he has been carrying out the investigations. The various phenomena, as they have developed, have all tended to strengthen it. He is sure that the theory that electricity is fluid is disproven. He is equally sure that the two views in regard to its single or dual nature are also untrue.

An exact statement of Mr. Kinraide's views on this subject will form an interesting part of the treatise he intends to issue. This treatise will be a running commentary on the series of electrographs and the conditions under which they were made. As a summary of the knowledge gleaned from the plates, Mr. Kinraide will certainly formulate some views which will be entirely new to the world of scientific investigators in the field of electricity.

FAILURES BEFORE SUCCESS.

In speaking of his many trials before success was reached, Mr. Kinraide said:

"These beautiful and perfect plates do not tell the story of my many failures, but I have a stack of spoiled negatives big enough to make a green-house. Disappointing failures in securing photographs were not, however, my only ones. I first had to construct my apparatus. After I had discovered the secret of the flat-disc coil, I was at the mercy of the condenser for weeks. When I had made that satisfactory, I found that the ordinary oil insulation used in high-voltage apparatus would not withstand the enormous strain. Then I had to work for a long time before I found just the right combination of rosin and beeswax that I now use. Then I had to learn the process of developing my plates, as I could not wait to have them sent out to a photographer. The electrographing apparatus, as it stands in its completed form, is entirely unique. There is no other like it in the world. It controls a higher voltage than any other instrument so far made, this being made possible by the new flat disc coil, which is Mr. Kinraide's most valuable invention. This consists of No. 34 wire wound concentrically in about 1,000 turns, making a disc about twelve inches in diameter. This form of coil will, Mr. Kinraide is confident, supplant the Rumkoff coil in all kinds of electrical appliances used in high-voltage work. It will easily withstand the pressure under which the Rumkoff coil splinters to atoms.

The beautifully polished brass sphere from which the current discharges surmounts the apparatus. Upon it, the sensitive plate is carefully balanced. When the current is broken, the sphere becomes a ball of intensified light. The negative electricity shoots out its graceful, quivering fronds in pale, delicate violet, while the heavier, plumous positive glows with a more brilliant intensity, still violet in tinge. Sometimes they are much shorter. Sometimes these gorgeous displays shoot out into the air to a length of two or three feet. The length depends somewhat upon the size of the sphere used. Mr. Kinraide has used spheres from one to eight inches in diameter. He has obtained the best results from the five-and six-inch spheres. With the The definition has never before been secured in the same length of time. The plate was an ordinary standard plate and no special steps were taken in developing it. If an especially prepared X-Ray plate had been used, it is probable that a much clearer definition would have been secured.

An extensive commercial application of the flat disc coil will be in the line of wireless telegraphy. This coil, Mr. Kinraide believes, is destined to revolutionize the apparatus now used for making experiments in this department of electrical science. He has already demonstrated this to his entire satisfaction, and as soon as he is able to discontinue his electrographing work, he intends to devote himself exclusively to perfecting his wireless telegraphy devices. He expects to begin work along this line during the coming summer. Already he has transmitted signals over short

distances with surprising results. His experiments so far have been with the telegraphing device used with wires in lecture halls. With this appliance, yet without even a perpendicular or a ground wire, he has sent signals with perfect ease from the cellar of his house to the cupola, four floors above. This, perhaps, seems simple but when it is remembered that the house is filled with a network of charged wires in voltages from 20 to 550, with dynamos in constant motion and with countless storage batteries, it can be seen that for an electrical impulse to be sent through the various floors and to escape the powerful attractions surrounding it and be recorded by the receiving apparatus is full of significance. As yet, Mr. Kinraide has not used code signals, but he proposes to do so in his forthcoming experiments.

He has had equal success in transmitting electrical impulses from his laboratory to a house at perhaps a quarter of a mile distant. Here, again, neither perpendicular nor ground wire was used, and yet every impulse sent was recorded. This is greater success than that obtained under the recent trials at Blue Hill Observatory, which were carried on under the auspices of the Smithsonian Institution

A WONDERFUL LABORATORY.

The originator of this interesting theory of world-building is not yet 36 years old. He has been interested in the study of electricity since boyhood. When he was only ten years old, he began experimenting. Most of his work has been along the lines of independent investigation, and because he is so young, the world may rightly look to him for other marvelous discoveries.

To the scientists of Boston, he is already well known, but by the general public, he has scarcely been heard of. This is due to several causes. In the first place, he is an extremely modest man. He shrinks in an exceptional degree from anything which would seem like heralding himself or his work. In the second place, he has always had ample means at his command and so has never been obliged to work along commercial lines and in competition with other experimenters. Still, a third reason is in the fact that all his work has been carried on in his own house where persons other than invited guests have not obstructed. As a consequence, half the people in Jamaica Plain have never even heard of Spring Park Laboratory.

This laboratory, by the way, is a marvel in the perfection of its equipment. It is one of the most perfectly fitted in the country. Every appliance that could possibly be needed is at hand. It is the workshop of a man of science rather than of an artisan. The utmost neatness and order prevail, and not a speck of dust is to be found. Mr. Kinraide employs several skilled mechanics. His master craftsman is one of the cleverest men in the country in his field. There is a constant hum of turning wheels, as the dynamos are in constant motion. As previously noted, these are powered by the city grid. There is one for the 550-volt commercial current and one each for the 220, 110, and 20-volt currents. In addition to this direct current, Mr. Kinraide uses large storage batteries to supply him with intermediate voltages, so that he can use a voltage from zero up to an indefinite number. To look at the outside of this remarkable laboratory, one would never suspect its true nature. "Ravenscroft," which is the name of the house, looks like the residence of a wealthy man.

There is no hint that it is the workshop of a great electrician. But as one steps onto the broad piazza and pulls the bell, his ear immediately catches the buzzing sound within. Then he knows that there is something besides an after-hours tea going on inside. The entire lower floor of the house to the left of the front entrance is given over to the laboratories, the house being specially designed for this purpose. To the right, in front, is Mr. Kinraide's private office, but leading from the small tiled hallway between is a second hall opening into the residential part of the house. Up from this inner hall leads the broad stairway to the wide parlors above.

Mr. Kinraide's "dark room," where he takes his photographs, is in the cellar. It is the most interesting room imaginable. Access to it is by means of a dark stairway leading from the office. This stairway is paneled in beautifully polished oak and softly carpeted. The room itself is fitted in the same style. It is very large and studded. A brilliant fire of coals glows in the grate. No ray of sunlight can penetrate this fantastic room, but at the touch of a button, it can be flooded with brilliant light. This is, perhaps, the fancy of a man of science. It is certainly a most interesting room. Here, Mr. Kinraide takes the wonderful electrographs, which are sure to make him famous. Here, too, he has a lantern for projecting onto a screen and studying the photographed plates. Mr. Kinraide, thus fortunately surrounded, can work with tranquility along the lines of his chosen profession, not caring whether the world pays any attention or not. He does not even advertise the X-Ray machine which he has made, and which is so valuable. "There is no need for me to do so," he says. "If a person is in search of an apparatus for X-Ray work, he will make inquiries and not be satisfied until he finds the best one there is. Naturally, a man's investigations would lead him to Boston, which seems to be a center for this work."

HIS EXPERIMENTS ENDANGER HIS LIFE.

One would not suspect from the quiet manner in which Mr. Kinraide talks about his electrical experiments that very much of his work is carried on under the most dangerous conditions. But as a matter of fact, he has several times barely escaped electrocuting himself. He frequently receives electrical discharges, and his hands show the marks in their seared flesh. "The nervous strain under which this work is carried on," he said, "is something practically impossible for anyone to realize. After receiving two or three discharges, I am unable to work for a considerable time. Then the fascination of the work comes on me again; I simply cannot stop. It is something that takes possession of one and impels him to go on.

Under the constant recognition of the ever-imminent danger to which he is curiously subjected, a curious and highly interesting muscular contraction has developed in Mr. Kinraide's arms. The contraction, wholly involuntary, is undoubtedly controlled by the nerves of the sympathetic nervous system. It has been the means of saving Mr. Kinraide's life on more than one occasion. It is an instinctive movement which leads him to draw his arms away from the instrument he is working with for two or three seconds before the force of the current has time to become fatal. It is a movement which takes place more quickly than it could be controlled by thought.

This would form an interesting study for the psychologist and neurologist. Upon it, Mr. Kinraide depends for his safety.

It is perhaps unnecessary to say that Mr. Kinraide is both a man of limitless patience and of great mechanical ability. Had he not been the former, he would never have devoted himself so constantly to his work to secure the results he has obtained; had he not been the latter, he would never have constructed the applications that have enabled him to reach the front rank among electrical investigators. Some of the most widely known scientists of this city speak in the most cordial terms of the remarkable achievements of Mr. Kinraide. Professor Cross, of the Institute of Technology says: "Mr. Kinraide's photographs of the electric spark are certainly the most remarkable ever obtained. He has any amount of inventive genius and is an exceptionally skillful mechanic. I consider his X-Ray screen the best made."

Some of his work in acoustics, to date, has gone beyond that done by any other investigator. I am told that his X-Ray machine is the best that has yet been made. His new form of induction coil is certainly very interesting. About its application to wireless telegraphy, I do not know, because I have not investigated it. Mr. Kinraide is an exceedingly modest man. His lecture given here before the Society of Arts could not have been more modestly given." Dr. C. L. Norton spoke of Mr. Kinraide as "an earnest and capable experimenter and a man of dignified standing among the professional scientists of Boston." He also referred to the various lines of investigation in which Mr. Kinraide had gone deeper than any other experimenter.

OTHER INVESTIGATIONS.

Before beginning this work in electricity, Mr. Kinraide had made some very interesting experiments in acoustics. He invented a series of forks and a device for measuring their wave length, which are capable of measuring sound waves from those inaudible to the human ear to those which vibrate over 100,000 times per second. There are about fifty forks in the series. This invention has no practical commercial application, but is of great value to scientific investigation. It should be added to this that out of his theory of world-building, Mr. Kinraide has developed, what seems to him even grander and more beautiful, a theory of eternity, of the Deity and of man's relation to the universe. This is still developing in his mind. "As yet," he says, "I have begun to get a glimpse of wondrous truths, hitherto hidden, and I have hardly had time to catch my breath since. The marvelous and satisfying beauty of these truths is growing on me every day." This theory of man's relation to the Universe is the direct outgrowth of Mr. Kinraide's experiments with electricity. It is, by far, the most beautiful and ennobling part of his work, but he has not yet formulated his views with sufficient clarity to make him willing to give them public expression.

ELECTRICITY: THE FORCE THAT BUILT THE UNIVERSE.

The theory of world-building, which has presented itself to Mr. Kinraide's mind in connection with his study of electricity, is the simplest of the many theories that have been propounded. He has developed it by analogy until it reaches into what people are accustomed to speak of as the spiritual world—until it embraces, indeed, almost every field of human knowledge.

By reference, again, to plate numbered III, it will be seen that the junction of the positive and negative electricity base to base takes the form of a comet. In securing this particular form, Mr.

Kinraide has carefully studied the conditions under which it was made. He can now bring up these conditions at will, and whenever it pleases him, he can go into his dark room and make a shower of these beautiful comets.

He claims that the conditions under which they are made in his laboratory are the same as those which must have existed millions of aeons ago, when what we may call the universe was in a state of chaos. This is, before the suns and stars were formed.

Of course, Mr. Kinraide reasons, under the same conditions similar results would follow. Then he explains what these results would be. In the first place, he assumes that before the worlds were formed, electricity was present everywhere in the cosmos. It was the only great physical force then operative. Primarily, it then existed in a state of equilibrium.

For some reason or other, the equilibrium was disturbed, and then electrical comets went swinging off into space. The negative one, going ahead, would be followed in a headlong chase by its brother, the positive one, trying to catch up with it. How many billions of leagues this great race may have gone on, no one will attempt to say, nor how many aeons it was kept up. But on and on, the chase would sweep through space until something would stop it.

This is how Mr. Kinraide believes it would be stopped. He assumes that in the mad rush, the electrical comet would attract cosmic dust to itself in much the same way that any static electrical machine in a laboratory will quickly gather the motes in the air to itself. As time went on, this accretion of dust would grow greater and greater. Polarization of the dust particles in the comet's path would ensue, and it would whirl along like a great sweeping machine, gathering into itself whatever came in its way...

In time, an enormous mass would be collected. Then the speed of the on-rushing force would be retarded, and the positive electricity would be able to overtake and unite with the negative. Then the cosmic dust, free to follow its own devices, would assume its natural, spherical condition. Thus the worlds were formed. This, at least, is Mr. Kinraide's theory, based on the marvelous results he has secured in his study of this mighty force. He says that every plate he secures has some new proof for him. He does not claim that electricity was the life principle, but he believes it was the first great physical force out of which all things else have developed. Beautifully analogous to all things animate, it, though inanimate, has at least a two-part nature, a dual manifestation.

Mr. Kinraide takes a natural pride in his successful inventions, his X-Ray apparatus and his wireless telegraphy devices, both of which are of direct commercial value, but the wonderful vistas of grandeur opening out before him along the line of this theory of the building of the universe so far eclipse in their absorbing interest all other phases of his study to which he has given his deepest attention.

It seems perhaps far-fetched that from the study of photographic plates and of the conditions under which they were produced a man can base a theory of world building. But that is what Mr.

Kinraide has done. Four years of closest study along this line have taught him wonderful facts, and the theory has worked itself out before his eyes, day by day, until it stands as clearly before him as any other law in nature. He appreciates the vastness of the ideas presented and watches their unfolding with deep reverence.

SOCIETY MEETING.

ELEVENTH ANNUAL MEETING OF AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THIRD DAY-THURSDAY, SEPTEMBER 26, CONTINUED.

Report of the Committee on Roentgen Ray - Dr. C. O. Files of Portland - Discussion.

*Held at Buffalo, N.Y., September 24, 25, and 26, 1901. Ernest Wende, M.D., of Buffalo, President

Dr. Charles O. Files of Portland, M.D., presented the report of the Committee on Roentgen Ray, and then asked that, in this connection, Mr. T. B. Kinraide of Boston be asked to describe the coil that he had devised. Mr. Kinraide described his apparatus as desired.

Mr. T. B. Kinraide of Boston said: The coil I have succeeded in making was the result of the repeated breaking down of the Ruhmkorff coils ranging from six to eighteen or twenty inches. I have succeeded very well in removing from the apparatus the danger of destruction so common to the ordinary Ruhmkorff coil. The high-potential regions of the Ruhmkorff coil are very close to the primary (see Fig. 1), being moved only by the strength of the insulation between the outer sections carrying high potential (D and E), and the iron core of the primary. In my experiments, the great difficulty met with was that the Ruhmkorff coil would break down, even through half-inch tubing covering the core. My object was to remove the high-potential region of the coil as far as possible from the primary. In my coil this has been done, the low-potential

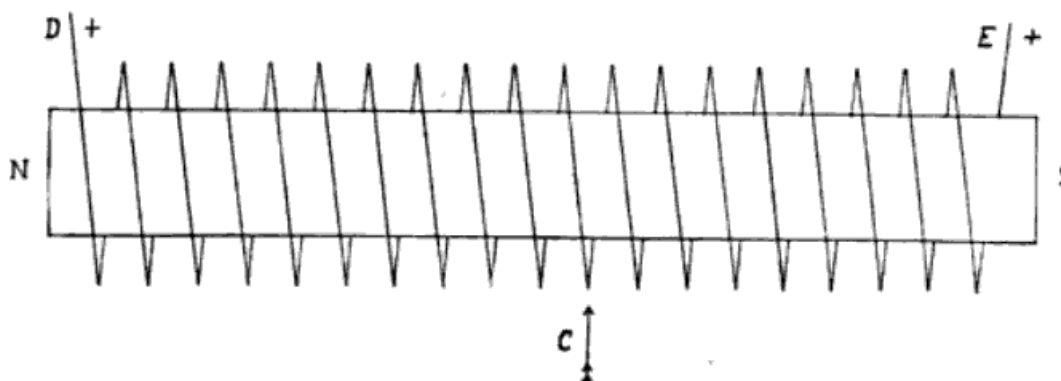


Fig. 1. D, and E, high-potential N. S. iron, are of the primary coil. C, low-potential region.

region of the single coil (G, Fig. 2) being the only part it could come in contact with. By a diagram on the blackboard showing the old cylindrical primary with its lines of force let me illustrate the action of these lines, and call attention to the fact that the moment the current is broken these lines of force

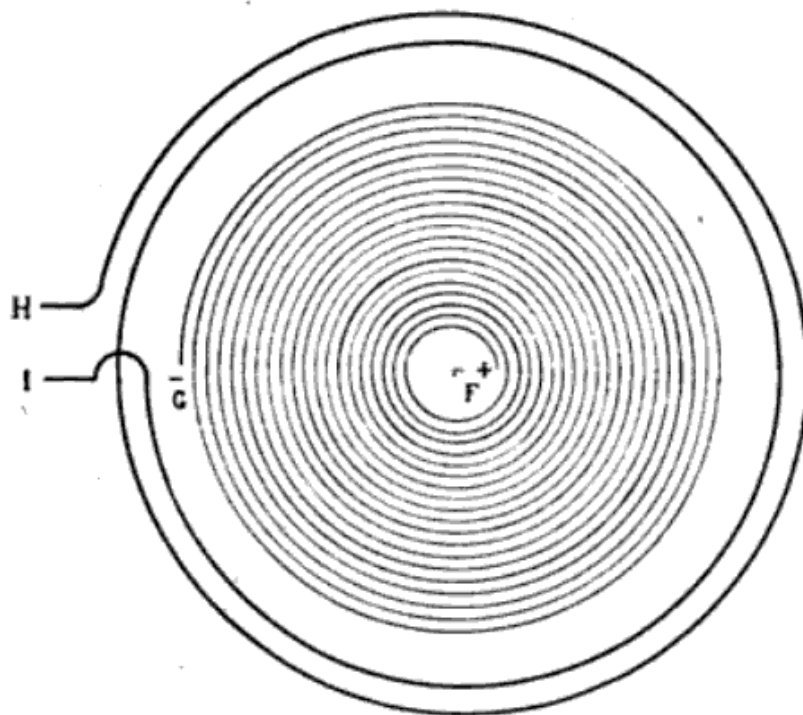


Fig. 2 Primary, low-potential region of high potential (H—I primary).

collapse and fall inward in the direction of the arrows (Fig. 3). In this way the highest potential is produced in the outer terminal of a thin flat spiral secondary, if located in the plane of the arrows, and the low potential at the center. By that method of winding, as the turns grow longer, the resistance per turn increases, and the tendency of the discharge to pass from one turn to the other increases. If a suitable primary were placed on the outside of this secondary, as in Fig. 2, the reverse would be the case, and hence the tendency to break down would be entirely removed in the section of the secondary. In my coil this is the arrangement adopted, and the lines of force fall away from the center towards the primary in the direction of the arrows in Fig. 4, producing a very high potential

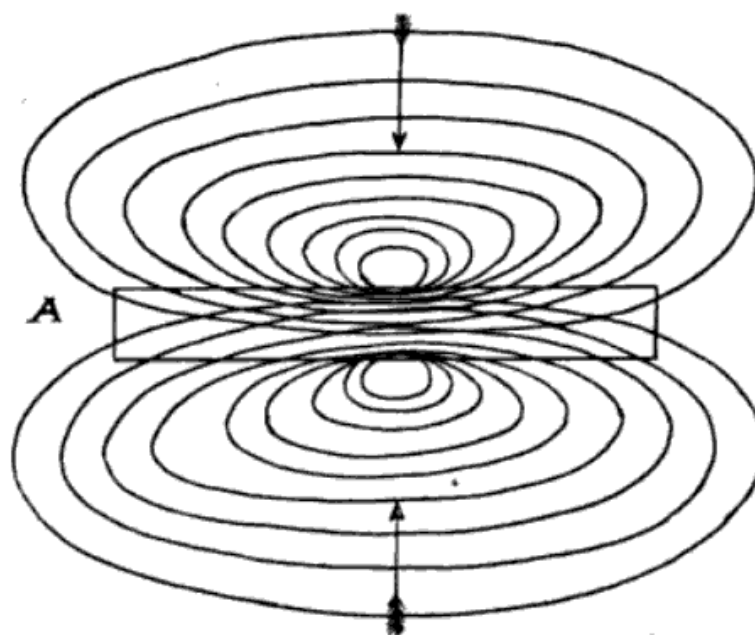


Fig. 3. Lines of force fall in the arrows in the older form of coil.

at the center (F, Fig. 2), and practically very little or no potential at the outer turns (G, Fig. 2), so that the center discharges in the proportion of about six inches towards the earth

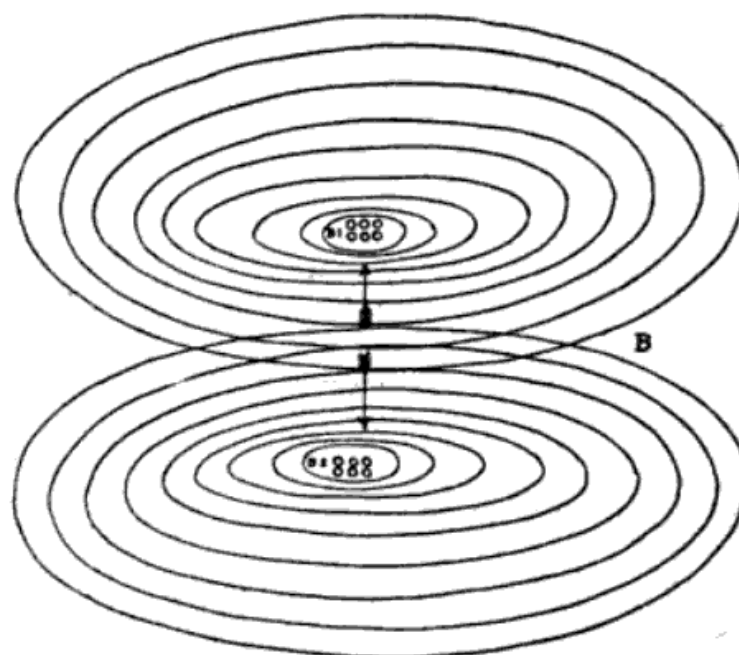
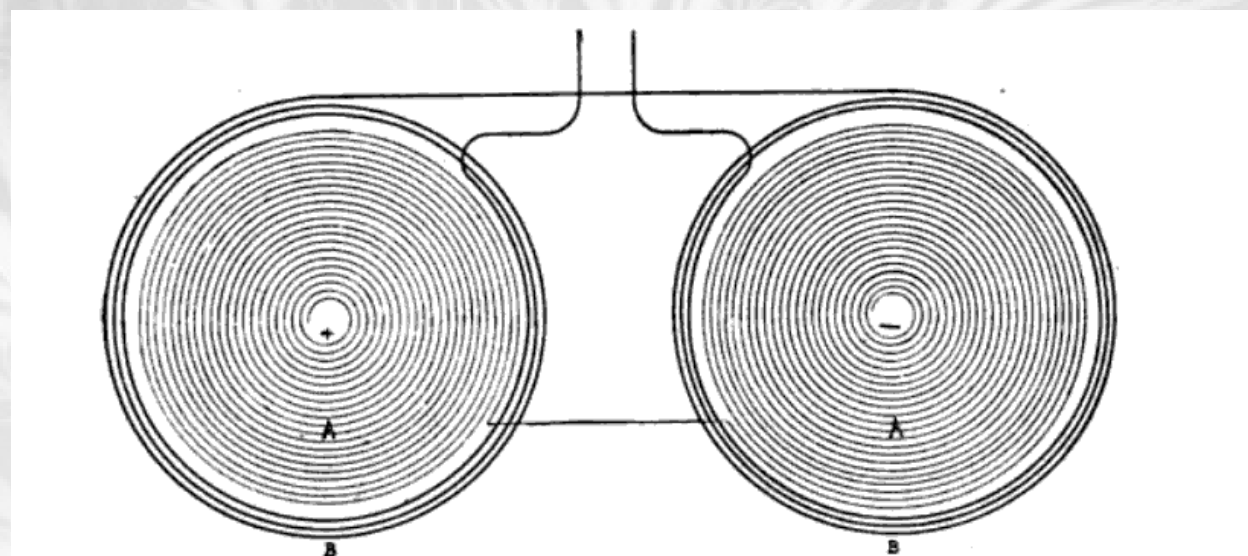


Fig. 4. Shows the arrangement by which the lines of force fall away from the center towards the primary, as indicated by the arrows.

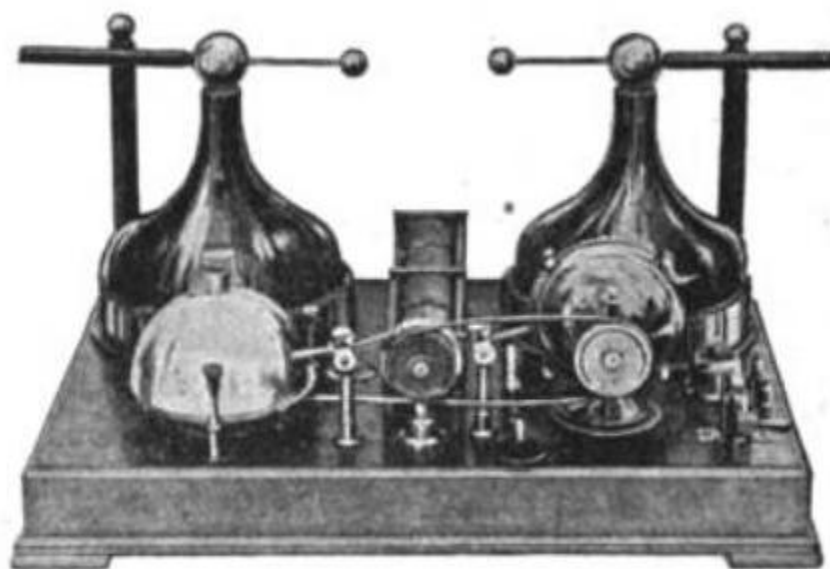
wire whilst the outer terminal discharges about three-fourths of an inch only. To remove all tendency of discharge towards the primary, two of these coils were placed side by side (see Fig. 5). The two primaries are so arranged that a high-potential positive and negative is obtained from the center terminals of the secondaries. There is practically no tendency whatever in this form of coil to break down. The primary is operated by a form of spark-gap, the efficiency of which is due to a low-potential current discharging across a very small air space, and



**Fig. 5. Shows the arrangement of two coils side by side: A.A, secondary.
B, B, primary.**

producing erosion of copper plates, which interrupt the circuit in the primary. The condenser has about 900 volts and is discharged through both primary circuits, producing a great many interruptions per second in the circuit of the induction coil proper. In the device used for charging the condenser there is a rotary brake in the circuit, with a coil connected with the street main. At each interruption of the latter coil the induced current charges the condenser, and with each charge, instead of the condenser breaking down, there is a breakdown at the air gap. This air gap is regulated at will by means of a lever. The rotary brake makes about 2400 interruptions per minute, and with each interruption here there are from 20 to 25 interruptions in the primary circuit of the induction coils, thus giving about 48,000 interruptions per minute. It is largely due to this very high frequency that the time of exposure for photographic work is so greatly reduced. If two wires are placed in the upper portions of the coils, they discharge freely into the air. If the discharge terminals are so far apart that the discharge will not pass between them, it passes just as freely through the atmosphere as if the poles were in contact. This furnishes an additional safeguard. There is no heating whatever in the large copper wire forming the primary, whilst the heating of the primary of the Ruhmkorff coil in close contact with the insulating compound of the secondary is too well known to comment upon. The secondary is embedded in a solid insulation of rosin and beeswax. My remarks on the Ruhmkorff coil are not intended to be derogatory of that coil, for I think too much of it, but I must necessarily make comparisons in order to show the distinguishing features of my apparatus. One excellent feature of the entire machine is that, if anything should happen to any part of it, it can be repaired at slight expense.

The apparatus weighs only about seventy-five pounds, and can therefore be taken to hospital wards or to a patient's house. I do not know exactly what the value of this apparatus is in electro-therapeutic work, but I think there is a good field for it. The instrument, by special winding, can be adapted to any form of current.



The Kinraide Coil.

Dr. R. J. Nunn said that Mr. Kinraide possessed remarkably fine photographs of sparks, and he would ask that Mr. Kinraide be requested to exhibit them at the next meeting of the Association.

Dr. W. H. White heartily endorsed this suggestion as, he said, the work was exceptionally fine.

The president then formally invited Mr. Kinraide to have these photographs at the next meeting of the Association.

Mr. Kinraide: When the apparatus is properly arranged there is produced from the center terminal a peculiar light violet discharge, coming out in thin streamers of such high potential that one can put the hands or the face in the path of the discharge and feel no shock. Along with this discharge is a tremendous generation of ozone, or correctly speaking, ozone and nitrous acid.

Dr. W. J. Morton asked for further information as to the nature of the discharge from the secondary; whether it is snappy and sharp, or bluish.

Mr. Kinraide: The discharge can be varied very considerably by simply moving the spark-gap plates to a greater or lesser distance from each other. When close together, the frequency of the discharge from the condenser is the greatest, and the result is a very hot and very severe current. When these plates are farther apart the condenser discharges in such a way as to produce a high frequency of vibration and almost painless discharge in the secondary. The low

potential obtained by having the plates rather close together gives the best results in X-Ray work.

Mr. R. G. Brown's article on "Organization of the Second International Congress of Electro-Therapeutists" was ordered read by title.

Dr. Newman, having learned of the complimentary action taken by the Association in regard to himself, asked the privilege of expressing at that time his sincere thanks for the resolution that the Association had passed expressive of its appreciation of his work.

Dr. Ernest Wende, in handing over the gavel to Dr. Frederic H. Morse, the president-elect, said: "My troubles are ended, and your troubles will now begin."

Dr. F. H. Morse: Dr. Newman assures me that he will try to live another year, and under those circumstances my work will be easy. I thank you for the honor conferred upon me, and assure you that I shall endeavor to do my best.

The following were announced as constituting the special committee on the nature of currents from static machines: Messrs. A. E. Kennelly and W. G. Jenks and Professor Samuel Sheldon of Brooklyn.

On motion of Dr. Reyburn, Dr. W. J. Morton was added to this committee.

On motion, the Association finally adjourned at 12:00

asked
for to let me
see photos - & explain the significance briefly.

July 22, 1901.

Monday Morning.

Mr. Gilder,

Editor Century Magazine,
New York City.

My dear Mr. Gilder,

Mr. Thomas B. Kewraide
of Jamaica Plain has, in
the course of extended ex-
periments, secured some
very remarkable and val-
uable photographic plates
containing records of elec-
trical discharges. These are
entirely different from
any plates of the kind
heretofore secured. They
show several things that

copying, Mass.

Mass.

no ^{other} photographs of electricity have ever shown. Prof. Cross of the Massachusetts Institute of Technology will be glad to assure you of their scientific value should you care to correspond with him on the subject.

I may add that the Institute has recently accepted from Mr. Kinraide a set of about fifty plates.

I have thought you might like to reproduce some of these plates - Mr. Kinraide speaks of them as "electrographs" - in the "Century". Mr. Kinraide has selected a small number, and has kindly allowed me to write a descriptive text explaining their meaning and the conditions under which the different ones were secured.

I think you might be interested to visit Mr. Kinraide's laboratory and to see for yourself what he has done in this and other lines of electrical investigation. Should you care to do this, Mr. Kinraide will be glad to welcome you and to arrange for you to meet Prof. Cross there.

You would then be able to satisfy yourself
as to the scientific value of these electrographs
and to judge whether or not an article in
regard to them would be desirable for the "Ben-
tury".

Trusting you will find it agree-
able to investigate Mr. Kinnaird's work,

Yours,
"Mr. Kinnaird's address is
Thomas B. Kinnaird, Esq.
Spring Park Ave.
Lanham Place,
Mass."

Very truly yours.
(Miss) Anabel Parker.
76 Munroe St.
Roxbury, Mass.

July 22, 1901
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Editor Century Magazine, -
New York City.

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(Miss) Anabel Parker
76 Munroe St.
Roxbury, Mass.

Mr. Kinraide’s address is
Thomas B. Kinraide, Esq.
Spring Park Ave.
Jamaica Plain,
Mass.

Roxbury, Mass.

July 25, 1901.

Mr. R. U. Johnson,
New York City.

My Dear Mr. Johnson:--

Your kind reply to me, under date of July 24,
is at hand.

You mention an article on Mr. Tesla's work printed in The Century Magazine for June, 1890. I think you must refer to the one that appeared in the issue for June 1900. That is on entirely different lines from the sketch of Mr. Kinraide's work which I have written.

As soon as I can communicate with Mr. Kinraide, who is just now out of town, I will forward to you the photographs together with the descriptive text.

Meantime, both Mr. Kinraide and myself would be glad to have you communicate with Prof. Cross whom you doubtless know by reputation.

Very truly yours,

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CENTURY
MAGAZINE

VOL. 60
—
1900

THE PROBLEM OF INCREASING HUMAN ENERGY.

WITH SPECIAL REFERENCE TO THE HARNESSING
OF THE SUN'S ENERGY.

BY NIKOLA TESLA.

ILLUSTRATED BY THE WRITER'S ELECTRICAL EXPERIMENTS, NOW FIRST PUBLISHED.

THE ONWARD MOVEMENT OF MAN—THE
ENERGY OF THE MOVEMENT—THE THREE
WAYS OF INCREASING HUMAN ENERGY.

OF all the endless variety of phenomena which nature presents to our senses, there is none that fills our minds with greater wonder than that inconceivably complex movement which, in its entirety, we designate as human life. Its mysterious origin is veiled in the forever impenetrable mist of the past, its character is rendered incomprehensible by its infinite intricacy, and its destination is hidden in the unfathomable depths of the future. Whence does it come? What is it? Whither does it tend? are the great questions which the sages of all times have endeavored to answer.

Modern science says: The sun is the past, the earth is the present, the moon is the future. From an incandescent mass we have originated, and into a frozen mass we shall turn. Merciless is the law of nature, and rapidly and irresistibly we are drawn to our doom. Lord Kelvin, in his profound meditations, allows us only a short span of life, something like six million years, after which time the sun's bright light will have ceased to shine, and its life-giving heat will have ebbed away, and our own earth will be a lump of ice, hurrying on through the eternal night. But do not let us despair. There will still be left on it a glimmering spark of life, and there will be a chance to kindle a new fire on some distant star. This wonderful possibility seems, indeed, to exist, judging from Professor Dewar's beautiful experiments with liquid air, which show that germs of organic life are not destroyed by cold, no matter how intense; consequently they may be transmitted through the interstellar space. Meanwhile the cheering lights of science and art, ever increasing in intensity, illuminate our path, and the marvels they disclose, and the enjoyments they offer,

make us measurably forgetful of the gloomy future.

Though we may never be able to comprehend human life, we know certainly that it is a movement, of whatever nature it be. The existence of a movement unavoidably implies a body which is being moved and a force which is moving it. Hence, wherever there is life, there is a mass moved by a force. All mass possesses inertia, all force tends to persist. Owing to this universal property and condition, a body, be it at rest or in motion, tends to remain in the same state, and a force, manifesting itself anywhere and through whatever cause, produces an equivalent opposing force, and as an absolute necessity of this it follows that every movement in nature must be rhythmical. Long ago this simple truth was clearly pointed out by Herbert Spencer, who arrived at it through a somewhat different process of reasoning. It is borne out in everything we perceive—in the movement of a planet, in the surging and ebbing of the tide, in the reverberations of the air, the swinging of a pendulum, the oscillations of an electric current, and in the infinitely varied phenomena of organic life. Does not the whole of human life attest it? Birth, growth, old age, and death of an individual, family, race, or nation, what is it all but a rhythm? All life-manifestation, then, even in its most intricate form, as exemplified in man, however involved and inscrutable, is only a movement, to which the same general laws of movement which govern throughout the physical universe must be applicable.

When we speak of man, we have a conception of humanity as a whole, and before applying scientific methods to the investigation of his movement, we must accept this as a physical fact. But can any one doubt to-day that all the millions of individuals and all the innumerable types and characters constitute an entity, a unit? Though free to

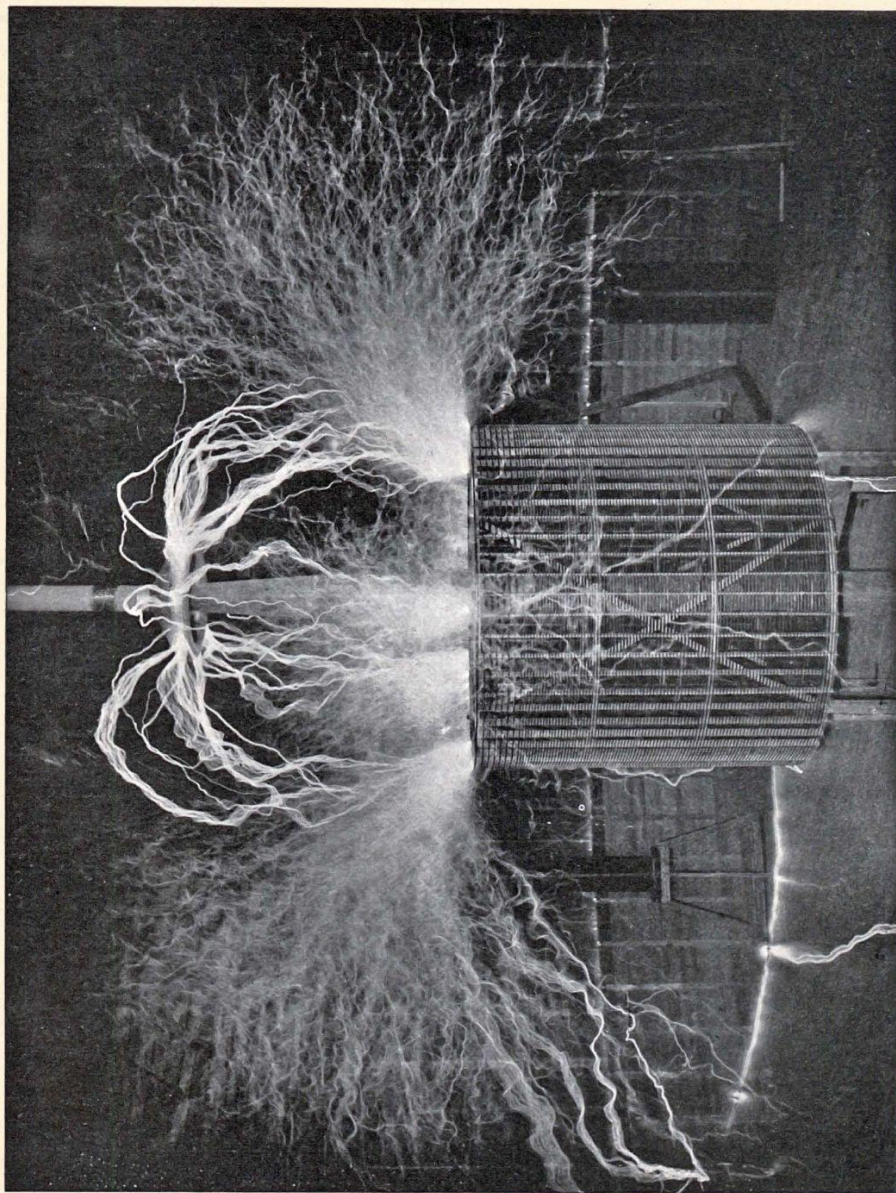


FIG. 1. BURNING THE NITROGEN OF THE ATMOSPHERE.

NOTE TO FIG. 1.—This result is produced by the discharge of an electrical oscillator giving twelve million volts. The electrical pressure, alternating one hundred thousand times per second, excites the normally inert nitrogen, causing it to combine with the oxygen. The flame-like discharge shown in the photograph measures sixty-five feet across.

THE PROBLEM OF INCREASING HUMAN ENERGY.

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think and act, we are held together, like the stars in the firmament, with ties inseparable. These ties we cannot see, but we can feel them. I cut myself in the finger, and it pains me: this finger is a part of me. I see a friend hurt, and it hurts me, too: my friend and I are one. And now I see stricken down an enemy, a lump of matter which, of all the lumps of matter in the universe, I care least for, and still it grieves me. Does this not prove that each of us is only a part of a whole?

For ages this idea has been proclaimed in the consummately wise teachings of religion, probably not alone as a means of insuring peace and harmony among men, but as a deeply founded truth. The Buddhist expresses it in one way, the Christian in another, but both say the same: We are all one. Metaphysical proofs are, however, not the only ones which we are able to bring forth in support of this idea. Science, too, recognizes this connectedness of separate individuals, though not quite in the same sense as it admits that the suns, planets, and moons of a constellation are one body, and there can be no doubt that it will be experimentally confirmed in times to come, when our means and methods for investigating psychical and other states and phenomena shall have been brought to great perfection. Still more: this one human being lives on and on. The individual is ephemeral, races and nations come and pass away, but man remains. Therein lies the profound difference between the individual and the whole. Therein, too, is to be found the partial explanation of many of those marvelous phenomena of heredity which are the result of countless centuries of feeble but persistent influence.

Conceive, then, man as a mass urged on by a force. Though this movement is not of a translatory character, implying change of place, yet the general laws of mechanical movement are applicable to it, and the energy associated with this mass can be measured, in accordance with well-known principles, by half the product of the mass with the square of a certain velocity. So, for instance, a cannon-ball which is at rest possesses a certain amount of energy in the form of heat, which we measure in a similar way. We imagine the ball to consist of innumerable minute particles, called atoms or molecules, which vibrate or whirl around one another. We determine their masses and velocities, and from them the energy of each of these minute systems, and adding them all together, we get

an idea of the total heat-energy contained in the ball, which is only seemingly at rest. In this purely theoretical estimate this energy may then be calculated by multiplying half of the total mass—that is, half of the sum of all the small masses—with the square of a velocity which is determined from the velocities of the separate particles. In like manner we may conceive of human energy being measured by half the human mass multiplied with the square of a velocity which we are not yet able to compute. But our deficiency in this knowledge will not vitiate the truth of the deductions I shall draw, which rest on the firm basis that the same laws of mass and force govern throughout nature.

Man, however, is not an ordinary mass, consisting of spinning atoms and molecules, and containing merely heat-energy. He is a mass possessed of certain higher qualities by reason of the creative principle of life with which he is endowed. His mass, as the water in an ocean wave, is being continuously exchanged, new taking the place of the old. Not only this, but he grows, propagates, and dies, thus altering his mass independently, both in bulk and density. What is most wonderful of all, he is capable of increasing or diminishing his velocity of movement by the mysterious power he possesses of appropriating more or less energy from other substance, and turning it into motive energy. But in any given moment we may ignore these slow changes and assume that human energy is measured by half the product of man's mass with the square of a certain hypothetical velocity. However we may compute this velocity, and whatever we may take as the standard of its measure, we must, in harmony with this conception, come to the conclusion that the great problem of science is, and always will be, to increase the energy thus defined. Many years ago, stimulated by the perusal of that deeply interesting work, Draper's "History of the Intellectual Development of Europe," depicting so vividly human movement, I recognized that to solve this eternal problem must ever be the chief task of the man of science. Some results of my own efforts to this end I shall endeavor briefly to describe here.

Let, then, in diagram *a*, *M* represent the mass of man. This mass is impelled in one direction by a force *f*, which is resisted by another partly frictional and partly negative force *R*, acting in a direction exactly opposite, and retarding the movement of the mass. Such an antagonistic force is present

in every movement, and must be taken into consideration. The difference between these two forces is the effective force which imparts a velocity V to the mass M in the direction of the arrow on the line representing the force f . In accordance with the pre-

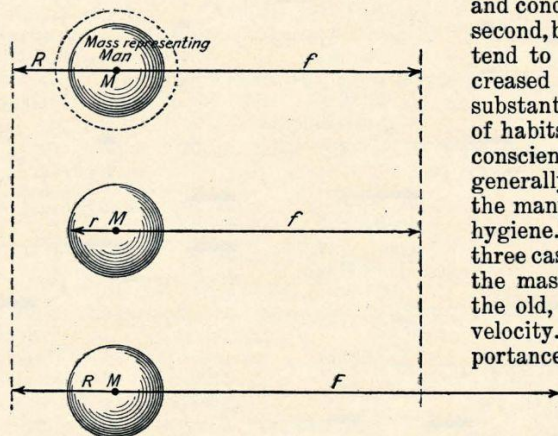


DIAGRAM a. THE THREE WAYS OF INCREASING HUMAN ENERGY.

ceding, the human energy will then be given by the product $\frac{1}{2} MV^2 = \frac{1}{2} MV \times V$, in which M is the total mass of man in the ordinary interpretation of the term "mass," and V is a certain hypothetical velocity, which, in the present state of science, we are unable exactly to define and determine. To increase the human energy is, therefore, equivalent to increasing this product, and there are, as will readily be seen, only three ways possible to attain this result, which are illustrated in the above diagram. The first way, shown in the top figure, is to increase the mass (as indicated by the dotted circle), leaving the two opposing forces the same. The second way is to reduce the retarding force R to a smaller value r , leaving the mass and the impelling force the same, as diagrammatically shown in the middle figure. The third way, which is illustrated in the last figure, is to increase the impelling force f to a higher value F , while the mass and the retarding force R remain unaltered. Evidently fixed limits exist as regards increase of mass and reduction of retarding force, but the impelling force can be increased indefinitely. Each of these three possible solutions presents a different aspect of the main problem of increasing human energy, which is thus divided into three distinct problems, to be successively considered.

THE FIRST PROBLEM: HOW TO INCREASE THE HUMAN MASS—THE BURNING OF ATMOSPHERIC NITROGEN.

VIEWED generally, there are obviously two ways of increasing the mass of mankind: first, by aiding and maintaining those forces and conditions which tend to increase it; and, second, by opposing and reducing those which tend to diminish it. The mass will be increased by careful attention to health, by substantial food, by moderation, by regularity of habits, by the promotion of marriage, by conscientious attention to the children, and, generally, stated, by the observance of all the many precepts and laws of religion and hygiene. But in adding new mass to the old, three cases again present themselves. Either the mass added is of the same velocity as the old, or it is of a smaller or of a higher velocity. To gain an idea of the relative importance of these cases, imagine a train composed of, say, one hundred locomotives running on a track, and suppose that, to increase the energy of the moving mass, four more locomotives are added to the train. If these four move at the

same velocity at which the train is going, the total energy will be increased four per cent.; if they are moving at only one half of that velocity, the increase will amount to only one per cent.; if they are moving at twice that velocity, the increase of energy will be sixteen per cent. This simple illustration shows that it is of the greatest importance to add mass of a higher velocity. Stated more to the point, if, for example, the children be of the same degree of enlightenment as the parents,—that is, mass of the "same velocity,"—the energy will simply increase proportionately to the number added. If they are less intelligent or advanced, or mass of "smaller velocity," there will be a very slight gain in the energy; but if they are further advanced, or mass of "higher velocity," then the new generation will add very considerably to the sum total of human energy. Any addition of mass of "smaller velocity," beyond that indispensable amount required by the law expressed in the proverb, "Mens sana in corpore sano," should be strenuously opposed. For instance, the mere development of muscle, as aimed at in some of our colleges, I consider equivalent to adding mass of "smaller velocity," and I would not commend it, although my views were different when I was a student myself. Moderate exercise, insuring the right balance between

mind and body, and the highest efficiency of performance, is, of course, a prime requirement. The above example shows that the most important result to be attained is the education, or the increase of the "velocity," of the mass newly added.

Conversely, it scarcely need be stated that everything that is against the teachings of religion and the laws of hygiene is tending to decrease the mass. Whisky, wine, tea, coffee, tobacco, and other such stimulants are responsible for the shortening of the lives of many, and ought to be used with moderation. But I do not think that rigorous measures of suppression of habits followed through many generations are commendable. It is wiser to preach moderation than abstinence. We have become accustomed to these stimulants, and if such reforms are to be effected, they must be slow and gradual. Those who are devoting their energies to such ends could make themselves far more useful by turning their efforts in other directions, as, for instance, toward providing pure water.

For every person who perishes from the effects of a stimulant, at least a thousand die from the consequences of drinking impure water. This precious fluid, which daily infuses new life into us, is likewise the chief vehicle through which disease and death enter our bodies. The germs of destruction it conveys are enemies all the more terrible as they perform their fatal work unperceived. They seal our doom while we live and enjoy. The majority of people are so ignorant or careless in drinking water, and the consequences of this are so disastrous, that a philanthropist can scarcely use his efforts better than by endeavoring to enlighten those who are thus injuring themselves. By systematic purification and sterilization of the drinking-water the human mass would be very considerably increased. It should be made a rigid rule—which might be enforced by law—to boil or to sterilize otherwise the drinking-water in every household and public place. The mere filtering does not afford sufficient security against infection. All ice for internal uses should be artificially prepared from water thoroughly sterilized. The importance of eliminating germs of disease from the city water is generally recognized, but little is being done to improve the existing conditions, as no satisfactory method of sterilizing great quantities of water has as yet been brought forward. By improved electrical appliances we are now enabled to produce ozone cheaply and in large amounts, and this ideal disin-

fectant seems to offer a happy solution of the important question.

Gambling, business rush, and excitement, particularly on the exchanges, are causes of much mass-reduction, all the more so because the individuals concerned represent units of higher value. Incapacity of observing the first symptoms of an illness, and careless neglect of the same, are important factors of mortality. In noting carefully every new sign of approaching danger, and making conscientiously every possible effort to avert it, we are not only following wise laws of hygiene in the interest of our well-being and the success of our labors, but we are also complying with a higher moral duty. Every one should consider his body as a priceless gift from one whom he loves above all, as a marvelous work of art, of undescrivable beauty and mastery beyond human conception; and so delicate and frail that a word, a breath, a look, nay, a thought, may injure it. Uncleanliness, which breeds disease and death, is not only a self-destructive but a highly immoral habit. In keeping our bodies free from infection, healthful, and pure, we are expressing our reverence for the high principle with which they are endowed. He who follows the precepts of hygiene in this spirit is proving himself, so far, truly religious. Laxity of morals is a terrible evil, which poisons both mind and body, and which is responsible for a great reduction of the human mass in some countries. Many of the present customs and tendencies are productive of similar hurtful results. For example, the society life, modern education and pursuits of women, tending to draw them away from their household duties and make men out of them, must needs detract from the elevating ideal they represent, diminish the artistic creative power, and cause sterility and a general weakening of the race. A thousand other evils might be mentioned, but all put together, in their bearing upon the problem under discussion, they would not equal a single one, the want of food, brought on by poverty, destitution, and famine. Millions of individuals die yearly for want of food, thus keeping down the mass. Even in our enlightened communities, and notwithstanding the many charitable efforts, this is still, in all probability, the chief evil. I do not mean here absolute want of food, but want of healthful nutriment.

How to provide good and plentiful food is, therefore, a most important question of the day. On general principles the raising of cattle as a means of providing food is

objectionable, because, in the sense interpreted above, it must undoubtedly tend to the addition of mass of a "smaller velocity." It is certainly preferable to raise vegetables, and I think, therefore, that vegetarianism is a commendable departure from the established barbarous habit. That we can subsist on plant food and perform our work even to advantage is not a theory, but a well-demonstrated fact. Many races living almost exclusively on vegetables are of superior physique and strength. There is no doubt that some plant food, such as oatmeal, is more economical than meat, and superior to it in regard to both mechanical and mental performance. Such food, moreover, taxes our digestive organs decidedly less, and, in making us more contented and sociable, produces an amount of good difficult to estimate. In view of these facts every effort should be made to stop the wanton and cruel slaughter of animals, which must be destructive to our morals. To free ourselves from animal instincts and appetites, which keep us down, we should begin at the very root from which they spring: we should effect a radical reform in the character of the food.

There seems to be no *philosophical* necessity for food. We can conceive of organized beings living without nourishment, and deriving all the energy they need for the performance of their life-functions from the ambient medium. In a crystal we have the clear evidence of the existence of a formative life-principle, and though we cannot understand the life of a crystal, it is none the less a living being. There may be, besides crystals, other such individualized, material systems of beings, perhaps of gaseous constitution, or composed of substance still more tenuous. In view of this possibility,—nay, probability,—we cannot apodictically deny the existence of organized beings on a planet merely because the conditions on the same are unsuitable for the existence of life as we conceive it. We cannot even, with positive assurance, assert that some of them might not be present here, in this our world, in the very midst of us, for their constitution and life-manifestation may be such that we are unable to perceive them.

The production of artificial food as a means for causing an increase of the human mass naturally suggests itself, but a direct attempt of this kind to provide nourishment does not appear to me rational, at least not for the present. Whether we could thrive

on such food is very doubtful. We are the result of ages of continuous adaptation, and we cannot radically change without unforeseen and, in all probability, disastrous consequences. So uncertain an experiment should not be tried. By far the best way, it seems to me, to meet the ravages of the evil, would be to find ways of increasing the productivity of the soil. With this object the preservation of forests is of an importance which cannot be overestimated, and in this connection, also, the utilization of water-power for purposes of electrical transmission, dispensing in many ways with the necessity of burning wood, and tending thereby to forest preservation, is to be strongly advocated. But there are limits in the improvement to be effected in this and similar ways.

To increase materially the productivity of the soil, it must be more effectively fertilized by artificial means. The question of food-production resolves itself, then, into the question how best to fertilize the soil. What it is that made the soil is still a mystery. To explain its origin is probably equivalent to explaining the origin of life itself. The rocks, disintegrated by moisture and heat and wind and weather, were in themselves not capable of maintaining life. Some unexplained condition arose, and some new principle came into effect, and the first layer capable of sustaining low organisms, like mosses, was formed. These, by their life and death, added more of the life-sustaining quality to the soil, and higher organisms could then subsist, and so on and on, until at last highly developed plant and animal life could flourish. But though the theories are, even now, not in agreement as to how fertilization is effected, it is a fact, only too well ascertained, that the soil cannot indefinitely sustain life, and some way must be found to supply it with the substances which have been abstracted from it by the plants. The chief and most valuable among these substances are compounds of nitrogen, and the cheap production of these is, therefore, the key for the solution of the all-important food problem. Our atmosphere contains an inexhaustible amount of nitrogen, and could we but oxidize it and produce these compounds, an incalculable benefit for mankind would follow.

Long ago this idea took a powerful hold on the imagination of scientific men, but an efficient means for accomplishing this result could not be devised. The problem was rendered extremely difficult by the extraordinary inertness of the nitrogen, which refuses to

combine even with oxygen. But here electricity comes to our aid: the dormant affinities of the element are awakened by an electric current of the proper quality. As a lump of coal which has been in contact with oxygen for centuries without burning will combine with it when once ignited, so nitrogen, excited by electricity, will burn. I did not succeed, however, in producing electrical discharges exciting very effectively the atmospheric nitrogen until a comparatively recent date, although I showed, in May, 1891, in a scientific lecture, a novel form of discharge or electrical flame named "St. Elmo's hotfire," which, besides being capable of generating ozone in abundance, also possessed, as I pointed out on that occasion, distinctly the quality of exciting chemical affinities. This discharge or flame was then only three or four inches long, its chemical action was likewise very feeble, and consequently the process of oxidation of the nitrogen was wasteful. How to intensify this action was the question. Evidently electric currents of a peculiar kind had to be produced in order to render the process of nitrogen combustion more efficient.

The first advance was made in ascertaining that the chemical activity of the discharge was very considerably increased by using currents of extremely high frequency or rate of vibration. This was an important improvement, but practical considerations soon set a definite limit to the progress in this direction. Next, the effects of the electrical pressure of the current impulses, of their wave-form and other characteristic features, were investigated. Then the influence of the atmospheric pressure and temperature and of the presence of water and other bodies was studied, and thus the best conditions for causing the most intense chemical action of the discharge and securing the highest efficiency of the process were gradually ascertained. Naturally, the improvements were not quick in coming; still, little by little, I advanced. The flame grew larger and larger, and its oxidizing action more and more intense. From an insignificant brush-discharge a few inches long it developed into a marvelous electrical phenomenon, a roaring blaze, devouring the nitrogen of the atmosphere and measuring sixty or seventy feet across. Thus slowly, almost imperceptibly, possibility became accomplishment. All is not yet done, by any means, but to what a degree my efforts have been rewarded an idea may be gained from an inspection of Fig. 1 (p. 176), which, with its title, is self-explanatory. The flame-like dis-

charge visible is produced by the intense electrical oscillations which pass through the coil shown, and violently agitate the electrified molecules of the air. By this means a strong affinity is created between the two normally indifferent constituents of the atmosphere, and they combine readily, even if no further provision is made for intensifying the chemical action of the discharge. In the manufacture of nitrogen compounds by this method, of course, every possible means bearing upon the intensity of this action and the efficiency of the process will be taken advantage of, and, besides, special arrangements will be provided for the fixation of the compounds formed, as they are generally unstable, the nitrogen becoming again inert after a little lapse of time. Steam is a simple and effective means for fixing permanently the compounds. The result illustrated makes it practicable to oxidize the atmospheric nitrogen in unlimited quantities, merely by the use of cheap mechanical power and simple electrical apparatus. In this manner many compounds of nitrogen may be manufactured all over the world, at a small cost, and in any desired amount, and by means of these compounds the soil can be fertilized and its productiveness indefinitely increased. An abundance of cheap and healthful food, not artificial, but such as we are accustomed to, may thus be obtained. This new and inexhaustible source of food-supply will be of incalculable benefit to mankind, for it will enormously contribute to the increase of the human mass, and thus add immensely to human energy. Soon, I hope, the world will see the beginning of an industry which, in time to come, will, I believe, be in importance next to that of iron.

THE SECOND PROBLEM: HOW TO REDUCE THE FORCE RETARDING THE HUMAN MASS—THE ART OF TELAUTOMATICS.

As before stated, the force which retards the onward movement of man is partly frictional and partly negative. To illustrate this distinction I may name, for example, ignorance, stupidity, and imbecility as some of the purely frictional forces, or resistances devoid of any directive tendency. On the other hand, visionariness, insanity, self-destructive tendency, religious fanaticism, and the like, are all forces of a negative character, acting in definite directions. To reduce or entirely to overcome these dissimilar retarding forces, radically different methods must be employed. One knows, for instance, what

a fanatic may do, and one can take preventive measures, can enlighten, convince, and possibly direct him, turn his vice into virtue; but one does not know, and never can know, what a brute or an imbecile may do, and one must deal with him as with a mass, inert, without mind, let loose by the mad elements. A negative force always implies some quality, not infrequently a high one, though badly directed, which it is possible to turn to good advantage; but a directionless, frictional force involves unavoidable loss. Evidently, then, the first and general answer to the above question is: turn all negative force in the right direction and reduce all frictional force.

There can be no doubt that, of all the frictional resistances, the one that most retards human movement is ignorance. Not without reason said that man of wisdom, Buddha: "Ignorance is the greatest evil in the world." The friction which results from ignorance, and which is greatly increased owing to the numerous languages and nationalities, can be reduced only by the spread of knowledge and the unification of the heterogeneous elements of humanity. No effort could be better spent. But however ignorance may have retarded the onward movement of man in times past, it is certain that, nowadays, negative forces have become of greater importance. Among these there is one of far greater moment than any other. It is called organized warfare. When we consider the millions of individuals, often the ablest in mind and body, the flower of humanity, who are compelled to a life of inactivity and unproductiveness, the immense sums of money daily required for the maintenance of armies and war apparatus, representing ever so much of human energy, all the effort uselessly spent in the production of arms and implements of destruction, the loss of life and the fostering of a barbarous spirit, we are appalled at the inestimable loss to mankind which the existence of these deplorable conditions must involve. What can we do to combat best this great evil?

Law and order absolutely require the maintenance of organized force. No community can exist and prosper without rigid discipline. Every country must be able to defend itself, should the necessity arise. The conditions of to-day are not the result of yesterday, and a radical change cannot be effected to-morrow. If the nations would at once disarm, it is more than likely that a state of things worse than war itself would follow.

Universal peace is a beautiful dream, but not at once realizable. We have seen recently that even the noble effort of the man invested with the greatest worldly power has been virtually without effect. And no wonder, for the establishment of universal peace is, for the time being, a physical impossibility. War is a negative force, and cannot be turned in a positive direction without passing through the intermediate phases. It is the problem of making a wheel, rotating one way, turn in the opposite direction without slowing it down, stopping it, and speeding it up again the other way.

It has been argued that the perfection of guns of great destructive power will stop warfare. So I myself thought for a long time, but now I believe this to be a profound mistake. Such developments will greatly modify, but not arrest it. On the contrary, I think that every new arm that is invented, every new departure that is made in this direction, merely invites new talent and skill, engages new effort, offers a new incentive, and so only gives a fresh impetus to further development. Think of the discovery of gunpowder. Can we conceive of any more radical departure than was effected by this innovation? Let us imagine ourselves living in that period: would we not have thought then that warfare was at an end, when the armor of the knight became an object of ridicule, when bodily strength and skill, meaning so much before, became of comparatively little value? Yet gunpowder did not stop warfare; quite the opposite—it acted as a most powerful incentive. Nor do I believe that warfare can ever be arrested by any scientific or ideal development, so long as similar conditions to those now prevailing exist, because war has itself become a science, and because war involves some of the most sacred sentiments of which man is capable. In fact, it is doubtful whether men who would not be ready to fight for a high principle would be good for anything at all. It is not the mind which makes man, nor is it the body; it is mind and body. Our virtues and our failings are inseparable, like force and matter. When they separate, man is no more.

Another argument, which carries considerable force, is frequently made, namely, that war must soon become impossible because the means of defense are outstripping the means of attack. This is only in accordance with a fundamental law which may be expressed by the statement that it is easier to destroy than to build. This law defines human capacities and human conditions.

Were these such that it would be easier to build than to destroy, man would go on unresisted, creating and accumulating without limit. Such conditions are not of this earth. A being which could do this would not be a man; it might be a god. Defense will always have the advantage over attack, but this alone, it seems to me, can never stop war. By the use of new principles of defense we can render harbors impregnable against attack, but we cannot by such means prevent two war-ships meeting in battle on the high sea. And then, if we follow this idea to its ultimate development, we are led to the conclusion that it would be better for mankind if attack and defense were just oppositely related; for if every country, even the smallest, could surround itself with a wall absolutely impenetrable, and could defy the rest of the world, a state of things would surely be brought on which would be extremely unfavorable to human progress. It is by abolishing all the barriers which separate nations and countries that civilization is best furthered.

Again, it is contended by some that the advent of the flying-machine must bring on universal peace. This, too, I believe to be an entirely erroneous view. The flying-machine is certainly coming, and very soon, but the conditions will remain the same as before. In fact, I see no reason why a ruling power, like Great Britain, might not govern the air as well as the sea. Without wishing to put myself on record as a prophet, I do not hesitate to say that the next years will see the establishment of an "air-power," and its center may not be far from New York. But, for all that, men will fight on merrily.

The ideal development of the war principle would ultimately lead to the transformation of the whole energy of war into purely potential, explosive energy, like that of an electrical condenser. In this form the war-energy could be maintained without effort; it would need to be much smaller in amount, while incomparably more effective.

As regards the security of a country against foreign invasion, it is interesting to note that it depends only on the relative, and not on the absolute, number of the individuals or magnitude of the forces, and that, if every country should reduce the war-force in the same ratio, the security would remain unaltered. An international agreement with the object of reducing to a minimum the war-force which, in view of the present still imperfect education of the masses, is absolutely indispensable, would,

therefore, seem to be the first rational step to take toward diminishing the force retarding human movement.

Fortunately, the existing conditions cannot continue indefinitely, for a new element is beginning to assert itself. A change for the better is imminent, and I shall now endeavor to show what, according to my ideas, will be the first advance toward the establishment of peaceful relations between nations, and by what means it will eventually be accomplished.

Let us go back to the early beginning, when the law of the stronger was the only law. The light of reason was not yet kindled, and the weak was entirely at the mercy of the strong. The weak individual then began to learn how to defend himself. He made use of a club, stone, spear, sling, or bow and arrow, and in the course of time, instead of physical strength, intelligence became the chief deciding factor in the battle. The wild character was gradually softened by the awakening of noble sentiments, and so, imperceptibly, after ages of continued progress, we have come from the brutal fight of the unreasoning animal to what we call the "civilized warfare" of to-day, in which the combatants shake hands, talk in a friendly way, and smoke cigars in the entr'actes, ready to engage again in deadly conflict at a signal. Let pessimists say what they like, here is an absolute evidence of great and gratifying advance.

But now, what is the next phase in this evolution? Not peace as yet, by any means. The next change which should naturally follow from modern developments should be the continuous diminution of the number of individuals engaged in battle. The apparatus will be one of specifically great power, but only a few individuals will be required to operate it. This evolution will bring more and more into prominence a machine or mechanism with the fewest individuals as an element of warfare, and the absolutely unavoidable consequence of this will be the abandonment of large, clumsy, slowly moving, and unmanageable units. Greatest possible speed and maximum rate of energy-delivery by the war apparatus will be the main object. The loss of life will become smaller and smaller, and finally, the number of the individuals continuously diminishing, merely machines will meet in a contest without bloodshed, the nations being simply interested, ambitious spectators. When this happy condition is realized, peace will be assured. But, no matter to what degree of perfection rapid-

fire guns, high-power cannon, explosive projectiles, torpedo-boats, or other implements of war may be brought, no matter how destructive they may be made, that condition can never be reached through any such development. All such implements require men for their operation; men are indispensable parts of the machinery. Their object is to kill and to destroy. Their power resides in their capacity for doing evil. So long as men meet in battle, there will be bloodshed. Bloodshed will ever keep up barbarous passion. To break this fierce spirit, a radical departure must be made, an entirely new principle must be introduced, something that never existed before in warfare—a principle which will forcibly, unavoidably, turn the battle into a mere spectacle, a play, a contest without loss of blood. To bring on this result men must be dispensed with: machine must fight machine. But how accomplish that which seems impossible? The answer is simple enough: produce a machine capable of acting as though it were part of a human being—no mere mechanical contrivance, comprising levers, screws, wheels, clutches, and nothing more, but a machine embodying a higher principle, which will enable it to perform its duties as though it had intelligence, experience, reason, judgment, a mind! This conclusion is the result of my thoughts and observations which have extended through virtually my whole life, and I shall now briefly describe how I came to accomplish that which at first seemed an unrealizable dream.

A long time ago, when I was a boy, I was afflicted with a singular trouble, which seems to have been due to an extraordinary excitability of the retina. It was the appearance of images which, by their persistence, marred the vision of real objects and interfered with thought. When a word was said to me, the image of the object which it designated would appear vividly before my eyes, and many times it was impossible for me to tell whether the object I saw was real or not. This caused me great discomfort and anxiety, and I tried hard to free myself of the spell. But for a long time I tried in vain, and it was not, as I still clearly recollect, until I was about twelve years old that I succeeded for the first time, by an effort of the will, in banishing an image which presented itself. My happiness will never be as complete as it was then, but, unfortunately (as I thought at that time), the old trouble returned, and with it my anxiety. Here it was that the observations to which I refer began.

I noted, namely, that whenever the image of an object appeared before my eyes I had seen something which reminded me of it. In the first instances I thought this to be purely accidental, but soon I convinced myself that it was not so. A visual impression, consciously or unconsciously received, invariably preceded the appearance of the image. Gradually the desire arose in me to find out, every time, what caused the images to appear, and the satisfaction of this desire soon became a necessity. The next observation I made was that, just as these images followed as a result of something I had seen, so also the thoughts which I conceived were suggested in like manner. Again, I experienced the same desire to locate the image which caused the thought, and this search for the original visual impression soon grew to be a second nature. My mind became automatic, as it were, and in the course of years of continued, almost unconscious performance, I acquired the ability of locating every time and, as a rule, instantly the visual impression which started the thought. Nor is this all. It was not long before I was aware that also all my movements were prompted in the same way, and so, searching, observing, and verifying continuously, year after year, I have, by every thought and every act of mine, demonstrated, and do so daily, to my absolute satisfaction, that I am an automaton endowed with power of movement, which merely responds to external stimuli beating upon my sense organs, and thinks and acts and moves accordingly. I remember only one or two cases in all my life in which I was unable to locate the first impression which prompted a movement or a thought, or even a dream.

With these experiences it was only natural that, long ago, I conceived the idea of constructing an automaton which would mechanically represent me, and which would respond, as I do myself, but, of course, in a much more primitive manner, to external influences. Such an automaton evidently had to have motive power, organs for locomotion, directive organs, and one or more sensitive organs so adapted as to be excited by external stimuli. This machine would, I reasoned, perform its movements in the manner of a living being, for it would have all the chief mechanical characteristics or elements of the same. There was still the capacity for growth, propagation, and, above all, the mind which would be wanting to make the model complete. But growth was not necessary in this case, since a machine could be manufactured full-grown, so to

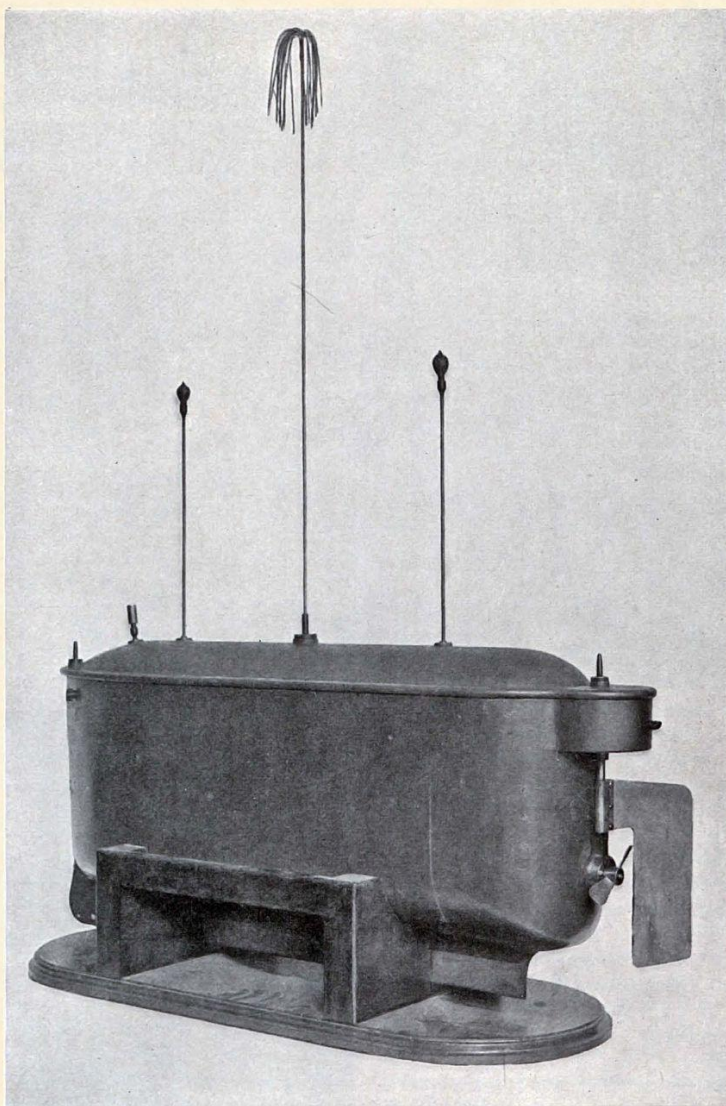


FIG. 2. THE FIRST PRACTICAL TELAUTOMATON.

A machine having all its bodily or translatory movements and the operations of the interior mechanism controlled from a distance without wires. The crewless boat shown in the photograph contains its own motive power, propelling- and steering-machinery, and numerous other accessories, all of which are controlled by transmitting from a distance, without wires, electrical oscillations to a circuit carried by the boat and adjusted to respond only to these oscillations.

speak. As to the capacity for propagation, it could likewise be left out of consideration, for in the mechanical model it merely signified a process of manufacture. Whether the automaton be of flesh and bone, or of wood and steel, it mattered little, provided it could perform all the duties required of it like an intelligent being. To do so, it had to have an element corresponding to the mind, which

would effect the control of all its movements and operations, and cause it to act, in any unforeseen case that might present itself, with knowledge, reason, judgment, and experience. But this element I could easily embody in it by conveying to it my own intelligence, my own understanding. So this invention was evolved, and so a new art came into existence, for which the name



FIG. 3. EXPERIMENT TO ILLUSTRATE THE SUPPLYING OF ELECTRICAL ENERGY THROUGH A SINGLE WIRE WITHOUT RETURN.

An ordinary incandescent lamp, connected with one or both of its terminals to the wire forming the upper free end of the coil shown in the photograph, is lighted by electrical vibrations conveyed to it through the coil from an electrical oscillator, which is worked only to one fifth of one per cent. of its full capacity.

"telautomatics" has been suggested, which means the art of controlling the movements and operations of distant automatons.

This principle evidently was applicable to any kind of machine that moves on land or in the water or in the air. In applying it practically for the first time, I selected a boat (see Fig. 2). A storage battery placed within it furnished the motive power. The propeller, driven by a motor, represented the locomotive organs. The rudder, controlled by another motor likewise driven by the battery, took the place of the directive organs. As to the sensitive organ, obviously the first thought was to utilize a device responsive to rays of light, like a selenium cell, to represent the human eye. But upon closer inquiry I found that, owing to experimental and other difficulties, no thoroughly satisfactory control of the automaton could be effected by light, radiant heat, Hertzian radiations, or by rays in general, that is, disturbances which pass in straight lines through space. One of the reasons was that any obstacle coming between the operator and the distant automaton would place it beyond his control. Another reason was that the sensitive device representing the eye would have to be in a definite position with respect to the distant controlling apparatus, and this necessity would impose great limitations in the control. Still another and very important reason was that, in using rays, it would be difficult, if not impossible, to give to the automaton individual features or characteristics distinguishing it from other machines of this kind. Evidently the automaton should respond only to an individual call, as a person responds to a name. Such considerations led me to conclude that the sensitive device of the machine should

correspond to the ear rather than to the eye of a human being, for in this case its actions could be controlled irrespective of intervening obstacles, regardless of its position relative to the distant controlling apparatus, and, last, but not least, it would remain deaf and unresponsive, like a faithful servant, to all calls but that of its master. These requirements made it imperative to use, in the control of the automaton, instead of light- or other rays, waves or disturbances which propagate in all directions through space, like sound, or which follow a path of least resistance, however curved. I attained the result aimed at by means of an electric circuit placed within the boat, and adjusted, or "tuned," exactly to electrical vibrations of the proper kind transmitted to it from a

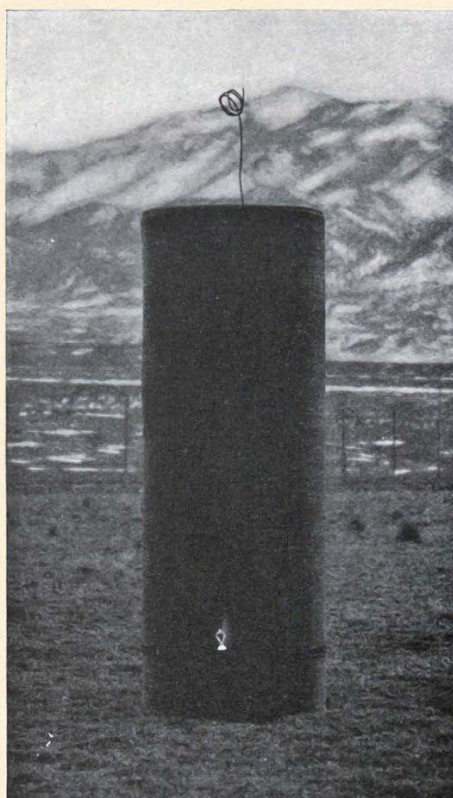


FIG. 4. EXPERIMENT TO ILLUSTRATE THE TRANSMISSION OF ELECTRICAL ENERGY THROUGH THE EARTH WITHOUT WIRE.

The coil shown in the photograph has its lower end or terminal connected to the ground, and is exactly attuned to the vibrations of a distant electrical oscillator. The lamp lighted is in an independent wire loop, energized by induction from the coil excited by the electrical vibrations transmitted to it through the ground from the oscillator, which is worked only to five per cent of its full capacity.

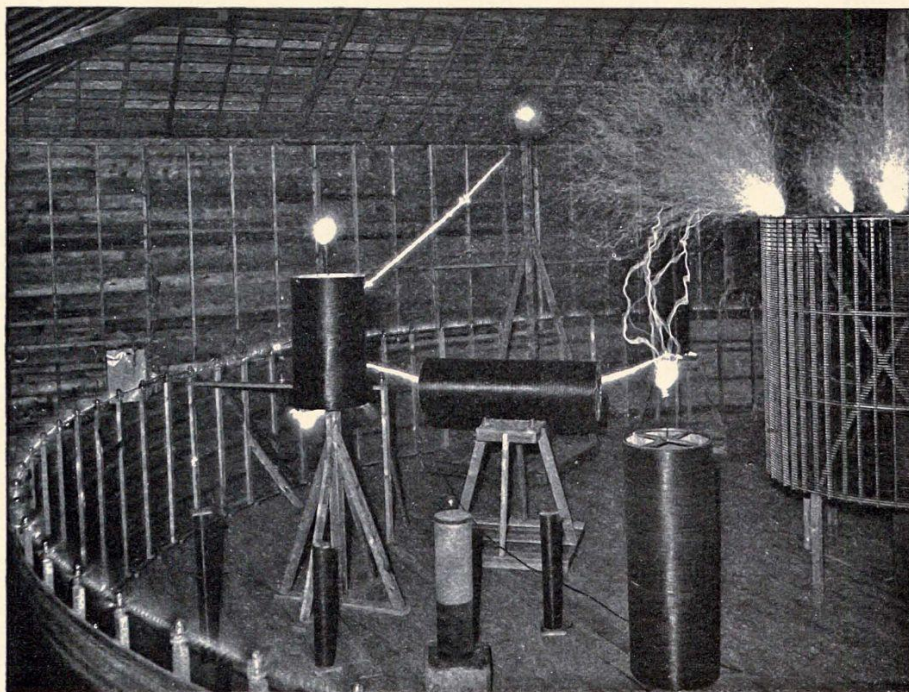


FIG. 5. PHOTOGRAPHIC VIEW OF COILS RESPONDING TO ELECTRICAL OSCILLATIONS.

The picture shows a number of coils, differently attuned and responding to the vibrations transmitted to them through the earth from an electrical oscillator. The large coil on the right, discharging strongly, is tuned to the fundamental vibration, which is fifty thousand per second; the two larger vertical coils to twice that number; the smaller white wire coil to four times that number, and the remaining small coils to higher tones. The vibrations produced by the oscillator were so intense that they affected perceptibly a small coil tuned to the twenty-sixth higher tone.

distant "electrical oscillator." This circuit, in responding, however feebly, to the transmitted vibrations, affected magnets and other contrivances, through the medium of which were controlled the movements of the propeller and rudder, and also the operations of numerous other appliances.

By the simple means described the knowledge, experience, judgment—the mind, so to speak—of the distant operator were embodied in that machine, which was thus enabled to move and to perform all its operations with reason and intelligence. It behaved just like a blindfolded person obeying directions received through the ear.

The automatons so far constructed had "borrowed minds," so to speak, as each merely formed part of the distant operator who conveyed to it his intelligent orders; but this art is only in the beginning. I purpose to show that, however impossible it may now seem, an automaton may be contrived which will have its "own mind," and by this I mean that it will be able, independent of any operator, left entirely to itself, to perform, in response to external

influences affecting its sensitive organs, a great variety of acts and operations as if it had intelligence. It will be able to follow a course laid out or to obey orders given far in advance; it will be capable of distinguishing between what it ought and what it ought not to do, and of making experiences or, otherwise stated, of recording impressions which will definitely affect its subsequent actions. In fact, I have already conceived such a plan.

Although I evolved this invention many years ago and explained it to my visitors very frequently in my laboratory demonstrations, it was not until much later, long after I had perfected it, that it became known, when, naturally enough, it gave rise to much discussion and to sensational reports. But the true significance of this new art was not grasped by the majority, nor was the great force of the underlying principle recognized. As nearly as I could judge from the numerous comments which then appeared, the results I had obtained were considered as entirely impossible. Even the few who were disposed to admit the practicability of the

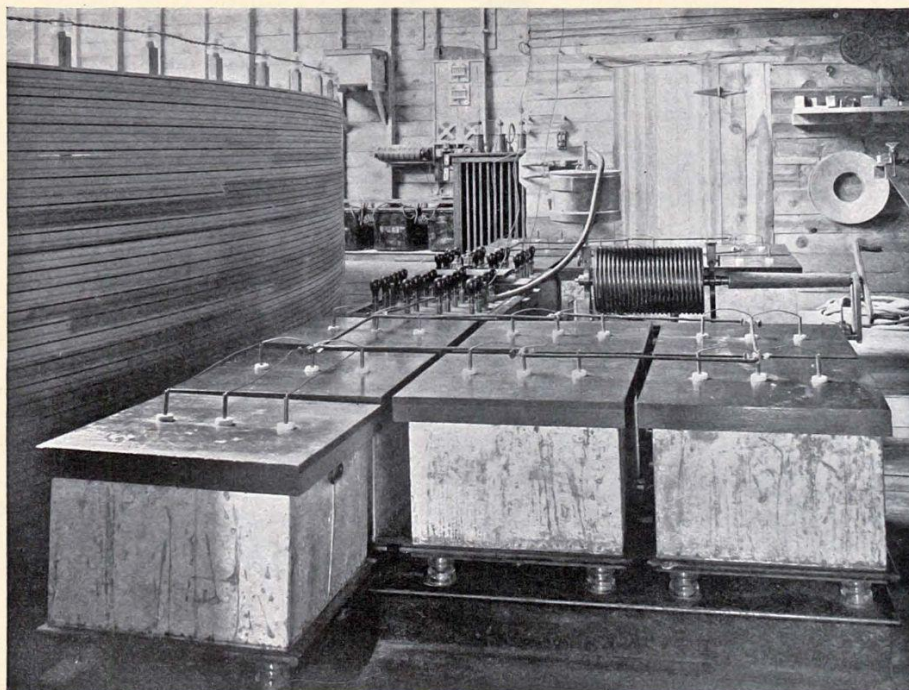


FIG. 6. PHOTOGRAPHIC VIEW OF THE ESSENTIAL PARTS OF THE ELECTRICAL OSCILLATOR USED IN THE EXPERIMENTS DESCRIBED.

invention saw in it merely an automobile torpedo, which was to be used for the purpose of blowing up battle-ships, with doubtful success. The general impression was that I contemplated simply the steering of such a vessel by means of Hertzian or other rays. There are torpedoes steered electrically by wires, and there are means of communicating without wires, and the above was, of course, an obvious inference. Had I accomplished nothing more than this, I should have made a small advance indeed. But the art I have evolved does not contemplate merely the change of direction of a moving vessel; it affords a means of absolutely controlling, in every respect, all the innumerable transitory movements, as well as the operations of all the internal organs, no matter how many, of an individualized automaton. Criticisms to the effect that the control of the automaton could be interfered with were made by people who do not even dream of the wonderful results which can be accomplished by the use of electrical vibrations. The world moves slowly, and new truths are difficult to see. Certainly, by the use of this principle, an arm for attack as well as defense may be provided, of a destructiveness all the greater as the principle is applicable

to submarine and aerial vessels. There is virtually no restriction as to the amount of explosive it can carry, or as to the distance at which it can strike, and failure is almost impossible. But the force of this new principle does not wholly reside in its destructiveness. Its advent introduces into warfare an element which never existed before—a fighting-machine without men as a means of attack and defense. The continuous development in this direction must ultimately make war a mere contest of machines without men and without loss of life—a condition which would have been impossible without this new departure, and which, in my opinion, must be reached as preliminary to permanent peace. The future will either bear out or disprove these views. My ideas on this subject have been put forth with deep conviction, but in a humble spirit.

The establishment of permanent peaceful relations between nations would most effectively reduce the force retarding the human mass, and would be the best solution of this great human problem. But will the dream of universal peace ever be realized? Let us hope that it will. When all darkness shall be dissipated by the light of science, when all nations shall be merged into one, and

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patriotism shall be identical with religion, when there shall be one language, one country, one end, then the dream will have become reality.

THE THIRD PROBLEM: HOW TO INCREASE THE
FORCE ACCELERATING THE HUMAN MASS—
THE HARNESSING OF THE SUN'S ENERGY.

OF the three possible solutions of the main problem of increasing human energy, this is by far the most important to consider, not only because of its intrinsic significance, but also because of its intimate bearing on all the many elements and conditions which determine the movement of humanity. In order to proceed systematically, it would be necessary for me to dwell on all those considerations which have guided me from the outset in my efforts to arrive at a solution, and which have led me, step by step, to the results I shall now describe. As a preliminary study of the problem an analytical investigation, such as I have made, of the chief forces which determine the onward move-

ment, would be of advantage, particularly in conveying an idea of that hypothetical "velocity" which, as explained in the beginning, is a measure of human energy; but to deal with this specifically here, as I would desire, would lead me far beyond the scope of the present subject. Suffice it to state that the resultant of all these forces is always in the direction of reason, which, therefore, determines, at any time, the direction of human movement. This is to say that every effort which is scientifically applied, rational, useful, or practical, must be in the direction in which the mass is moving. The practical, rational man, the observer, the man of business, he who reasons, calculates, or determines in advance, carefully applies his effort so that when coming into effect it will be in the direction of the movement, making it thus most efficient, and in this knowledge and ability lies the secret of his success. Every new fact discovered, every new experience or new element added to our knowledge and entering into the domain of reason, affects the same and, therefore, changes



FIG. 7. EXPERIMENT TO ILLUSTRATE AN INDUCTIVE EFFECT OF AN ELECTRICAL OSCILLATOR OF GREAT POWER.

The photograph shows three ordinary incandescent lamps lighted to full candle-power by currents induced in a local loop consisting of a single wire forming a square of fifty feet each side, which includes the lamps, and which is at a distance of one hundred feet from the primary circuit energized by the oscillator. The loop likewise includes an electrical condenser, and is exactly attuned to the vibrations of the oscillator, which is worked at less than five per cent. of its total capacity.

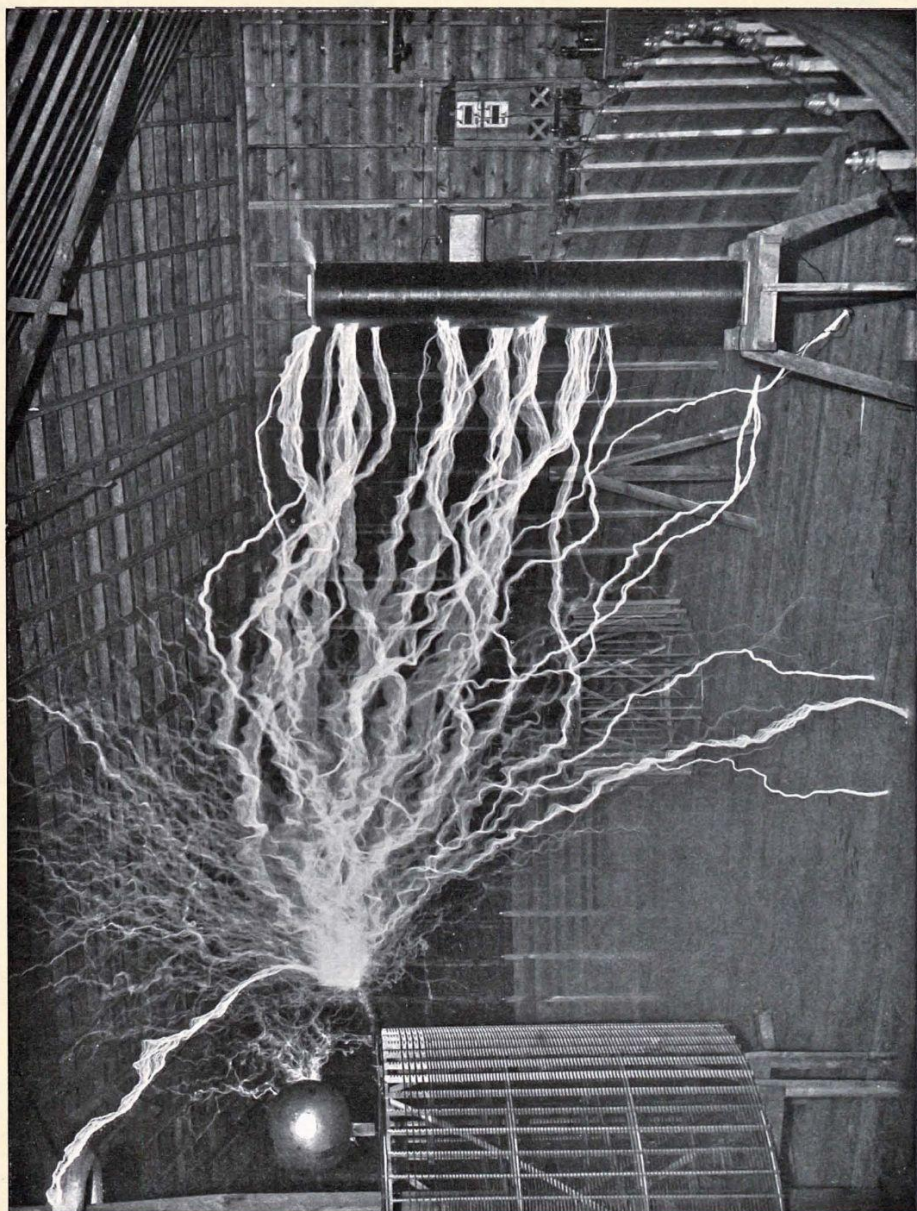


FIG. 8. EXPERIMENT TO ILLUSTRATE THE CAPACITY OF THE OSCILLATOR FOR PRODUCING ELECTRICAL EXPLOSIONS OF GREAT POWER.

NOTE TO FIG. 8.—The coil, partly shown in the photograph, creates an alternative movement of electricity from the earth into a large reservoir and back at the rate of one hundred thousand alternations per second. The adjustments are such that the reservoir is filled full and bursts at each alternation just at the moment when the electrical pressure reaches the maximum. The discharge escapes with a deafening noise, striking an unconnected coil twenty-two feet away, and creating such a commotion of electricity in the earth that sparks an inch long can be drawn from a water-main at a distance of three hundred feet from the laboratory.

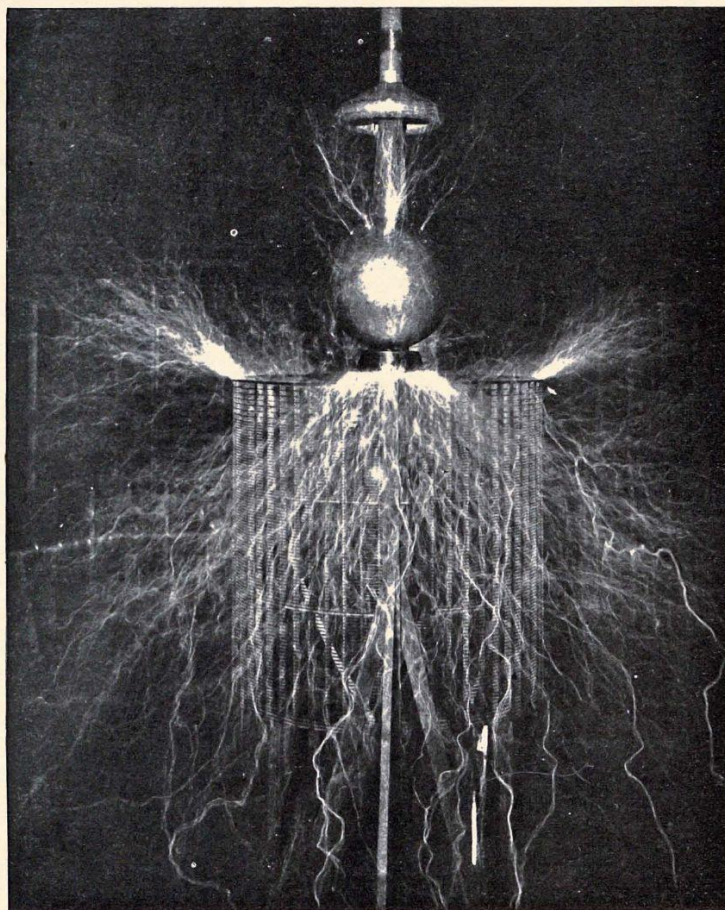


FIG. 9. EXPERIMENT TO ILLUSTRATE THE CAPACITY OF THE OSCILLATOR FOR CREATING
A GREAT ELECTRICAL MOVEMENT.

The ball shown in the photograph, covered with a polished metallic coating of twenty square feet of surface, represents a large reservoir of electricity, and the inverted tin pan underneath, with a sharp rim, a big opening through which the electricity can escape before filling the reservoir. The quantity of electricity set in movement is so great that, although most of it escapes through the rim of the pan or opening provided, the ball or reservoir is nevertheless alternately emptied and filled to overflowing (as is evident from the discharge escaping on the top of the ball) one hundred and fifty thousand times per second.

the direction of the movement, which, however, must always take place along the resultant of all those efforts which, at that time, we designate as reasonable, that is, self-preserving, useful, profitable, or practical. These efforts concern our daily life, our necessities and comforts, our work and business, and it is these which drive man onward.

But looking at all this busy world about us, on all this complex mass as it daily throbs and moves, what is it but an immense clock-work driven by a spring? In the morning, when we rise, we cannot fail to note that all the objects about us are manufactured by machinery: the water we use is lifted by

steam-power; the trains bring our breakfast from distant localities; the elevators in our dwelling and in our office building, the cars that carry us there, are all driven by power; in all our daily errands, and in our very life-pursuit, we depend upon it; all the objects we see tell us of it; and when we return to our machine-made dwelling at night, lest we should forget it, all the material comforts of our home, our cheering stove and lamp, remind us how much we depend on power. And when there is an accidental stoppage of the machinery, when the city is snow-bound, or the life-sustaining movement otherwise temporarily arrested, we are affrighted to realize

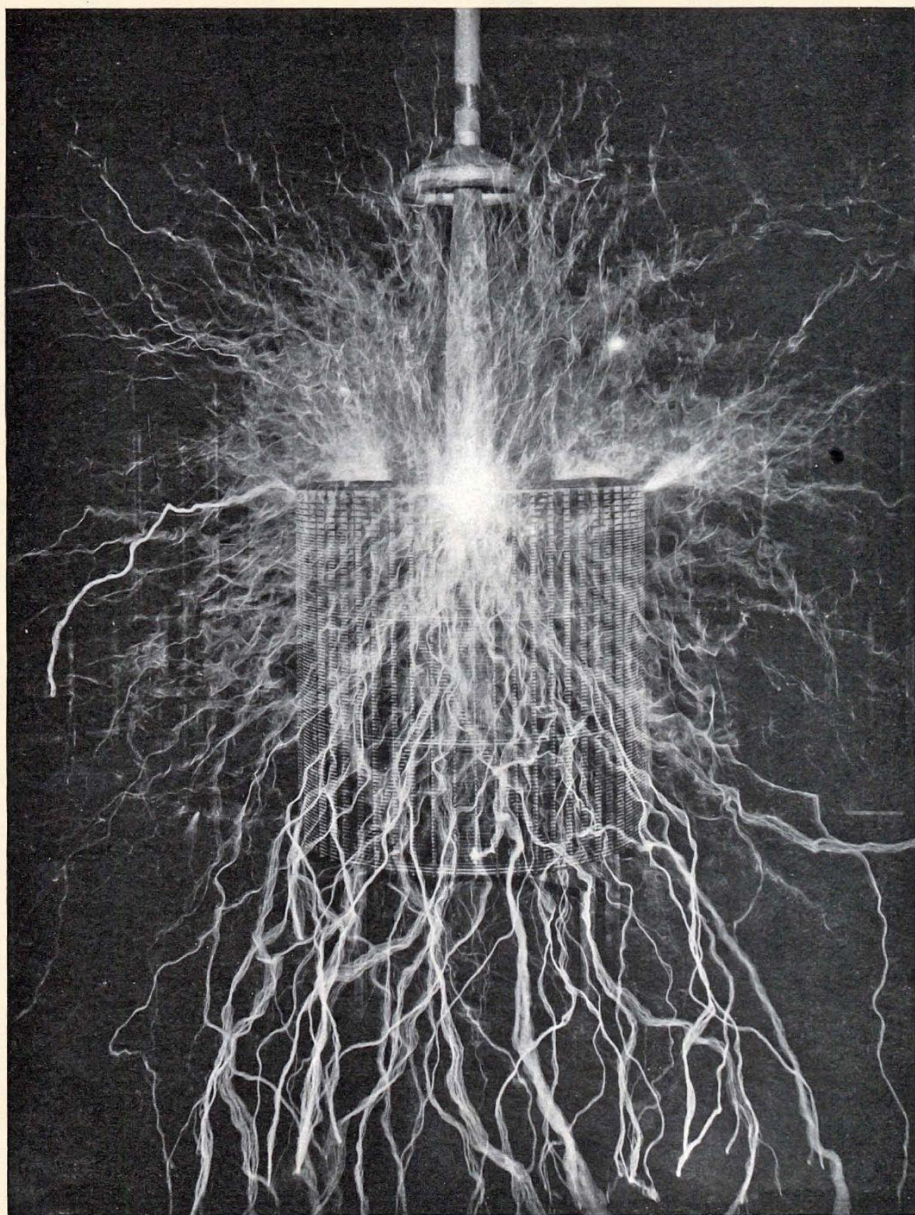


FIG. 10. PHOTOGRAPHIC VIEW OF AN EXPERIMENT TO ILLUSTRATE AN EFFECT OF AN ELECTRICAL OSCILLATOR DELIVERING ENERGY AT A RATE OF SEVENTY-FIVE THOUSAND HORSE-POWER.

The discharge, creating a strong draft owing to the heating of the air, is carried upward through the open roof of the building. The greatest width across is nearly seventy feet. The pressure is over twelve million volts, and the current alternates one hundred and thirty thousand times per second.

how impossible it would be for us to live the life we live without motive power. Motive power means work. To increase the force accelerating human movement means, therefore, to perform more work.

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So we find that the three possible solutions of the great problem of increasing human energy are answered by the three words: *food, peace, work*. Many a year I have thought and pondered, lost myself in

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speculations and theories, considering man as a mass moved by a force, viewing his inexplicable movement in the light of a mechanical one, and applying the simple principles of mechanics to the analysis of the same until I arrived at these solutions, only to realize that they were taught to me in my early childhood. These three words sound the key-notes of the Christian religion. Their scientific meaning and purpose are now clear to me: food to increase the mass, peace to diminish the retarding force, and work to increase the force accelerating human movement. These are the only three solutions which are possible of that great problem, and all of them have one object, one end, namely, to increase human energy. When we recognize this, we cannot help wondering how profoundly wise and scientific and how immensely practical the Christian religion is, and in what a marked contrast it stands in this respect to other religions. It is unmistakably the result of practical experiment and scientific observation which have extended through ages, while other religions seem to be the outcome of merely abstract reasoning. Work, untiring effort, useful and accumulative, with periods of rest and recuperation aiming at higher efficiency, is its chief and ever-recurring command. Thus we are inspired both by Christianity and Science to do our utmost toward increasing the performance of mankind. This most important of human problems I shall now specifically consider.

THE SOURCE OF HUMAN ENERGY—THE THREE WAYS OF DRAWING ENERGY FROM THE SUN.

FIRST let us ask: Whence comes all the motive power? What is the spring that drives all? We see the ocean rise and fall, the rivers flow, the wind, rain, hail, and snow beat on our windows, the trains and steamers come and go; we hear the rattling noise of carriages, the voices from the street; we feel, smell, and taste; and we think of all this. And all this movement, from the surging of the mighty ocean to that subtle movement concerned in our thought, has but one common cause. All this energy emanates from one single center, one single source—the sun. The sun is the spring that drives all. The sun maintains all human life and supplies all human energy. Another answer we have now found to the above great question: To increase the force accelerating human movement means to turn to the uses

of man more of the sun's energy. We honor and revere those great men of bygone times whose names are linked with immortal achievements, who have proved themselves benefactors of humanity—the religious reformer with his wise maxims of life, the philosopher with his deep truths, the mathematician with his formulæ, the physicist with his laws, the discoverer with his principles and secrets wrested from nature, the artist with his forms of the beautiful; but who honors him, the greatest of all,—who can tell the name of him,—who first turned to use the sun's energy to save the effort of a weak fellow-creature? That was man's first act of scientific philanthropy, and its consequences have been incalculable.

From the very beginning three ways of drawing energy from the sun were open to man. The savage, when he warmed his frozen limbs at a fire kindled in some way, availed himself of the energy of the sun stored in the burning material. When he carried a bundle of branches to his cave and burned them there, he made use of the sun's stored energy transported from one to another locality. When he set sail to his canoe, he utilized the energy of the sun supplied to the atmosphere or ambient medium. There can be no doubt that the first is the oldest way. A fire, found accidentally, taught the savage to appreciate its beneficial heat. He then very likely conceived the idea of carrying the glowing embers to his abode. Finally he learned to use the force of a swift current of water or air. It is characteristic of modern development that progress has been effected in the same order. The utilization of the energy stored in wood or coal, or, generally speaking, fuel, led to the steam-engine. Next a great stride in advance was made in energy-transportation by the use of electricity, which permitted the transfer of energy from one locality to another without transporting the material. But as to the utilization of the energy of the ambient medium, no radical step forward has as yet been made known.

The ultimate results of development in these three directions are: first, the burning of coal by a cold process in a battery; second, the efficient utilization of the energy of the ambient medium; and, third, the transmission without wires of electrical energy to any distance. In whatever way these results may be arrived at, their practical application will necessarily involve an extensive use of iron, and this invaluable metal will undoubtedly be an essential element in the further de-

velopment along these three lines. If we succeed in burning coal by a cold process and thus obtaining electrical energy in an efficient and inexpensive manner, we shall require in many practical uses of this energy electric motors—that is, iron. If we are successful in deriving energy from the ambient medium, we shall need, both in the obtainment and utilization of the energy, machinery—again, iron. If we realize the transmission of electrical energy without wires on an industrial scale, we shall be compelled to use extensively electric generators—once more, iron. Whatever we may do, iron will probably be the chief means of accomplishment in the near future, possibly more so than in the past. How long its reign will last is difficult to tell, for even now aluminium is looming up as a threatening competitor. But for the time being, next to providing new resources of energy, it is of the greatest importance to make improvements in the manufacture and utilization of iron. Great advances are possible in these latter directions, which, if brought about, would enormously increase the useful performance of mankind.

GREAT POSSIBILITIES OFFERED BY IRON FOR
INCREASING HUMAN PERFORMANCE—ENOR-
MOUS WASTE IN IRON MANUFACTURE.

IRON is by far the most important factor in modern progress. It contributes more than any other industrial product to the force accelerating human movement. So general is the use of this metal, and so intimately is it connected with all that concerns our life, that it has become as indispensable to us as the very air we breathe. Its name is synonymous with usefulness. But, however great the influence of iron may be on the present human development, it does not add to the force urging man onward nearly as much as it might. First of all, its manufacture as now carried on is connected with an appalling waste of fuel—that is, waste of energy. Then, again, only a part of all the iron produced is applied for useful purposes. A good part of it goes to create frictional resistances, while still another large part is the means of developing negative forces greatly retarding human movement. Thus the negative force of war is almost wholly represented in iron. It is impossible to estimate with any degree of accuracy the magnitude of this greatest of all retarding forces, but it is certainly very considerable. If the present positive impelling force due to all useful applications

of iron be represented by ten, for instance, I should not think it exaggeration to estimate the negative force of war, with due consideration of all its retarding influences and results, at, say, six. On the basis of this estimate the effective impelling force of iron in the positive direction would be measured by the difference of these two numbers, which is four. But if, through the establishment of universal peace, the manufacture of war machinery should cease, and all struggle for supremacy between nations should be turned into healthful, ever active and productive commercial competition, then the positive impelling force due to iron would be measured by the sum of those two numbers, which is sixteen—that is, this force would have four times its present value. This example is, of course, merely intended to give an idea of the immense increase in the useful performance of mankind which would result from a radical reform of the iron industries supplying the implements of warfare.

A similar inestimable advantage in the saving of energy available to man would be secured by obviating the great waste of coal which is inseparably connected with the present methods of manufacturing iron. In some countries, as in Great Britain, the hurtful effects of this squandering of fuel are beginning to be felt. The price of coal is constantly rising, and the poor are made to suffer more and more. Though we are still far from the dreaded "exhaustion of the coal-fields," philanthropy commands us to invent novel methods of manufacturing iron, which will not involve such barbarous waste of this valuable material from which we derive at present most of our energy. It is our duty to coming generations to leave this store of energy intact for them, or at least not to touch it until we shall have perfected processes for burning coal more efficiently. Those who are to come after us will need fuel more than we do. We should be able to manufacture the iron we require by using the sun's energy, without wasting any coal at all. As an effort to this end the idea of smelting iron ores by electric currents obtained from the energy of falling water has naturally suggested itself to many. I have myself spent much time in endeavoring to evolve such a practical process, which would enable iron to be manufactured at small cost. After a prolonged investigation of the subject, finding that it was unprofitable to use the currents generated directly for smelting the ore, I devised a method which is far more economical.

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ECONOMICAL PRODUCTION OF IRON BY A
NEW PROCESS.

THE industrial project, as I worked it out six years ago, contemplated the employment of the electric currents derived from the energy of a waterfall, not directly for smelting the ore, but for decomposing water, as a preliminary step. To lessen the cost of the plant, I proposed to generate the currents in exceptionally cheap and simple dynamos, which I designed for this sole purpose. The hydrogen liberated in the electrolytic decomposition was to be burned or recombined with oxygen, not with that from which it was separated, but with that of the atmosphere. Thus very nearly the total electrical energy used up in the decomposition of the water would be recovered in the form of heat resulting from the recombination of the hydrogen. This heat was to be applied to the smelting of the ore. The oxygen gained as a by-product in the decomposition of the water I intended to use for certain other industrial purposes, which would probably yield good financial returns, inasmuch as this is the cheapest way of obtaining this gas in large quantities. In any event, it could be employed to burn all kinds of refuse, cheap hydrocarbon, or coal of the most inferior quality which could not be burned in air or be otherwise utilized to advantage, and thus again a considerable amount of heat would be made available for the smelting of the ore. To increase the economy of the process I contemplated, furthermore, using an arrangement such that the hot metal and the products of combustion, coming out of the furnace, would give up their heat upon the cold ore going into the furnace, so that comparatively little of the heat-energy would be lost in the smelting. I calculated that probably forty thousand pounds of iron could be produced per horse-power per annum by this method. Liberal allowances were made for those losses which are unavoidable, the above quantity being about half of that theoretically obtainable. Relying on this estimate and on practical data with reference to a certain kind of sand ore existing in abundance in the region of the Great Lakes, including cost of transportation and labor, I found that in some localities iron could be manufactured in this manner cheaper than by any of the adopted methods. This result would be attained all the more surely if the oxygen obtained from the water, instead of being used for smelting the ore, as assumed,

should be more profitably employed. Any new demand for this gas would secure a higher revenue from the plant, thus cheapening the iron. This project was advanced merely in the interest of industry. Some day, I hope, a beautiful industrial butterfly will come out of the dusty and shriveled chrysalis.

The production of iron from sand ores by a process of magnetic separation is highly commendable in principle, since it involves no waste of coal; but the usefulness of this method is largely reduced by the necessity of melting the iron afterward. As to the crushing of iron ore, I would consider it rational only if done by water-power, or by energy otherwise obtained without consumption of fuel. An electrolytic cold process, which would make it possible to extract iron cheaply, and also to mold it into the required forms without any fuel consumption, would, in my opinion, be a very great advance in iron manufacture. In common with some other metals, iron has so far resisted electrolytic treatment, but there can be no doubt that such a cold process will ultimately replace in metallurgy the present crude method of casting, and thus obviate the enormous waste of fuel necessitated by the repeated heating of metal in the foundries.

Up to a few decades ago the usefulness of iron was based almost wholly on its remarkable mechanical properties, but since the advent of the commercial dynamo and electric motor its value to mankind has been greatly increased by its unique magnetic qualities. As regards the latter, iron has been greatly improved of late. The signal progress began about thirteen years ago, when I discovered that in using soft Bessemer steel instead of wrought iron, as then customary, in an alternating motor, the performance of the machine was doubled. I brought this fact to the attention of Mr. Albert Schmid, to whose untiring efforts and ability is largely due the supremacy of American electrical machinery, and who was then superintendent of an industrial corporation engaged in this field. Following my suggestion, he constructed transformers of steel, and they showed the same marked improvement. The investigation was then systematically continued under Mr. Schmid's guidance, the impurities being gradually eliminated from the "steel" (which was only such in name, for in reality it was pure soft iron), and soon a product resulted which admitted of little further improvement.

THE COMING AGE OF ALUMINIUM—DOOM OF
THE COPPER INDUSTRY—THE GREAT CIVILIZING
POTENCY OF THE NEW METAL.

WITH the advances made in iron of late years we have arrived virtually at the limits of improvement. We cannot hope to increase very materially its tensile strength, elasticity, hardness, or malleability, nor can we expect to make it much better as regards its magnetic qualities. More recently a notable gain was secured by the mixture of a small percentage of nickel with the iron, but there is not much room for further advance in this direction. New discoveries may be expected, but they cannot greatly add to the valuable properties of the metal, though they may considerably reduce the cost of manufacture. The immediate future of iron is assured by its cheapness and its unrivaled mechanical and magnetic qualities. These are such that no other product can compete with it now. But there can be no doubt that, at a time not very distant, iron, in many of its now uncontested domains, will have to pass the scepter to another: the coming age will be the age of aluminium. It is only seventy years since this wonderful metal was discovered by Woehler, and the aluminium industry, scarcely forty years old, commands already the attention of the entire world. Such rapid growth has not been recorded in the history of civilization before. Not long ago aluminium was sold at the fanciful price of thirty or forty dollars per pound; to-day it can be had in any desired amount for as many cents. What is more, the time is not far off when this price, too, will be considered fanciful, for great improvements are possible in the methods of its manufacture. Most of the metal is now produced in the electric furnace by a process combining fusion and electrolysis, which offers a number of advantageous features, but involves naturally a great waste of the electrical energy of the current. My estimates show that the price of aluminium could be considerably reduced by adopting in its manufacture a method similar to that proposed by me for the production of iron. A pound of aluminium requires for fusion only about seventy per cent. of the heat needed for melting a pound of iron, and inasmuch as its weight is only about one third of that of the latter, a volume of aluminium four times that of iron could be obtained from a given amount of heat-energy. But a cold electrolytic process of manufacture is the ideal solution, and on this I have placed my hope.

The absolutely unavoidable consequence of the advance of the aluminium industry will be the annihilation of the copper industry. They cannot exist and prosper together, and the latter is doomed beyond any hope of recovery. Even now it is cheaper to convey an electric current through aluminium wires than through copper wires; aluminium castings cost less, and in many domestic and other uses copper has no chance of successfully competing. A further material reduction of the price of aluminium cannot but be fatal to copper. But the progress of the former will not go on unchecked, for, as it ever happens in such cases, the larger industry will absorb the smaller one: the giant copper interests will control the pygmy aluminium interests, and the slow-pacing copper will reduce the lively gait of aluminium. This will only delay, not avoid, the impending catastrophe.

Aluminium, however, will not stop at downing copper. Before many years have passed it will be engaged in a fierce struggle with iron, and in the latter it will find an adversary not easy to conquer. The issue of the contest will largely depend on whether iron shall be indispensable in electric machinery. This the future alone can decide. The magnetism as exhibited in iron is an isolated phenomenon in nature. What it is that makes this metal behave so radically different from all other materials in this respect has not yet been ascertained, though many theories have been suggested. As regards magnetism, the molecules of the various bodies behave like hollow beams partly filled with a heavy fluid and balanced in the middle in the manner of a see-saw. Evidently some disturbing influence exists in nature which causes each molecule, like such a beam, to tilt either one or the other way. If the molecules are tilted one way, the body is magnetic; if they are tilted the other way, the body is non-magnetic; but both positions are stable, as they would be in the case of the hollow beam, owing to the rushing of the fluid to the lower end. Now, the wonderful thing is that the molecules of all known bodies went one way, while those of iron went the other way. This metal, it would seem, has an origin entirely different from that of the rest of the globe. It is highly improbable that we shall discover some other and cheaper material which will equal or surpass iron in magnetic qualities.

Unless we should make a radical departure in the character of the electric currents employed, iron will be indispensable. Yet

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the advantages it offers are only apparent. So long as we use feeble magnetic forces it is by far superior to any other material; but if we find ways of producing great magnetic forces, then better results will be obtainable without it. In fact, I have already produced electric transformers in which no iron is employed, and which are capable of performing ten times as much work per pound of weight as those with iron. This result is attained by using electric currents of a very high rate of vibration, produced in novel ways, instead of the ordinary currents now employed in the industries. I have also succeeded in operating electric motors without iron by such rapidly vibrating currents, but the results, so far, have been inferior to those obtained with ordinary motors constructed of iron, although theoretically the former should be capable of performing incomparably more work per unit of weight than the latter. But the seemingly insuperable difficulties which are now in the way may be overcome in the end, and then iron will be done away with, and all electric machinery will be manufactured of aluminium, in all probability, at prices ridiculously low. This would be a severe, if not a fatal, blow to iron. In many other branches of industry, as ship-building, or wherever lightness of structure is required, the progress of the new metal will be much quicker. For such uses it is eminently suitable, and is sure to supersede iron sooner or later. It is highly probable that in the course of time we shall be able to give it many of those qualities which make iron so valuable.

While it is impossible to tell when this industrial revolution will be consummated, there can be no doubt that the future belongs to aluminium, and that in times to come it will be the chief means of increasing human performance. It has in this respect capacities greater by far than those of any other metal. I should estimate its civilizing potency at fully one hundred times that of iron. This estimate, though it may astonish, is not at all exaggerated. First of all, we must remember that there is thirty times as much aluminium as iron in bulk, available for the uses of man. This in itself offers great possibilities. Then, again, the new metal is much more easily workable, which adds to its value. In many of its properties it partakes of the character of a precious metal, which gives it additional worth. Its electric conductivity, which, for a given weight, is greater than that of any other metal, would be alone sufficient to make it one of the most

important factors in future human progress. Its extreme lightness makes it far more easy to transport the objects manufactured. By virtue of this property it will revolutionize naval construction, and in facilitating transport and travel it will add enormously to the useful performance of mankind. But its greatest civilizing potency will be, I believe, in aerial travel, which is sure to be brought about by means of it. Telegraphic instruments will slowly enlighten the barbarian. Electric motors and lamps will do it more quickly, but quicker than anything else the flying-machine will do it. By rendering travel ideally easy it will be the best means for unifying the heterogeneous elements of humanity. As the first step toward this realization we should produce a lighter storage-battery or get more energy from coal.

EFFORTS TOWARD OBTAINING MORE ENERGY FROM COAL—THE ELECTRIC TRANSMISSION—THE GAS-ENGINE—THE COLD-COAL BATTERY.

I REMEMBER that at one time I considered the production of electricity by burning coal in a battery as the greatest achievement toward advancing civilization, and I am surprised to find how much the continuous study of these subjects has modified my views. It now seems to me that to burn coal, however efficiently, in a battery would be a mere makeshift, a phase in the evolution toward something much more perfect. After all, in generating electricity in this manner, we should be destroying material, and this would be a barbarous process. We ought to be able to obtain the energy we need without consumption of material. But I am far from underrating the value of such an efficient method of burning fuel. At the present time most motive power comes from coal, and, either directly or by its products, it adds vastly to human energy. Unfortunately, in all the processes now adopted, the larger portion of the energy of the coal is uselessly dissipated. The best steam-engines utilize only a small part of the total energy. Even in gas-engines, in which, particularly of late, better results are obtainable, there is still a barbarous waste going on. In our electric-lighting systems we scarcely utilize one third of one per cent., and in lighting by gas a much smaller fraction, of the total energy of the coal. Considering the various uses of coal throughout the world, we certainly do not utilize more than two per cent. of its energy theoretically available. The man who should stop this senseless waste would be a great

benefactor of humanity, though the solution he would offer could not be a permanent one, since it would ultimately lead to the exhaustion of the store of material. Efforts toward obtaining more energy from coal are now being made chiefly in two directions—by generating electricity and by producing gas for motive-power purposes. In both of these lines notable success has already been achieved.

The advent of the alternating-current system of electric power-transmission marks an epoch in the economy of energy available to man from coal. Evidently all electrical energy obtained from a waterfall, saving so much fuel, is a net gain to mankind, which is all the more effective as it is secured with little expenditure of human effort, and as this most perfect of all known methods of deriving energy from the sun contributes in many ways to the advancement of civilization. But electricity enables us also to get from coal much more energy than was practicable in the old ways. Instead of transporting the coal to distant places of consumption, we burn it near the mine, develop electricity in the dynamos, and transmit the current to remote localities, thus effecting a considerable saving. Instead of driving the machinery in a factory in the old wasteful way by belts and shafting, we generate electricity by steam-power and operate electric motors. In this manner it is not uncommon to obtain two or three times as much effective motive power from the fuel, besides securing many other important advantages. It is in this field as much as in the transmission of energy to great distances that the alternating system, with its ideally simple machinery, is bringing about an industrial revolution. But in many lines this progress has not yet been felt. For example, steamers and trains are still being propelled by the direct application of steam-power to shafts or axles. A much greater percentage of the heat-energy of the fuel could be transformed in motive energy by using, in place of the adopted marine engines and locomotives, dynamos driven by specially designed high-pressure steam- or gas-engines and by utilizing the electricity generated for the propulsion. A gain of fifty to one hundred per cent. in the effective energy derived from the coal could be secured in this manner. It is difficult to understand why a fact so plain and obvious is not receiving more attention from engineers. In ocean steamers such an improvement would be particularly desirable, as it

would do away with noise and increase materially the speed and the carrying capacity of the liners.

Still more energy is now being obtained from coal by the latest improved gas-engine, the economy of which is, on the average, probably twice that of the best steam-engine. The introduction of the gas-engine is very much facilitated by the importance of the gas industry. With the increasing use of the electric light more and more of the gas is utilized for heating and motive-power purposes. In many instances gas is manufactured close to the coal-mine and conveyed to distant places of consumption, a considerable saving both in the cost of transportation and in utilization of the energy of the fuel being thus effected. In the present state of the mechanical and electrical arts the most rational way of deriving energy from coal is evidently to manufacture gas close to the coal store, and to utilize it, either on the spot or elsewhere, to generate electricity for industrial uses in dynamos driven by gas-engines. The commercial success of such a plant is largely dependent upon the production of gas-engines of great nominal horsepower, which, judging from the keen activity in this field, will soon be forthcoming. Instead of consuming coal directly, as usual, gas should be manufactured from it and burned to economize energy.

But all such improvements cannot be more than passing phases in the evolution toward something far more perfect, for ultimately we must succeed in obtaining electricity from coal in a more direct way, involving no great loss of its heat-energy. Whether coal can be oxidized by a cold process is still a question. Its combination with oxygen always evolves heat, and whether the energy of the combination of the carbon with another element can be turned directly into electrical energy has not yet been determined. Under certain conditions nitric acid will burn the carbon, generating an electric current, but the solution does not remain cold. Other means of oxidizing coal have been proposed, but they have offered no promise of leading to an efficient process. My own lack of success has been complete, though perhaps not quite so complete as that of some who have "perfected" the cold-coal battery. This problem is essentially one for the chemist to solve. It is not for the physicist, who determines all his results in advance, so that, when the experiment is tried, it cannot fail. Chemistry, though a positive science, does not yet admit of a solution by

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such positive methods as those which are available in the treatment of many physical problems. The result, if possible, will be arrived at through patient trying rather than through deduction or calculation. The time will soon come, however, when the chemist will be able to follow a course clearly mapped out beforehand, and when the process of his arriving at a desired result will be purely constructive. The cold-coal battery would give a great impetus to electrical development; it would lead very shortly to a practical flying-machine, and would enormously enhance the introduction of the automobile. But these and many other problems will be better solved, and in a more scientific manner, by a light-storage battery.

ENERGY FROM THE MEDIUM—THE WINDMILL
AND THE SOLAR ENGINE—MOTIVE POWER
FROM TERRESTRIAL HEAT—ELECTRICITY
FROM NATURAL SOURCES.

BESIDES fuel, there is abundant material from which we might eventually derive power. An immense amount of energy is locked up in limestone, for instance, and machines can be driven by liberating the carbonic acid through sulphuric acid or otherwise. I once constructed such an engine, and it operated satisfactorily.

But, whatever our resources of primary energy may be in the future, we must, to be rational, obtain it without consumption of any material. Long ago I came to this conclusion, and to arrive at this result only two ways, as before indicated, appeared possible—either to turn to use the energy of the sun stored in the ambient medium, or to transmit, through the medium, the sun's energy to distant places from some locality where it was obtainable without consumption of material. At that time I at once rejected the latter method as entirely impracticable, and turned to examine the possibilities of the former.

It is difficult to believe, but it is, nevertheless, a fact, that since time immemorial man has had at his disposal a fairly good machine which has enabled him to utilize the energy of the ambient medium. This machine is the windmill. Contrary to popular belief, the power obtainable from wind is very considerable. Many a deluded inventor has spent years of his life in endeavoring to "harness the tides," and some have even proposed to compress air by tide- or wave-power for supplying energy, never understanding the signs of the old windmill on the hill, as it

sorrowfully waved its arms about and bade them stop. The fact is that a wave- or tide-motor would have, as a rule, but a small chance of competing commercially with the windmill, which is by far the better machine, allowing a much greater amount of energy to be obtained in a simpler way. Wind-power has been, in old times, of inestimable value to man, if for nothing else but for enabling him to cross the seas, and it is even now a very important factor in travel and transportation. But there are great limitations in this ideally simple method of utilizing the sun's energy. The machines are large for a given output, and the power is intermittent, thus necessitating the storage of energy and increasing the cost of the plant.

A far better way, however, to obtain power would be to avail ourselves of the sun's rays, which beat the earth incessantly and supply energy at a maximum rate of over four million horse-power per square mile. Although the average energy received per square mile in any locality during the year is only a small fraction of that amount, yet an inexhaustible source of power would be opened up by the discovery of some efficient method of utilizing the energy of the rays. The only rational way known to me at the time when I began the study of this subject was to employ some kind of heat- or thermodynamic engine, driven by a volatile fluid evaporated in a boiler by the heat of the rays. But closer investigation of this method, and calculation, showed that, notwithstanding the apparently vast amount of energy received from the sun's rays, only a small fraction of that energy could be actually utilized in this manner. Furthermore, the energy supplied through the sun's radiations is periodical, and the same limitations as in the use of the windmill I found to exist here also. After a long study of this mode of obtaining motive power from the sun, taking into account the necessarily large bulk of the boiler, the low efficiency of the heat-engine, the additional cost of storing the energy, and other drawbacks, I came to the conclusion that the "solar engine," a few instances excepted, could not be industrially exploited with success.

Another way of getting motive power from the medium without consuming any material would be to utilize the heat contained in the earth, the water, or the air for driving an engine. It is a well-known fact that the interior portions of the globe are very hot, the temperature rising, as observa-

tions show, with the approach to the center at the rate of approximately 1° C. for every hundred feet of depth. The difficulties of sinking shafts and placing boilers at depths of, say, twelve thousand feet, corresponding to an increase in temperature of about 120° C., are not insuperable, and we could certainly avail ourselves in this way of the internal heat of the globe. In fact, it would not be necessary to go to any depth at all in order to derive energy from the stored terrestrial heat. The superficial layers of the earth and the air strata close to the same are at a temperature sufficiently high to evaporate some extremely volatile substances, which we might use in our boilers instead of water. There is no doubt that a vessel might be propelled on the ocean by an engine driven by such a volatile fluid, no other energy being used but the heat abstracted from the water. But the amount of power which could be obtained in this manner would be, without further provision, very small.

Electricity produced by natural causes is another source of energy which might be rendered available. Lightning discharges involve great amounts of electrical energy, which we could utilize by transforming and storing it. Some years ago I made known a method of electrical transformation which renders the first part of this task easy, but the storing of the energy of lightning discharges will be difficult to accomplish. It is well known, furthermore, that electric currents circulate constantly through the earth, and that there exists between the earth and any air stratum a difference of electrical pressure, which varies in proportion to the height.

In recent experiments I have discovered two novel facts of importance in this connection. One of these facts is that an electric current is generated in a wire extending from the ground to a great height by the axial, and probably also by the translatory, movement of the earth. No appreciable current, however, will flow continuously in the wire unless the electricity is allowed to leak out into the air. Its escape is greatly facilitated by providing at the elevated end of the wire a conducting terminal of great surface, with many sharp edges or points. We are thus enabled to get a continuous supply of electrical energy by merely supporting a wire at a height, but, unfortunately, the amount of electricity which can be so obtained is small.

The second fact which I have ascertained is that the upper air strata are permanently charged with electricity opposite to that of

the earth. So, at least, I have interpreted my observations, from which it appears that the earth, with its adjacent insulating and outer conducting envelop, constitutes a highly charged electrical condenser containing, in all probability, a great amount of electrical energy which might be turned to the uses of man, if it were possible to reach with a wire to great altitudes.

It is possible, and even probable, that there will be, in time, other resources of energy opened up, of which we have no knowledge now. We may even find ways of applying forces such as magnetism or gravity for driving machinery without using any other means. Such realizations, though highly improbable, are not impossible. An example will best convey an idea of what we can hope to attain and what we can never attain. Imagine a disk of some homogeneous material turned perfectly true and arranged to turn in frictionless bearings on a horizontal shaft above the ground. This disk, being under the above conditions perfectly balanced, would rest in any position. Now, it is possible that we may learn how to make such a disk rotate continuously and perform work by the force of gravity without any further effort on our part; but it is perfectly impossible for the disk to turn and to do work without any force from the outside. If it could do so, it would be what is designated scientifically as a "perpetuum mobile," a machine creating its own motive power. To make the disk rotate by the force of gravity we have only to invent a screen against this force. By such a screen we could prevent this force from acting on one half of the disk, and the rotation of the latter would follow. At least, we cannot deny such a possibility until we know exactly the nature of the force of gravity. Suppose that this force were due to a movement comparable to that of a stream of air passing from above toward the center of the earth. The effect of such a stream upon both halves of the disk would be equal, and the latter would not rotate ordinarily; but if one half should be guarded by a plate arresting the movement, then it would turn.

A DEPARTURE FROM KNOWN METHODS—POSSIBILITY OF A "SELF-ACTING" ENGINE OR MACHINE, INANIMATE, YET CAPABLE, LIKE A LIVING BEING, OF DERIVING ENERGY FROM THE MEDIUM—THE IDEAL WAY OF OBTAINING MOTIVE POWER.

WHEN I began the investigation of the subject under consideration, and when the preceding or similar ideas presented themselves

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to me for the first time, though I was then unacquainted with a number of the facts mentioned, a survey of the various ways of utilizing the energy of the medium convinced me, nevertheless, that to arrive at a thoroughly satisfactory practical solution a radical departure from the methods then known had to be made. The windmill, the solar engine, the engine driven by terrestrial heat, had their limitations in the amount of power obtainable. Some new way had to be discovered which would enable us to get more energy. There was enough heat-energy in the medium, but only a small part of it was available for the operation of an engine in the ways then known. Besides, the energy was obtainable only at a very slow rate. Clearly, then, the problem was to discover some new method which would make it possible both to utilize more of the heat-energy of the medium and also to draw it away from the same at a more rapid rate.

I was vainly endeavoring to form an idea of how this might be accomplished, when I read some statements from Carnot and Lord Kelvin (then Sir William Thomson) which meant virtually that it is impossible for an inanimate mechanism or self-acting machine to cool a portion of the medium below the temperature of the surrounding, and operate by the heat abstracted. These statements interested me intensely. Evidently a living being could do this very thing, and since the experiences of my early life which I have related had convinced me that a living being is only an automaton, or, otherwise stated, a "self-acting engine," I came to the conclusion that it was possible to construct a machine which would do the same. As the first step toward this realization I conceived the following mechanism. Imagine a thermopile consisting of a number of bars of metal extending from the earth to the outer space beyond the atmosphere. The heat from below, conducted upward along these metal bars, would cool the earth or the sea or the air, according to the location of the lower parts of the bars, and the result, as is well known, would be an electric current circulating in these bars. The two terminals of the thermopile could now be joined through an electric motor, and, theoretically, this motor would run on and on, until the media below would be cooled down to the temperature of the outer space. This would be an inanimate engine which, to all evidence, would be cooling a portion of the medium below the temperature of the surrounding, and operating by the heat abstracted.

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But was it not possible to realize a similar condition without necessarily going to a height? Conceive, for the sake of illustra-

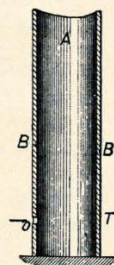


DIAGRAM *b*. OBTAINING ENERGY FROM THE AMBIENT MEDIUM.

A, medium with little energy; *B, B*, ambient medium with much energy; *O*, path of the energy.

tion, an inclosure *T*, as illustrated in diagram *b*, such that energy could not be transferred across it except through a channel or path *O*, and that, by some means or other, in this inclosure a medium were maintained which would have little energy, and that on the outer side of the same there would be the ordinary ambient medium with much energy. Under these assumptions the energy would flow through the path *O*, as indicated by the arrow, and might then be converted on its passage into some other form of energy. The question was, Could such a condition be attained? Could we produce artificially such a "sink" for the energy of the ambient medium to flow in? Suppose that an extremely low temperature could be maintained by some process in a given space; the surrounding medium would then be compelled to give off heat, which could be converted into mechanical or other form of energy, and utilized. By realizing such a plan, we should be enabled to get at any point of the globe a continuous supply of energy, day and night. More than this, reasoning in the abstract, it would seem possible to cause a quick circulation of the medium, and thus draw the energy at a very rapid rate.

Here, then, was an idea which, if realizable, afforded a happy solution of the problem of getting energy from the medium. But was it realizable? I convinced myself that it was so in a number of ways, of which one is the following. As regards heat, we are at a high level, which may be represented by the surface of a mountain lake considerably above the sea, the level of which may mark the absolute zero of temperature existing in the interstellar space. Heat, like water, flows

from high to low level, and, consequently, just as we can let the water of the lake run down to the sea, so we are able to let heat from the earth's surface travel up into the cold region above. Heat, like water, can perform work in flowing down, and if we had any doubt as to whether we could derive energy from the medium by means of a thermopile, as before described, it would be dispelled by this analogue. But can we produce cold in a given portion of the space and cause the heat to flow in continually? To create such a "sink," or "cold hole," as we might say, in the medium, would be equivalent to producing in the lake a space either empty or filled with something much lighter than water. This we could do by placing in the lake a tank, and pumping all the water out of the latter. We know, then, that the water, if allowed to flow back into the tank, would, theoretically, be able to perform exactly the same amount of work which was used in pumping it out, but not a bit more. Consequently nothing could be gained in this double operation of first raising the water and then letting it fall down. This would mean that it is impossible to create such a sink in the medium. But let us reflect a moment. Heat, though following certain general laws of mechanics, like a fluid, is not such; it is energy which may be converted into other forms of energy as it passes from a high to a low level. To make our mechanical analogy complete and true, we must, therefore, assume that the water, in its passage into the tank, is converted into something else, which may be taken out of it without using any, or by using very little, power. For example, if heat be represented in this analogue by the water of the lake, the oxygen and hydrogen composing the water may illustrate other forms of energy into which the heat is transformed in passing from hot to cold. If the process of heat-transformation were absolutely perfect, no heat at all would arrive at the low level, since all of it would be converted into other forms of energy. Corresponding to this ideal case, all the water flowing into the tank would be decomposed into oxygen and hydrogen before reaching the bottom, and the result would be that water would continually flow in, and yet the tank would remain entirely empty, the gases formed escaping. We would thus produce, by expending initially a certain amount of work to create a sink for the heat or, respectively, the water to flow in, a condition enabling us to get any amount of energy without further effort.

This would be an ideal way of obtaining motive power. We do not know of any such absolutely perfect process of heat-conversion, and consequently some heat will generally reach the low level, which means to say, in our mechanical analogue, that some water will arrive at the bottom of the tank, and a gradual and slow filling of the latter will take place, necessitating continuous pumping out. But evidently there will be less to pump out than flows in, or, in other words, less energy will be needed to maintain the initial condition than is developed by the fall, and this is to say that some energy will be gained from the medium. What is not converted in flowing down can just be raised up with its own energy, and what is converted is clear gain. Thus the virtue of the principle I have discovered resides wholly in the conversion of the energy on the downward flow.

FIRST EFFORTS TO PRODUCE THE SELF-ACTING ENGINE—THE MECHANICAL OSCILLATOR—WORK OF DEWAR AND LINDE—LIQUID AIR.

HAVING recognized this truth, I began to devise means for carrying out my idea, and, after long thought, I finally conceived a combination of apparatus which should make possible the obtaining of power from the medium by a process of continuous cooling of atmospheric air. This apparatus, by continually transforming heat into mechanical work, tended to become colder and colder, and if it only were practicable to reach a very low temperature in this manner, then a sink for the heat could be produced, and energy could be derived from the medium. This seemed to be contrary to the statements of Carnot and Lord Kelvin before referred to, but I concluded from the theory of the process that such a result could be attained. This conclusion I reached, I think, in the latter part of 1883, when I was in Paris, and it was at a time when my mind was being more and more dominated by an invention which I had evolved during the preceding year, and which has since become known under the name of the "rotating magnetic field." During the few years which followed I elaborated further the plan I had imagined, and studied the working conditions, but made little headway. The commercial introduction in this country of the invention before referred to required most of my energies until 1889, when I again took up the idea of the self-acting machine. A closer in-

vestigation of the principles involved, and calculation, now showed that the result I aimed at could not be reached in a practical manner by ordinary machinery, as I had in the beginning expected. This led me, as a next step, to the study of a type of engine generally designated as "turbine," which at first seemed to offer better chances for a realization of the idea. Soon I found, however, that the turbine, too, was unsuitable. But my conclusions showed that if an engine of a peculiar kind could be brought to a high degree of perfection, the plan I had conceived was realizable, and I resolved to proceed with the development of such an engine, the primary object of which was to secure the greatest economy of transformation of heat into mechanical energy. A characteristic feature of the engine was that the work-performing piston was not connected with anything else, but was perfectly free to vibrate at an enormous rate. The mechanical difficulties encountered in the construction of this engine were greater than I had anticipated, and I made slow progress. This work was continued until early in 1892, when I went to London, where I saw Professor Dewar's admirable experiments with liquefied gases. Others had liquefied gases before, and notably Ozlewski and Pictet had performed creditable early experiments in this line, but there was such a vigor about the work of Dewar that even the old appeared new. His experiments showed, though in a way different from that I had imagined, that it was possible to reach a very low temperature by transforming heat into mechanical work, and I returned, deeply impressed with what I had seen, and more than ever convinced that my plan was practicable. The work temporarily interrupted was taken up anew, and soon I had in a fair state of perfection the engine which I have named "the mechanical oscillator." In this machine I succeeded in doing away with all packings, valves, and lubrication, and in producing so rapid a vibration of the piston that shafts of tough steel, fastened to the same and vibrated longitudinally, were torn asunder. By combining this engine with a dynamo of special design I produced a highly efficient electrical generator, invaluable in measurements and determinations of physical quantities on account of the unvarying rate of oscillation obtainable by its means. I exhibited several types of this machine, named "mechanical and electrical oscillator," before the Electrical Congress at the World's Fair in Chicago during the summer of 1893, in a lecture which, on

account of other pressing work, I was unable to prepare for publication. On that occasion I exposed the principles of the mechanical oscillator, but the original purpose of this machine is explained here for the first time.

In the process, as I had primarily conceived it, for the utilization of the energy of the ambient medium, there were five essential elements in combination, and each of these had to be newly designed and perfected, as no such machines existed. The mechanical oscillator was the first element of this combination, and having perfected this, I turned to the next, which was an air-compressor of a design in certain respects resembling that of the mechanical oscillator. Similar difficulties in the construction were again encountered, but the work was pushed vigorously, and at the close of 1894 I had completed these two elements of the combination, and thus produced an apparatus for compressing air, virtually to any desired pressure, incomparably simpler, smaller, and more efficient than the ordinary. I was just beginning work on the third element, which together with the first two would give a refrigerating machine of exceptional efficiency and simplicity, when a misfortune befell me in the burning of my laboratory, which crippled my labors and delayed me. Shortly afterward Dr. Carl Linde announced the liquefaction of air by a self-cooling process, demonstrating that it was practicable to proceed with the cooling until liquefaction of the air took place. This was the only experimental proof which I was still wanting that energy was obtainable from the medium in the manner contemplated by me.

The liquefaction of air by a self-cooling process was not, as popularly believed, an accidental discovery, but a scientific result which could not have been delayed much longer, and which, in all probability, could not have escaped Dewar. This fascinating advance, I believe, is largely due to the powerful work of this great Scotchman. Nevertheless, Linde's is an immortal achievement. The manufacture of liquid air has been carried on for four years in Germany, on a scale much larger than in any other country, and this strange product has been applied for a variety of purposes. Much was expected of it in the beginning, but so far it has been an industrial ignis fatuus. By the use of such machinery as I am perfecting, its cost will probably be greatly lessened, but even then its commercial success will be ques-

tionable. When used as a refrigerant it is uneconomical, as its temperature is unnecessarily low. It is as expensive to maintain a body at a very low temperature as it is to keep it very hot; it takes coal to keep air cold. In oxygen manufacture it cannot yet compete with the electrolytic method. For use as an explosive it is unsuitable, because its low temperature again condemns it to a small efficiency, and for motive-power purposes its cost is still by far too high. It is of interest to note, however, that in driving an engine by liquid air a certain amount of energy may be gained from the engine, or, stated otherwise, from the ambient medium which keeps the engine warm, each two hundred pounds of iron-casting of the latter contributing energy at the rate of about one effective horse-power during one hour. But this gain of the consumer is offset by an equal loss of the producer.

Much of this task on which I have labored so long remains to be done. A number of mechanical details are still to be perfected and some difficulties of a different nature to be mastered, and I cannot hope to produce a self-acting machine deriving energy from the ambient medium for a long time yet, even if all my expectations should materialize. Many circumstances have occurred which have retarded my work of late, but for several reasons the delay was beneficial.

One of these reasons was that I had ample time to consider what the ultimate possibilities of this development might be. I worked for a long time fully convinced that the practical realization of this method of obtaining energy from the sun would be of incalculable industrial value, but the continued study of the subject revealed the fact that while it will be commercially profitable if my expectations are well founded, it will not be so to an extraordinary degree.

DISCOVERY OF UNEXPECTED PROPERTIES OF THE ATMOSPHERE—STRANGE EXPERIMENTS—TRANSMISSION OF ELECTRICAL ENERGY THROUGH ONE WIRE WITHOUT RETURN—TRANSMISSION THROUGH THE EARTH WITHOUT ANY WIRE.

ANOTHER of these reasons was that I was led to recognize the transmission of electrical energy to any distance through the media as by far the best solution of the great problem of harnessing the sun's energy for the uses of man. For a long time I was convinced that such a transmission on an

industrial scale could never be realized, but a discovery which I made changed my view. I observed that under certain conditions the atmosphere, which is normally a high insulator, assumes conducting properties, and so becomes capable of conveying any amount of electrical energy. But the difficulties in the way of a practical utilization of this discovery for the purpose of transmitting electrical energy without wires were seemingly insuperable. Electrical pressures of many millions of volts had to be produced and handled; generating apparatus of a novel kind, capable of withstanding the immense electrical stresses, had to be invented and perfected, and a complete safety against the dangers of the high-tension currents had to be attained in the system before its practical introduction could be even thought of. All this could not be done in a few weeks or months, or even years. The work required patience and constant application, but the improvements came, though slowly. Other valuable results were, however, arrived at in the course of this long-continued work, of which I shall endeavor to give a brief account, enumerating the chief advances as they were successively effected.

The discovery of the conducting properties of the air, though unexpected, was only a natural result of experiments in a special field which I had carried on for some years before. It was, I believe, during 1889 that certain possibilities offered by extremely rapid electrical oscillations determined me to design a number of special machines adapted for their investigation. Owing to the peculiar requirements, the construction of these machines was very difficult, and consumed much time and effort; but my work on them was generously rewarded, for I reached by their means several novel and important results. One of the earliest observations I made with these new machines was that electrical oscillations of an extremely high rate act in an extraordinary manner upon the human organism. Thus, for instance, I demonstrated that powerful electrical discharges of several hundred thousand volts, which at that time were considered absolutely deadly, could be passed through the body without inconvenience or hurtful consequences. These oscillations produced other specific physiological effects, which, upon my announcement, were eagerly taken up by skilled physicians and further investigated. This new field has proved itself fruitful beyond expectation, and in the few years which have passed since, it has been

developed to such an extent that it now forms a legitimate and important department of medical science. Many results, thought impossible at that time, are now readily obtainable with these oscillations, and many experiments undreamed of then can now be readily performed by their means. I still remember with pleasure how, nine years ago, I passed the discharge of a powerful induction-coil through my body to demonstrate before a scientific society the comparative harmlessness of very rapidly vibrating electric currents, and I can still recall the astonishment of my audience. I would now undertake, with much less apprehension than I had in that experiment, to transmit through my body with such currents the entire electrical energy of the dynamos now working at Niagara—forty or fifty thousand horsepower. I have produced electrical oscillations which were of such intensity that when circulating through my arms and chest they have melted wires which joined my hands, and still I felt no inconvenience. I have energized with such oscillations a loop of heavy copper wire so powerfully that masses of metal, and even objects of an electrical resistance specifically greater than that of human tissue, brought close to or placed within the loop, were heated to a high temperature and melted, often with the violence of an explosion, and yet into this very space in which this terribly destructive turmoil was going on I have repeatedly thrust my head without feeling anything or experiencing injurious after-effects.

Another observation was that by means of such oscillations light could be produced in a novel and more economical manner, which promised to lead to an ideal system of electric illumination by vacuum-tubes, dispensing with the necessity of renewal of lamps or incandescent filaments, and possibly also with the use of wires in the interior of buildings. The efficiency of this light increases in proportion to the rate of the oscillations, and its commercial success is, therefore, dependent on the economical production of electrical vibrations of transcending rates. In this direction I have met with gratifying success of late, and the practical introduction of this new system of illumination is not far off.

The investigations led to many other valuable observations and results, one of the more important of which was the demonstration of the practicability of supplying electrical energy through one wire without return. At first I was able to transmit in this novel

manner only very small amounts of electrical energy, but in this line also my efforts have been rewarded with similar success.

The photograph shown in Fig. 3 (see p. 186) illustrates, as its title explains, an actual transmission of this kind effected with apparatus used in other experiments here described. To what a degree the appliances have been perfected since my first demonstrations early in 1891 before a scientific society, when my apparatus was barely capable of lighting one lamp (which result was considered wonderful), will appear when I state that I have now no difficulty in lighting in this manner four or five hundred lamps, and could light many more. In fact, there is no limit to the amount of energy which may in this way be supplied to operate any kind of electrical device.

After demonstrating the practicability of this method of transmission, the thought naturally occurred to me to use the earth as a conductor, thus dispensing with all wires. Whatever electricity may be, it is a fact that it behaves like an incompressible fluid, and the earth may be looked upon as an immense reservoir of electricity, which, I thought, could be disturbed effectively by a properly designed electrical machine. Accordingly, my next efforts were directed toward perfecting a special apparatus which would be highly effective in creating a disturbance of electricity in the earth. The progress in this new direction was necessarily very slow and the work discouraging, until I finally succeeded in perfecting a novel kind of transformer or induction-coil, particularly suited for this special purpose. That it is practicable, in this manner, not only to transmit minute amounts of electrical energy for operating delicate electrical devices, as I contemplated at first, but also electrical energy in appreciable quantities, will appear from an inspection of Fig. 4 (see p. 186), which illustrates an actual experiment of this kind performed with the same apparatus. The result obtained was all the more remarkable as the top end of the coil was not connected to a wire or plate for magnifying the effect.

"WIRELESS" TELEGRAPHY—THE SECRET OF TUNING—ERRORS IN THE HERTZIAN INVESTIGATIONS—A RECEIVER OF WONDERFUL SENSITIVENESS.

As the first valuable result of my experiments in this latter line a system of telegraphy without wires resulted, which I described in two

scientific lectures in February and March, 1893. It is mechanically illustrated in diagram *c*, the upper part of which shows the electrical arrangement as I described it then, while the lower part illustrates its mechanical analogue. The system is extremely simple in principle. Imagine two tuning-forks F, F_1 , one at the sending- and the other at the receiving-station respectively, each having attached to its lower prong a minute piston p , fitting in a cylinder. Both the cylinders communicate with a large reservoir R , with elastic walls, which is supposed to be closed and filled with a light and incompressible fluid. By striking repeatedly one of the prongs of the tuning-fork F , the small piston p below would be vibrated, and its vibrations, transmitted through the fluid, would reach the distant fork F_1 , which is "tuned" to the fork F , or, stated otherwise, of exactly the same note as the latter. The fork F_1 would now be set vibrating, and its vibration would be intensified by the continued action of the distant fork F until its upper prong, swinging far out, would make an electrical connection with a stationary contact c' , starting in this manner some electrical or other appliances which may be used for recording the signals. In this simple way messages could be exchanged between the two stations, a similar contact c' being provided for this purpose, close to the upper prong of the fork F , so that the apparatus at each station could be employed in turn as receiver and transmitter.

The electrical system illustrated in the upper figure of diagram *c* is exactly the same in principle, the two wires or circuits ESP and $E_1S_1P_1$, which extend vertically to a height, representing the two tuning-forks with the pistons attached to them. These circuits are connected with the ground by plates E, E_1 , and to two elevated metal sheets P, P_1 , which store electricity and thus magnify considerably the effect. The closed reservoir R , with elastic walls, is in this case replaced by the earth, and the fluid by electricity. Both of these circuits are "tuned" and operate just like the two tuning-forks. Instead of striking the fork F at the sending-station, electrical oscillations are produced in the vertical sending- or transmitting-wire ESP , as by the action of a source S , included in this wire, which

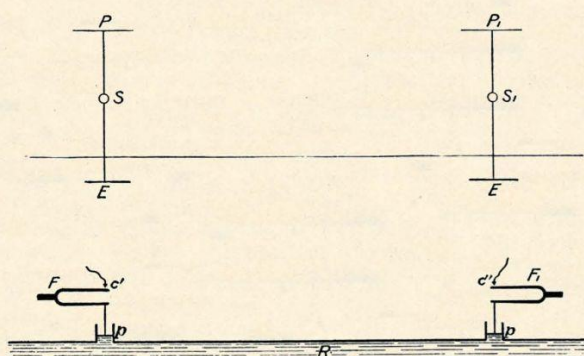


DIAGRAM *c*. "WIRELESS" TELEGRAPHY MECHANICALLY ILLUSTRATED.

spread through the ground and reach the distant vertical receiving-wire $E_1S_1P_1$, exciting corresponding electrical oscillations in the same. In the latter wire or circuit is included a sensitive device or receiver S_1 , which is thus set in action and made to operate a relay or other appliance. Each station is, of course, provided both with a source of electrical oscillations S and a sensitive receiver S_1 , and a simple provision is made for using each of the two wires alternately to send and to receive the messages.

The exact attunement of the two circuits secures great advantages, and, in fact, it is essential in the practical use of the system. In this respect many popular errors exist, and, as a rule, in the technical reports on this subject circuits and appliances are described as affording these advantages when from their very nature it is evident that this is impossible. In order to attain the best results it is essential that the length of each wire or circuit, from the ground connection to the top, should be equal to one quarter of the wave-length of the electrical vibration in the wire, or else equal to that length multiplied by an odd number. Without the observation of this rule it is virtually impossible to prevent the interference and insure the privacy of messages. Therein lies the secret of tuning. To obtain the most satisfactory results it is, however, necessary to resort to electrical vibrations of low pitch. The Hertzian spark apparatus, used generally by experimenters, which produces oscillations of a very high rate, permits no effective tuning, and slight disturbances are sufficient to render an exchange of messages impracticable. But scientifically designed, efficient appliances allow nearly perfect adjustment. An experiment performed with the improved apparatus repeatedly referred to, and intended to convey an idea of this feature, is

illustrated in Fig. 5 (p. 187), which is sufficiently explained by its note.

Since I described these simple principles of telegraphy without wires I have had frequent occasion to note that the identical features and elements have been used, in the evident belief that the signals are being transmitted to considerable distances by "Hertzian" radiations. This is only one of many misapprehensions to which the investigations of the lamented physicist have given rise. About thirty-three years ago Maxwell, following up a suggestive experiment made by Faraday in 1845, evolved an ideally simple theory which intimately connected light, radiant heat, and electrical phenomena, interpreting them as being all due to vibrations of a hypothetical fluid of inconceivable tenuity, called the ether. No experimental verification was arrived at until Hertz, at the suggestion of Helmholtz, undertook a series of experiments to this effect. Hertz proceeded with extraordinary ingenuity and insight, but devoted little energy to the perfection of his old-fashioned apparatus. The consequence was that he failed to observe the important function which the air played in his experiments, and which I subsequently discovered. Repeating his experiments and reaching different results, I ventured to point out this oversight. The strength of the proofs brought forward by Hertz in support of Maxwell's theory resided in the correct estimate of the rates of vibration of the circuits he used. But I ascertained that he could not have obtained the rates he thought he was getting. The vibrations with identical apparatus he employed are, as a rule, much slower, this being due to the presence of air, which produces a dampening effect upon a rapidly vibrating electric circuit of high pressure, as a fluid does upon a vibrating tuning-fork. I have, however, discovered since that time other causes of error, and I have long ago ceased to look upon his results as being an experimental verification of the poetical conceptions of Maxwell. The work of the great German physicist has acted as an immense stimulus to contemporary electrical research, but it has likewise, in a measure, by its fascination, paralyzed the scientific mind, and thus hampered independent inquiry. Every new phenomenon which was discovered was made to fit the theory, and so very often the truth has been unconsciously distorted.

When I advanced this system of telegraphy, my mind was dominated by the idea of

effecting communication to any distance through the earth or environing medium, the practical consummation of which I considered of transcendent importance, chiefly on account of the moral effect which it could not fail to produce universally. As the first effort to this end I proposed, at that time, to employ relay-stations with tuned circuits, in the hope of making thus practicable signaling over vast distances, even with apparatus of very moderate power then at my command. I was confident, however, that with properly designed machinery signals could be transmitted to any point of the globe, no matter what the distance, without the necessity of using such intermediate stations. I gained this conviction through the discovery of a singular electrical phenomenon, which I described early in 1892, in lectures delivered before some scientific societies abroad, and which I have called a "rotating brush." This is a bundle of light which is formed, under certain conditions, in a vacuum-bulb, and which is of a sensitiveness to magnetic and electric influences bordering, so to speak, on the supernatural. This light-bundle is rapidly rotated by the earth's magnetism as many as twenty thousand times per second, the rotation in these parts being opposite to what it would be in the southern hemisphere, while in the region of the magnetic equator it should not rotate at all. In its most sensitive state, which is difficult to attain, it is responsive to electric or magnetic influences to an incredible degree. The mere stiffening of the muscles of the arm and consequent slight electrical change in the body of an observer standing at some distance from it, will perceptibly affect it. When in this highly sensitive state it is capable of indicating the slightest magnetic and electric changes taking place in the earth. The observation of this wonderful phenomenon impressed me strongly that communication at any distance could be easily effected by its means, provided that apparatus could be perfected capable of producing an electric or magnetic change of state, however small, in the terrestrial globe or environing medium.

DEVELOPMENT OF A NEW PRINCIPLE—THE ELECTRICAL OSCILLATOR—PRODUCTION OF IMMENSE ELECTRICAL MOVEMENTS—THE EARTH RESPONDS TO MAN—INTERPLANETARY COMMUNICATION NOW PROBABLE.

I RESOLVED to concentrate my efforts upon this venturesome task, though it involved

great sacrifice, for the difficulties to be mastered were such that I could hope to consummate it only after years of labor. It meant delay of other work to which I would have preferred to devote myself, but I gained the conviction that my energies could not be more usefully employed; for I recognized that an efficient apparatus for the production of powerful electrical oscillations, as was needed for that specific purpose, was the key to the solution of other most important electrical and, in fact, human problems. Not only was communication, to any distance, without wires possible by its means, but, likewise, the transmission of energy in great amounts, the burning of the atmospheric nitrogen, the production of an efficient illuminant, and many other results of inestimable scientific and industrial value. Finally, however, I had the satisfaction of accomplishing the task undertaken by the use of a new principle, the virtue of which is based on the marvelous properties of the electrical condenser. One of these is that it can discharge or explode its stored energy in an inconceivably short time. Owing to this it is unequalled in explosive violence. The explosion of dynamite is only the breath of a consumptive compared with its discharge. It is the means of producing the strongest current, the highest electrical pressure, the greatest commotion in the medium. Another of its properties, equally valuable, is that its discharge may vibrate at any rate desired up to many millions per second.

I had arrived at the limit of rates obtainable in other ways when the happy idea presented itself to me to resort to the condenser. I arranged such an instrument so as to be charged and discharged alternately in rapid succession through a coil with a few turns of stout wire, forming the primary of a transformer or induction-coil. Each time the condenser was discharged the current would quiver in the primary wire and induce corresponding oscillations in the secondary. Thus a transformer or induction-coil on new principles was evolved, which I have called "the electrical oscillator," partaking of those unique qualities which characterize the condenser, and enabling results to be attained impossible by other means. Electrical effects of any desired character and of intensities undreamed of before are now easily producible by perfected apparatus of this kind, to which frequent reference has been made, and the essential parts of which are shown in Fig. 6 (p. 188). For certain pur-

poses a strong inductive effect is required; for others the greatest possible suddenness; for others again, an exceptionally high rate of vibration or extreme pressure; while for certain other objects immense electrical movements are necessary. The photographs in Figs. 7, 8, 9, and 10, of experiments performed with such an oscillator, may serve to illustrate some of these features and convey an idea of the magnitude of the effects actually produced. The completeness of the titles of the figures referred to makes a further description of them unnecessary.

However extraordinary the results shown may appear, they are but trifling compared with those which are attainable by apparatus designed on these same principles. I have produced electrical discharges the actual path of which, from end to end, was probably more than one hundred feet long; but it would not be difficult to reach lengths one hundred times as great. I have produced electrical movements occurring at the rate of approximately one hundred thousand horse-power, but rates of one, five, or ten million horse-power are easily practicable. In these experiments effects were developed incomparably greater than any ever produced by human agencies, and yet these results are but an embryo of what is to be.

That communication without wires to any point of the globe is practicable with such apparatus would need no demonstration, but through a discovery which I made I obtained absolute certitude. Popularly explained, it is exactly this: When we raise the voice and hear an echo in reply, we know that the sound of the voice must have reached a distant wall, or boundary, and must have been reflected from the same. Exactly as the sound, so an electrical wave is reflected, and the same evidence which is afforded by an echo is offered by an electrical phenomenon known as a "stationary" wave—that is, a wave with fixed nodal and ventral regions. Instead of sending sound-vibrations toward a distant wall, I have sent electrical vibrations toward the remote boundaries of the earth, and instead of the wall the earth has replied. In place of an echo I have obtained a stationary electrical wave, a wave reflected from afar.

Stationary waves in the earth mean something more than mere telegraphy without wires to any distance. They will enable us to attain many important specific results impossible otherwise. For instance, by their use we may produce at will, from a sending-station, an electrical effect in any particular

region of the globe; we may determine the relative position or course of a moving object, such as a vessel at sea, the distance traversed by the same, or its speed; or we may send over the earth a wave of electricity traveling at any rate we desire, from the pace of a turtle up to lightning speed.

With these developments we have every reason to anticipate that in a time not very distant most telegraphic messages across the oceans will be transmitted without cables. For short distances we need a "wireless" telephone, which requires no expert operators. The greater the spaces to be bridged, the more rational becomes communication without wires. The cable is not only an easily damaged and costly instrument, but it limits us in the speed of transmission by reason of a certain electrical property inseparable from its construction. A properly designed plant for effecting communication without wires ought to have many times the working capacity of a cable, while it will involve incomparably less expense. Not a long time will pass, I believe, before communication by cable will become obsolete, for not only will signaling by this new method be quicker and cheaper, but also much safer. By using some new means for isolating the messages which I have contrived, an almost perfect privacy can be secured.

I have observed the above effects so far only up to a limited distance of about six hundred miles, but inasmuch as there is virtually no limit to the power of the vibrations producible with such an oscillator, I feel quite confident of the success of such a plant for effecting transoceanic communication. Nor is this all. My measurements and calculations have shown that it is perfectly practicable to produce on our globe, by the use of these principles, an electrical movement of such magnitude that, without the slightest doubt, its effect will be perceptible on some of our nearer planets, as Venus and Mars. Thus from mere possibility interplanetary communication has entered the stage of probability. In fact, that we can produce a distinct effect on one of these planets in this novel manner, namely, by disturbing the electrical condition of the earth, is beyond any doubt. This way of effecting such communication is, however, essentially different from all others which have so far been proposed by scientific men. In all the previous instances only a minute fraction of the total energy reaching the planet—as much as it would be possible to concentrate

in a reflector—could be utilized by the supposed observer in his instrument. But by the means I have developed he would be enabled to concentrate the larger portion of the entire energy transmitted to the planet in his instrument, and the chances of affecting the latter are thereby increased many millionfold.

Besides machinery for producing vibrations of the required power, we must have delicate means capable of revealing the effects of feeble influences exerted upon the earth. For such purposes, too, I have perfected new methods. By their use we shall likewise be able, among other things, to detect at considerable distance the presence of an iceberg or other object at sea. By their use, also, I have discovered some terrestrial phenomena still unexplained. That we can send a message to a planet is certain, that we can get an answer is probable: man is not the only being in the Infinite gifted with a mind.

TRANSMISSION OF ELECTRICAL ENERGY TO ANY DISTANCE WITHOUT WIRES—NOW PRACTICABLE—THE BEST MEANS OF INCREASING THE FORCE ACCELERATING THE HUMAN MASS.

THE most valuable observation made in the course of these investigations was the extraordinary behavior of the atmosphere toward electric impulses of excessive electromotive force. The experiments showed that the air at the ordinary pressure became distinctly conducting, and this opened up the wonderful prospect of transmitting large amounts of electrical energy for industrial purposes to great distances without wires, a possibility which, up to that time, was thought of only as a scientific dream. Further investigation revealed the important fact that the conductivity imparted to the air by these electrical impulses of many millions of volts increased very rapidly with the degree of rarefaction, so that air strata at very moderate altitudes, which are easily accessible, offer, to all experimental evidence, a perfect conducting path, better than a copper wire, for currents of this character.

Thus the discovery of these new properties of the atmosphere not only opened up the possibility of transmitting, without wires, energy in large amounts, but, what was still more significant, it afforded the certitude that energy could be transmitted in this manner economically. In this new system it matters little—in fact, almost

nothing—whether the transmission is effected at a distance of a few miles or of a few thousand miles.

While I have not, as yet, actually effected a transmission of a considerable amount of energy, such as would be of industrial importance, to a great distance by this new method, I have operated several model plants under exactly the same conditions which will exist in a large plant of this kind, and the practicability of the system is thoroughly demonstrated. The experiments have shown conclusively that, with two terminals maintained at an elevation of not more than thirty thousand to thirty-five thousand feet above sea-level, and with an electrical pressure of fifteen to twenty million volts, the energy of thousands of horse-power can be transmitted over distances which may be hundreds and, if necessary, thousands of miles. I am hopeful, however, that I may be able to reduce very considerably the elevation of the terminals now required, and with this object I am following up an idea which promises such a realization. There is, of course, a popular prejudice against using an electrical pressure of millions of volts, which may cause sparks to fly at distances of hundreds of feet, but, paradoxical as it may seem, the system, as I have described it in a technical publication, offers greater personal safety than most of the ordinary distribution circuits now used in the cities. This is, in a measure, borne out by the fact that, although I have carried on such experiments for a number of years, no injury has been sustained either by me or any of my assistants.

But to enable a practical introduction of the system, a number of essential requirements are still to be fulfilled. It is not enough to develop appliances by means of which such a transmission can be effected. The machinery must be such as to allow the transformation and transmission of electrical energy under highly economical and practical conditions. Furthermore, an inducement must be offered to those who are engaged in the industrial exploitation of natural sources of power, as waterfalls, by guaranteeing greater returns on the capital invested than they can secure by local development of the property.

From that moment when it was observed that, contrary to the established opinion, low and easily accessible strata of the atmosphere are capable of conducting electricity, the transmission of electrical energy without wires has become a rational task of the engineer, and one surpassing all others in importance. Its practical consummation would

mean that energy would be available for the uses of man at any point of the globe, not in small amounts such as might be derived from the ambient medium by suitable machinery, but in quantities virtually unlimited, from waterfalls. Export of power would then become the chief source of income for many happily situated countries, as the United States, Canada, Central and South America, Switzerland, and Sweden. Men could settle down everywhere, fertilize and irrigate the soil with little effort, and convert barren deserts into gardens, and thus the entire globe could be transformed and made a fitter abode for mankind. It is highly probable that if there are intelligent beings on Mars they have long ago realized this very idea, which would explain the changes on its surface noted by astronomers. The atmosphere on that planet, being of considerably smaller density than that of the earth, would make the task much more easy.

It is probable that we shall soon have a self-acting heat-engine capable of deriving moderate amounts of energy from the ambient medium. There is also a possibility—though a small one—that we may obtain electrical energy direct from the sun. This might be the case if the Maxwellian theory is true, according to which electrical vibrations of all rates should emanate from the sun. I am still investigating this subject. Sir William Crookes has shown in his beautiful invention known as the "radiometer" that rays may produce by impact a mechanical effect, and this may lead to some important revelation as to the utilization of the sun's rays in novel ways. Other sources of energy may be opened up, and new methods of deriving energy from the sun discovered, but none of these or similar achievements would equal in importance the transmission of power to any distance through the medium. I can conceive of no technical advance which would tend to unite the various elements of humanity more effectively than this one, or of one which would more add to and more economize human energy. It would be the best means of increasing the force accelerating the human mass. The mere moral influence of such a radical departure would be incalculable. On the other hand, if at any point of the globe energy can be obtained in limited quantities from the ambient medium by means of a self-acting heat-engine or otherwise, the conditions will remain the same as before. Human performance will be increased, but men will remain strangers as they were.

LATITUDE AND LONGITUDE AMONG REFORMERS.

211

I anticipate that many, unprepared for these results, which, through long familiarity, appear to me simple and obvious, will consider them still far from practical application. Such reserve, and even opposition, of some is as useful a quality and as necessary an element in human progress as the quick receptivity and enthusiasm of others. Thus, a mass which resists the force at first, once set in movement, adds to the energy. The scientific man does not aim at an immediate result. He does not expect that his advanced

ideas will be readily taken up. His work is like that of the planter—for the future. His duty is to lay the foundation for those who are to come, and point the way. He lives and labors and hopes with the poet who says:

Schaff, das Tagwerk meiner Hände,
Hohes Glück, dass ich's vollende!
Lass, o lass mich nicht ermatten!
Nein, es sind nicht leere Träume:
Jetzt nur Stangen, diese Bäume
Geben einst noch Frucht und Schatten.¹

¹ Daily work—my hands' employment,
To complete is pure enjoyment!
Let, oh, let me never falter!
No! there is no empty dreaming:

Lo! these trees, but bare poles seeming,
Yet will yield both fruit and shelter!
Goethe's "Hope,"
Translated by William Gibson, Com. U. S. N.

LATITUDE AND LONGITUDE AMONG REFORMERS.

BY THEODORE ROOSEVELT.

ONE of Miss Mary E. Wilkins's delightful heroines remarks, in speaking of certain would-be leaders of social reform in her village: "I don't know that I think they are so much above us as too far to one side. Sometimes it is longitude and sometimes it is latitude that separates people." This is true, and the philosophy it teaches applies quite as much to those who would reform the politics of a large city, or, for that matter, of the whole country, as to those who would reform the society of a hamlet.

There is always danger of being misunderstood when one writes about such a subject as this, because there are on each side unhealthy extremists who like to take half of any statement and twist it into an argument in favor of themselves or against their opponents. No single sentence or two is sufficient to explain a man's full meaning, any more than in a sentence or two it would be possible to treat the question of the necessity for, and the limitations of, proper party loyalty, with the thoroughness and justice shown, for instance, by Mr. Lecky in his recent queerly named volume, "The Map of Life."

All men in whose character there is not an element of hardened baseness must admit the need in our public life of those qualities which we somewhat vaguely group together when we speak of "reform," and all men of sound mind must also admit the need of efficiency. There are, of course, men of such low moral type, or of such ingrained cyni-

cism, that they do not believe in the possibility of making anything better, or do not care to see things better. There are also men who are slightly disordered mentally, or who are cursed with a moral twist which makes them champion reforms less from a desire to do good to others than as a kind of tribute to their own righteousness, for the sake of emphasizing their own superiority. From neither of these classes can we get any real help in the unending struggle for righteousness. There remains the great body of the people, including the entire body of those through whom the salvation of the people must ultimately be worked out. All these men combine or seek to combine in varying degrees the quality of striving after the ideal, that is, the quality which makes men reformers, and the quality of so striving through practical methods—the quality which makes men efficient. Both qualities are absolutely essential. The absence of either makes the presence of the other worthless or worse.

If there is one tendency of the day which more than any other is unhealthy and undesirable, it is the tendency to deify mere "smartness," unaccompanied by a sense of moral accountability. We shall never make our republic what it should be until as a people we thoroughly understand and put in practice the doctrine that success is abhorrent if attained by the sacrifice of the fundamental principles of morality. The successful man, whether in business or in politics, who has risen by conscienceless swindling of his neighbors, by deceit and chicanery, by

cilman, that they cannot pay interest on their capital if they reduce their fares or make large contribution to the city treasury.

The fact that a large portion of their stock is water is carefully kept out of sight in all these negotiations, and it is amazing that so little is said about it in the public discussions. This is the hinge on which the whole question turns. If the companies ought to be allowed to collect from the people of the city money enough to pay dividends on capital which represents no investments, then the franchises which they seek should be granted, and not otherwise. If they were satisfied with a fair remuneration on capital actually invested, their rates of service could in most cases be reduced by one third or one half. The saving which this signifies to the working-people, the clerks, the shop-girls, the vast majority of those who patronize these monopolies, is to each individual a considerable sum, and to the multitude a vast amount.

These are the interests which the city councils ought to protect in their negotiations with the public service corporations. Such corporations, so long as they are permitted to render these services, ought to have a fair remuneration upon the capital which they invest. No one wishes to deprive them of that. But they ought not to be permitted to levy tribute upon the public for remuneration upon stock which represents no expenditure—which represents only the value of the franchises given them by the city. This is precisely what, in nearly every instance, they are seeking; and the flagrant injustice of such concessions, the oppression of the poor involved in them, and the perfidy of the city officials who sacrifice the welfare of the people to their own greed, may be furnishing the materials of one of the darkest chapters in our political history.

"The Century's" Prizes for College Graduates.

ON the appearance of this number of THE CENTURY the third competition for the prizes offered to college graduates is brought to a close. The contest during the past year has been among students who received the degree of Bachelor of Arts at colleges in the United States during the commencement season of 1899. Those who receive that degree during the present season will be eligible to the fourth competition, and must send in their manuscripts on or before June 1, 1901, according to the rules printed below.

In the first competition all of the prizes were taken by young women, the poetical prize by Smith College, and the essay and story prizes by Vassar College.

In the second competition the three prizes went to institutions west of the Alleghanies, and two of the prizes fell to young men. These manuscripts have been printed during the present magazine year, as follows:

The prize poem, entitled "A Hill-Prayer," by Miss Marian Warner Wildman of Norwalk, Ohio, B.A. 1898, of the College for Women of Western Reserve University, at Cleveland, Ohio, in THE CENTURY for December.

The prize story, entitled "'Only the Master Shall Praise,'" by Mr. John M. Oskison of Vinita, Indian Territory, B.A. 1898, of Leland Stanford Jr. University, at Palo Alto, California, in THE CENTURY for January.

The prize essay, entitled "The Poetry of Blake: An Opinion," by Mr. Henry Justin Smith of Chicago, B.A. 1898, of the University of Chicago, in the present number.

THE RULES OF THE COMPETITION.

WITH the aim of encouraging literary activity among college graduates, THE CENTURY MAGAZINE offers to give, annually, during four successive years, three prizes of \$250 each, open to the competition of persons who receive the degree of Bachelor of Arts in any college or university in the United States during the commencement seasons of 1897, 1898, 1899, and 1900.

1. \$250 for the best metrical writing of not fewer than fifty lines.
2. \$250 for the best essay in the field of biography, history, or literary criticism, of not fewer than four thousand or more than eight thousand words.
3. \$250 for the best story of not fewer than four thousand or more than eight thousand words.

Manuscripts near to the minimum length are most to be desired, though under the rules a competitor may approach the maximum.

On or before June 1 of the year succeeding graduation, competitors must submit type-written manuscript to the Editor of THE CENTURY MAGAZINE, marked, outside and inside, "For the College Competition," signed by a pen-name, and accompanied by the name and address of the author in a separate sealed envelop, which will not be opened until the decision has been made.

A competitor may submit more than one manuscript. Manuscripts must not have been published.

The Editor, at his discretion, may withhold the award in any class in case no manuscript is thought worthy of the prize.

THE CENTURY MAGAZINE reserves the right to print the prize manuscripts without further payments, the copyright to revert to the authors three months after the date of publication in the magazine.

Announcement of the awards will be made in THE CENTURY MAGAZINE as early as possible in the autumn.

Mr. Tesla's Announcements.

It is well known that for many years Mr. Tesla has been addressing himself to the largest problems connected with the increase of human energy by electrical means, and in the eyes of the great number of eager investigators in the general field of electricity this fact will give piquancy to the important narrative of his work which he contributes to the present number of THE CENTURY. Happily, the paper is addressed also to the comprehension of the untechnical reader, who will find some of the ideas and results there set forth little short of the incredible. In general, much that must seem speculative to the layman can take its proper place only in the purview of the scientist, who knows what a part the imagination has played both as a forerunner and as a stimulus of discovery. In Sir Isaac Newton's day no doubt there were wiseacres who would have considered that eminent "dreamer" much more worthy of their respect if the fall of the historic apple had suggested to him not a mere trifle like the law of gravita-

OPEN LETTERS.

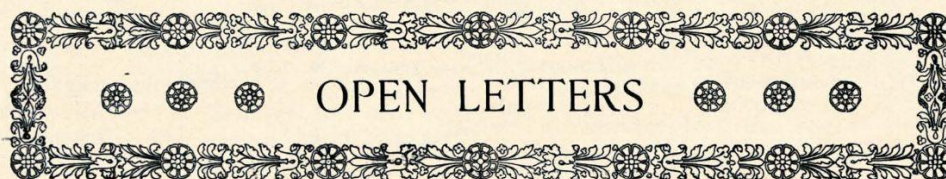
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tion, but some new and important device in cider-mills. The dullest observer is not likely to blink the practical bearings of Mr. Tesla's paper on manufactures, mining, invention, agriculture, commerce, transportation, war—in short, on modern life itself.

For the general reader, Mr. Tesla does what he confesses the author of "The Intellectual Development of Europe" did for him—namely, presents a new and never-to-be-forgotten conception of humanity moving as a mass. To follow his vivid

introduction is like looking down from a great height and seeing familiar and new regions in their true relationship. It begets the feeling of being a spectator at the progress of the world, of listening to the grandest of symphonies. It awakens in one a new interest in his fellow-men and a sobering and devout sense of his relation to the universe, helping him to realize the poet's vision:

One God, one law, one element,
And one far-off divine event,
To which the whole creation moves.



What is an Orphan?

THE DEFINITION GIVEN BY JOHN QUINCY ADAMS.

THE letter which follows is here printed from the original manuscript. It does not appear in the publication, "Girard Will Case," and, it is thought, has not before appeared in print. — EDITOR.

JOSEPH HOPKINSON ESQ^R
Judge U. S. District Court
Eastern District of Pennsylvania—
Philadelphia

QUINCY 8. May 1833

MY DEAR SIR—When Mr. Biddle first asked me the definition of the word Orphan, I thought it very easy to answer, and the first impression of my mind was, like yours—that it was a child without living Parents. A moment after, I thought that in Law, and in the intendment of common conversation, a fatherless child was an Orphan—and a second moment of reflection convinced me that at least for all beneficent purposes a motherless child, must be an Orphan. And I distinctly said to Mr. Biddle, that as an exposition of the will of Mr. Girard's Will, every infant within the age prescribed by him, and having lost *either* Parent, was an Orphan. The conversation at Mr. Biddle's table, in which you took part soon after followed, and left the question unsettled. Your very interesting Letter of the 20th ult^o does the same, and although it has suggested to me a further train of enquiry, and led me to a Multitude of other authorities, has only satisfied me that the indefiniteness of meaning attached to the word is of long standing and of wider extent than the English Language.

Johnson's Dictionary gives the derivation of the word from the Greek ὀρφανός. The original word then is Greek, and the English Language had adopted it Letter for Letter, with the omission only of the termination

What say the Greek Lexicons?

ὀρφανός-ῆ, ὅν. Orbus parente, vel parentibus, pupillus, orphanus.

2 Orbus quavis re, viduus carens *Hedericus*

In the original greek therefore it was received with two different acceptations first a child having lost both Parents, or either— Secondly a bereaved or needy person—

ὀρφανός, Orphanus, pupillus, orbus parentibus, desertus, privatus, q. al. ὀρφνός, obscurus, negligitur enim et veluti in tenebris vagatur—*Schrevelius*.

Darkness—Privation of Light—that is the root, and in the analogy of that derivation a motherless is pre-eminently an orphan child.

In the Epistle of James, Chap. 1. v. 27. The common English translation of the New Testament has it "Pure religion and undefiled before God, and the Father, is this—To visit the *fatherless* and widows in their affliction &c.—the word translated fatherless, is in the original Greek ὀρφανός

"A father of the fatherless, and a judge of the widows is God in his holy habitation." Psalm 68. 5. In the Septuagint Bible the word is ὀρφανῶν

The word fatherless is not synonymous with orphan, nor is it a correct translation of the Greek word ὀρφανός. Of the complex idea included in this latter word, bereavement, poverty, distress, constitute an essential element—the word is figurative; borrowed from the analogy of darkness, and associated with that of a public institution, providing for the wants of the sufferer. The word fatherless is a much more simple expression—a bare statement of the fact that the individual to whom it applies has no father, but not even necessarily implying that his father is dead—for it applies to a bastard no less than to an Orphan.

In the Celtic, and Saxon and Teutonic Origins of the English Language there is no word corresponding with that of Orphan. The institutions which gave occasion for the word, did not exist among those nations. The Germans who have not adopted the word from Greece, have one of which their etymologists are unable to trace a derivation. The word is "*Waise*," and it is used with

The Boston Post

E. A. GROOMER, EDITOR AND PUBLISHER

Boston, Mass., Sept. 3, 1901

Mr. R. U. Johnson
The Century Magazine,
New York City

My dear Mr. Johnson,

I have persuaded Mr. Kiraide to carry over to New York the electrical photographs of which you may remember I wrote you some time ago. I am sure you will, at least, be much interested in seeing them.

Mr. Kiraide will call on you probably on Thursday of this week.

Very truly yours,
Anabel Parker.
76 Munroe St.,
Roxbury, Mass.

The Boston Post
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STAFFORD HOTELS

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BUFFALO, N. Y.

CABLE ADDRESS "IMPERIAL."



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BROADWAY & 32ND STREET
NEW YORK
ROBERT STAFFORD

My dear Mr. Johnson:

I am quite ill this morning, it is impossible for me to leave my room to come to you, I will communicate with you as soon as I am able to do so.

The oppressive heat of yesterday was too much for me.

With many regrets I am
Sept. 5-1901 Sincerely yours
T. B. Pinraide

Hotel Imperial
Absolutely Fire-Proof
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NEW YORK
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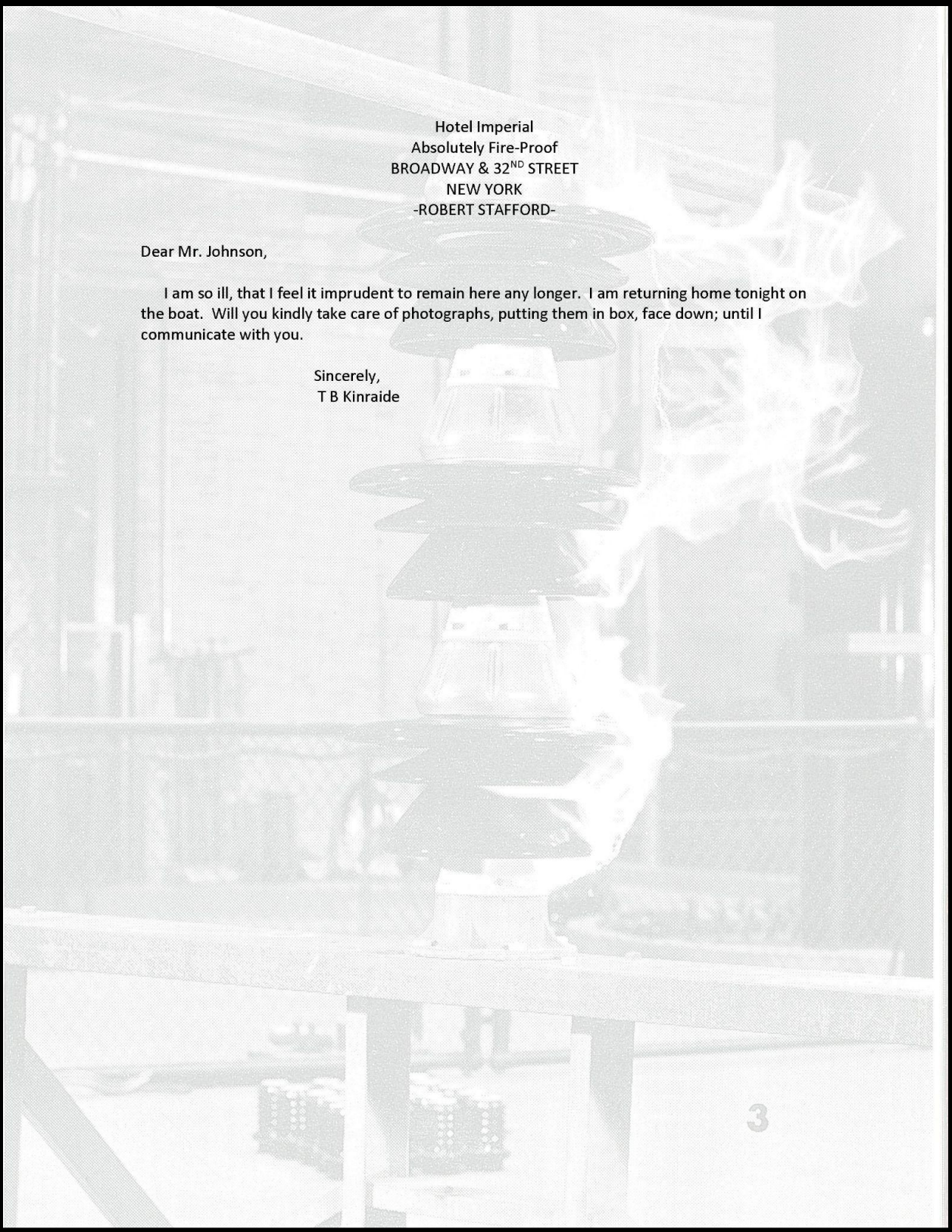
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Dear Mr. Johnson,

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Jamaica Plain
Sept 16 1901

Mr R U Johnson

Dear Mr Johnson

I thank you for
your interest in my recovery
from the ill turn I had in
N. Y.

I feel able to try
it over again - meaning of
course - to be more careful of
myself. I found the
same edition of Lord Armstrong's
work in our library and
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It makes no reference to

the discoveries I have made and in no way conflicts with the article. I will be more than glad to give Lord Armstrong due credit for what he has done in a suitable manner in the article after we have decided upon what can be done with it.

I feel greatly indebted to Mr Tesla for bringing my attention to a work that I would have had to apologize for not knowing about it. I am also indebted to you for the pleasure of meeting so very estimable a man - Mr Tesla. I expect to be in New York about the middle of this week and hope to be able to come to a satisfactory decision both as to the article and photographs.

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T. B. Kinraide

Form No. 1.

THE WESTERN UNION TELEGRAPH COMPANY.INCORPORATED
21,000 OFFICES IN AMERICA. CABLE SERVICE TO ALL THE WORLD.

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THOS. T. ECKEN, President and General Manager.

NUMBER SENT BY REC'D BY

RECEIVED at the WESTERN UNION BUILDING, 195 Broadway, N. Y. Sept 17 1901

Dated

To

Willimantic Conn 17
Mr R W Johnson
Century Co Union Square
N.Y.

Will be in New York tomorrow
morning will telephone
J B Kinraide

THE WESTERN UNION TELEGRAPH COMPANY

RECEIVED AT THE WESTERN UNION BUILDING, 195 BROADWAY, N. Y. Sept 17, 1901

Dated: Willimantic Conn 17
To: Mr. R. U. Johnson
Century Co. Union Square NY

Will be in New York tomorrow morning will telephone
T B Kinraide



WATSON & POWERS,
SAVANNAH, GA.

Mar 15 1902

Dear Mr Johnson

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I assure you I am very sincerely
yours

J B Kuiraida

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T B Kinraide

The Boston Post

E. A. GROVER, EDITOR AND PUBLISHER.

Boston, Mass., March 21, 1902.

Mr. B. U. Johnson
The Century Magazine.

My dear Mr. Johnson:

Mr. Kiraide has sent me the manuscript of our article in regard to his experiments. I have made the changes suggested and I hope the copy as it now stands will be available. There is no objection to your cutting out the first two and the last paragraphs, should you wish to do so for space considerations. The paragraph on page 10, beginning "Examine for a moment," could also be eliminated without seriously marring the purpose of the article. Both Mr. Kiraide and myself should, however, be glad if the article could be used in full. It has been prepared with a deal of painstaking and a serious desire to make it at the same time popular and scientifically accurate. I feel myself deeply indebted to Mr. Kiraide for his untiring patience and kindness, and, quite as much for his sake as for my own should be glad to have it given good space and make-up.

I should be glad to see proofs of the make-up, if it would be in accord with your custom to permit me to.

(over)

By this same mail, I am sending to Mr. Currier,
 who is now in Savannah. Can ^{you} the widest and changes.
 I shall ask him to write or wire you that they meet
 his approval.

Should you find further changes desirable,
 upon a second reading, I will endeavor to make them.
 I appreciate that since you take up the matter without
 being familiar with the experimental work, you are in
 the best possible position to judge whether or not it is
 quite clear enough to be understood by the average
 reader.

Thanking you for your kindly courtesy,
 I am,
 Very truly yours,

Knabel Parker,

The Boston Post,

Boston

THE BOSTON POST

Boston, Mass. March 21, 1902

Mr. R. U. Johnson
The Century Magazine

My dear Mr. Johnson,

Mr. Kinraide has sent me the manuscript of your article in regard to his experiments. I have made the changes suggested and I hope the copy as it now stands will be available. There is no objection to your cutting out the first two and the last paragraphs, should you wish to do so for space considerations. The paragraph on page 10, beginning "Examine for a moment" could also be eliminated without seriously marring the purpose of the article. Both Mr. Kinraide and myself should honestly be glad if the article could be used in full. It has been prepared with a deal of painstaking and a serious desire to make it at the same time "popular" and scientifically accurate. I feel myself, deeply indebted to Mr. Kinraide for his untiring patience and kindness, and, quite as much for his sake as my own should be glad to have it given good space and make-up.

I should be glad to see proofs of the make-up, if it would be in accord with your custom to permit me to.

By this same mail I am sending to Mr. Kinraide, who is now in Savannah, Ga. the underlining changes. I shall ask him to write or wire you that they meet his approval.

Should you find further changes desirable upon a second reading, I will endeavor to make them. I appreciate that time you take up the matter without being familiar with the experimental work. You are in the best possible position to judge whether or not it is quite clear enough to be understood by the average reader.

Thanking you for your kindly courtesy, I am, truly yours,

Anabel Parker
The Boston Post
Boston

Form No. 44.

NIGHT MESSAGE. **THE WESTERN UNION TELEGRAPH COMPANY.**

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THOS. T. ECKERT, President and General Manager.

NUMBER	SENT BY	REC'D BY	CHECK
167	Chas. R. Kinsaid	R. H. Johnson	

RECEIVED at the WESTERN UNION BUILDING, 195 Broadway, N. Y. *Me 25* 1902

Dated *Charleston S C 25*

To *Mr. R. H. Johnson 33 E 17 St*

Century Pub. Co New York

Changes in article are OK.

will be home Monday

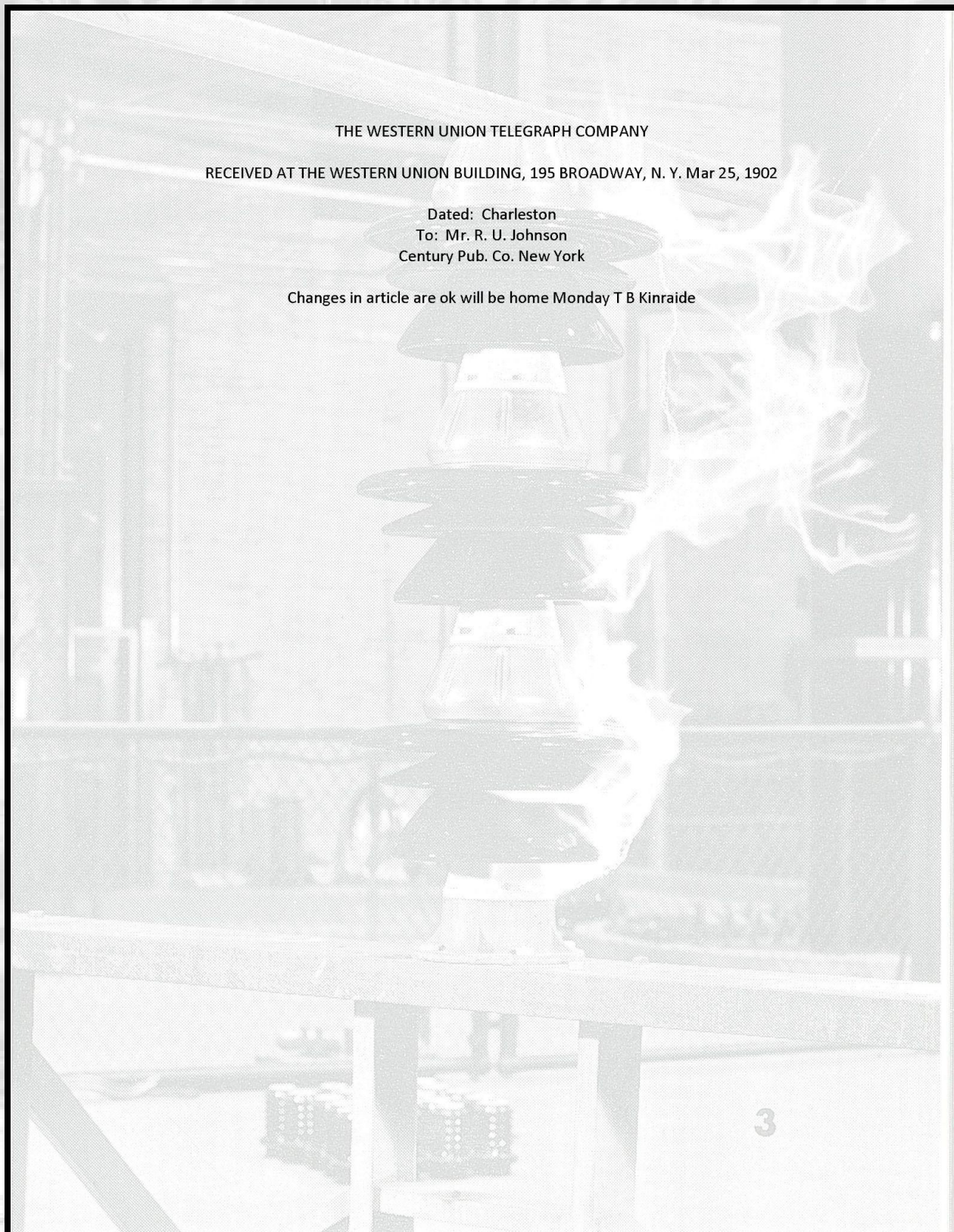
J. B. Kinsaid

THE WESTERN UNION TELEGRAPH COMPANY

RECEIVED AT THE WESTERN UNION BUILDING, 195 BROADWAY, N. Y. Mar 25, 1902

Dated: Charleston
To: Mr. R. U. Johnson
Century Pub. Co. New York

Changes in article are ok will be home Monday T B Kinraide



The Boston Post

E. A. GROZIER, EDITOR AND PUBLISHER.

Boston, Mass., March 25, 1912

Mr. R. U. Johnson,
The Century Magazine.

My dear Mr. Johnson, -

I am unable to tell you whether Mr. Kiraide, in speaking to me of photographs of sound waves, referred to the work of Prof. S. — (?) whom you mention or to that of some other investigator. He mentioned a name, but I am unable now to recall it.

I have written him asking him to communicate with you in regard to the matter. His absence in the South renders this delay unavoidable.

Sincerely yours,

Abdel Parker.

THE BOSTON POST

Boston, Mass. March 25, 1902

Mr. R. U. Johnson
The Century Magazine

My dear Mr. Johnson,

I am unable to tell you whether Mr. Kinraide in speaking to me of photographs of sound waves referred to the work of Prof. S.-----(?) whom you mention or to that of some other investigator. He mentioned a name, but I am unable now to recall it.

I have written him asking to communicate with you in regard to the matter. His absence in the south renders this delay unavoidable.

Sincerely yours,

Anabel Parker

The Boston Post

E. A. GROZIER EDITOR AND PUBLISHER.

Boston, Mass., April 10, 1902

Mr. R. B. Johnson,
The Century Magazine.

My dear Mr. Johnson,

I have to thank you for the proofs of
the Kuiraid article, which I herewith return,
corrected.

Mr. Kuiraid has just been in. He
is pleased with the article as it stands and
has no changes to request. I quite agree,
by my house, he would be glad to see
proofs of the half tone cuts when they
are ready.

Sent by
Ape 11/17/01

Sincerely yours,

Emmett Parker.

Mr Drake



THE BOSTON POST

Boston, Mass. April 10, 1902

Mr. R. U. Johnson
The Century Magazine

My dear Mr. Johnson,

I have to Thank you for the proofs of the Kinraide article, which I herewith return, corrected.

Mr. Kinraide has just been in. He is pleased with the article as it stands and has no changes to request. If quite agreeable, to be honest he would be glad to see proofs of the halftone cuts when they are ready.

Sincerely yours,
Anabel Parker

Anabel Parker

The Boston Post

E. A. GROZIER, EDITOR AND PUBLISHER.

Boston, Mass., Apr. 28, 1902

Mr. R. U. Johnson.
New York City.

My dear Mr. Johnson,

Mr. Kuivaido instructs me to say that the line under Plate I should be headed Andas. The delay in returning the proof to you is because of Mr. Kuivaido's absence from home, during which time his mail was unopened.

Mr. Kuivaido requests me to say that he regrets the delay.

Sincerely, Yours,
Chas. Parker

THE BOSTON POST

Boston, Mass. April 28, 1902

Mr. R. U. Johnson
New York City,

My dear Mr. Johnson,

Mr. Kinraide instructs me to say that the line under Plate 1 should be headed Anodos. The delay in returning the proof to you is because of Mr. Kinraide's absence from home during which time his mail was unopened.

Mr. Kinraide requests me to say that he regrets the delay.

Sincerely yours,
Anabel Parker

Anabel Parker

The Boston Post

E. A. GROZIER, EDITOR AND PUBLISHER.

Boston, Mass., July 14, 1902

Mr. R. U. Johnson,
The Century Magazine.

My dear Mr. Johnson:

I am uncertain as to whether or no
the matter of payment for my article
published in the July number of The
Century Magazine was referred to
when Mr. Kuraide saw you in New
York.

It was understood, however, between
Mr. Kuraide and myself that payment
for all the matter submitted would be made
to me. I write this to forestall any
question that might arise regarding this,
though perhaps it is unnecessary since
you doubtless remember that it was I
(over)

who submitted the article.

Thanking you for your kindly
courtesy throughout the correspondence,
I am,

Very truly yours,
Luabel Parker.

THE BOSTON POST

Boston, Mass. July 14, 1902

Mr. R. U. Johnson
The Century Magazine,

My dear Mr. Johnson,

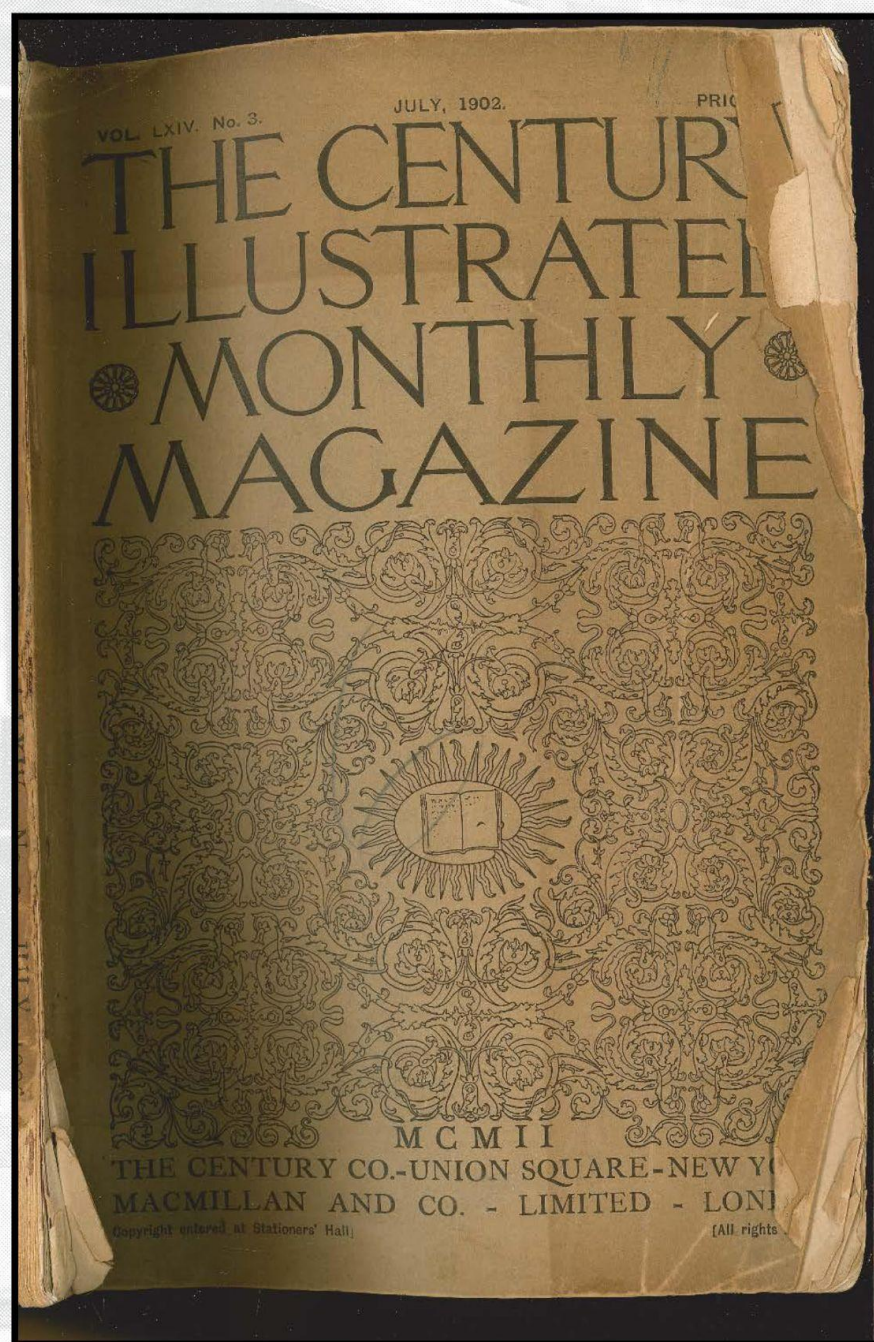
I am uncertain as to whether or not the matter of payment for my article published in the July number of the Century Magazine was referred to when Mr. Kinraide saw you in New York.

It was understood, however, between Mr. Kinraide and myself that payment for all the matter submitted would be made to me. I write this to forestall any question that might arise regarding this, though perhaps it is unnecessary since you doubtless remember that it was I who submitted the article.

Thanking your kindly courtesy throughout the correspondence, I am,

Very truly yours,
Anabel Parker

Anabel Parker



Two years have gone by, and I am one of the richest men in the city, and have no more money than will keep me alive.

Susan said I was half cracked like Uncle Philip, and broke off her engagement. In my despair I have advertised in the "Journal of Science," and have had absurd schemes sent me by the dozen. At last, as I talked too much about it, the thing became so well known that when I put the horror in a safe, in bank, I was promptly desired to withdraw it. I was in constant fear of burglars, and my landlady gave me notice to leave, because no one would stay in the house with that box. I am now advised to print my story and await advice from the ingenuity of the American mind.

I have moved into the suburbs and hidden the box and changed my name and my occupation. This I did to escape the curiosity of

the reporters. I ought to say that when the government officials came to hear of my inheritance, they very reasonably desired to collect the succession tax on my uncle's estate.

I was delighted to assist them. I told the collector my story, and showed him Uncle Philip's letter. Then I offered him the key, and asked for time to get half a mile away. That man said he would think it over and come back later.

This is all I have to say. I have made a will and left my rubies to the Society for the Prevention of Human Vivisection. If any man thinks this account a joke or an invention, let him coldly imagine the situation:

Given an iron box, known to contain wealth, said to contain dynamite, arranged to explode when the key is used to unlock it—what would any sane man do? What would he advise?

CURIOUS ELECTRICAL FORMS.

AS SHOWN IN MR. T. BURTON KINRAIDE'S RECENT PHOTOGRAPHS OF ELECTRICAL DISCHARGES.

BY ANABEL PARKER.

THE remarkable photographs which it is the object of this article to explain constitute a graphic record, a genuine autobiography, of certain phases of one of the most wonderful and subtle of the great forces of nature. They are the result of several years of experimenting by a Boston investigator, T. Burton Kinraide, and are the record of impressions made upon sensitive plates by discharges of electricity. These photographs show the form and character of the so-called positive and negative phases of electric energy, and of a third phase which has never before been revealed. They hint at an apparatus unique in its delicacy of control. Beyond this, they throw fresh light on the very nature and character of this great force.

All the plates here shown were produced by discharges of minute quantities of electricity. From this point of view, they present a striking contrast to the plates published in *THE CENTURY* for June, 1900. Those were photographs of the phenomena resulting from discharges from electrical oscillators of great power. They recorded experiments

made by that consummate genius of electrical investigation, Nikola Tesla, who delights in handling enormous quantities of electric energy.

By a cursory glance at the different plates and at the explanatory lines under them, it will be seen that whatever may be the outline of the entire design on the plate, there is one unvarying structural form for the positive phase and one for the negative. These are so dissimilar in character that they need never be confused. The positive phase has always the branching, fern-like structure which Mr. Kinraide calls filiciform, while the negative invariably shows the soft and feathery appearance which is well described as plumous. Whether the plate shows a single large disk composed of exquisitely delicate forms radiating from a center, or a series of zigzagging comets, one can readily tell by noting the structure whether the discharge which printed itself on the plate was in its positive or its negative phase.

This series of electrographs was, with a

few exceptions, produced by means of a condenser apparatus, upon one surface of which the sensitive plate was placed. This surface can be electrified either positively or negatively at the will of the operator. Suppose it to be negatively electrified, and then touched at the center by a small brass sphere which is in connection with the positive terminal of the apparatus. The instant discharge from the sphere rushes out in all directions over the surface of the plate, and there is produced the beautiful figure shown in Plate I. Suppose, on the other hand, that the condenser surface on which the sensitive plate rests is positively electrified, and that a brass sphere connected with the negative terminal be brought in contact with it. The energy is gathered up, as it were, from the plate, and rushing toward the conducting sphere, leaves on the surface the print of its vanishing footsteps, as in Plate II.

With one or two exceptions, all the plates here shown are based upon the existence of these two sets of conditions, i.e., a surface negatively electrified brought in contact with a positive terminal, and a surface positively electrified brought in contact with a negative terminal. The terminal may be connected with a single sphere, as already suggested, with a roller, or with tiny metallic balls or needle-points. The deft manipulation of these mechanical devices produces the variety of design. The plates which were produced under conditions other than these will be noted farther on.

It is now five years since Mr. Kinraide made the happy discovery which led him to experiment along the lines of electrical photography of which these beautiful plates are the result. The apparatus he at first used was quite unlike the one he is now using, and was without the condenser plates. Many of the results that can be obtained from the one now in use he was unable to obtain by means of the former, but untiring efforts to discover the causes of his failures finally brought a knowledge that enabled him to construct an apparatus capable of producing the perfect plates here shown. As in many other instances, failure lighted the way to success.

It is necessary to touch briefly on the construction of the apparatus and on the experiments carried on by means of it in order to give a clear idea of the way in which Mr. Kinraide has arrived at certain important conclusions. The apparatus has, as an interesting feature, a unique kind of secondary induction-coil consisting of a cir-

cular disk of fine wire wound in about one thousand turns. The peculiarity of this coil is that it will discharge out into the air as easily as the Ruhmkorff coil discharges toward its other terminal. In other words, the electric energy, instead of discharging from two equal potential terminals, as is the case where the Ruhmkorff coil is used, passes into the air almost wholly from one terminal. The non-discharging terminal is connected to an earth-wire, and thus its influence is entirely removed. The coil has a superb insulation, and will easily withstand a pressure under which the Ruhmkorff coil splinters to atoms. Thus the apparatus controls a higher voltage for the quantity than any other so far made.

It was while studying the discharge from this apparatus in the dark that Mr. Kinraide noticed peculiar, fern-like forms of a pale violet color radiating from the two-inch brass sphere which formed the discharging terminal. By manipulating the discharge, he could make a number of these beautiful, quivering forms appear. By using spheres of larger diameters and increasing the potential, he could increase the length and size of the light-forms until they would shoot out thirty inches beyond the sphere and reach an apparent thickness of half an inch. They looked like miniature forks of violet-tinged lightning, cleaving the darkness of the laboratory. By balancing an ordinary photographic plate on the top of the spherical terminal, film side down, and opening and closing the circuit once, a photograph of the quivering light-forms was secured. They recorded themselves as the filiciform or positive phase of electric energy. This was a first effort, and a first success.

Upon a reversal of the current, an entirely different phenomenon was observed. Instead of the branching outshoots of violet light, there appeared plume-like forms resembling the cattail of the meadow-flag. These seemed to be about an inch in diameter and seven inches long. An attempt to secure a photograph of these plume-like forms was made, but though the plate was as carefully adjusted and the current as skilfully manipulated as before, there was no record found upon the plate when it was developed. The experiment was repeated again and again, but with disheartening results. The plumeous forms could not be induced to make any impression on the sensitive plates. For two years Mr. Kinraide experimented, sacrificing plates enough to build a greenhouse. Then he made a discovery. The plumeous

forms were not, as he had supposed, discharging outward from the sphere; they were discharging inward from the surrounding air.

The discovery of this fact was of the greatest significance. It seemed to proclaim electric energy not a dual force with a dual activity, but a single force with a single line of direction for the sweep of its energy. Furthermore, it showed plainly that the so-called positive and negative phenomena indicate, the one an accumulation or heaping up of electric energy, the other a corresponding withdrawal. It was through study of the plumes forms that Mr. Kinraide was led to the discovery of the conditions necessary for the successful production of these photographs. He realized that, in order to secure on a photographic plate the record of the so-called negative electricity, the plate must represent the withdrawal of energy; in other words, it must be electrified and then made to discharge itself into some conductor.

With the condenser apparatus, he found no difficulty in securing the record of the negative phase. A photographic plate placed upon the positively electrified surface of the condenser became in turn positively electrified. Then, when any conductor connected with the negative terminal was brought into contact with it, the stored-up energy immediately sought an equilibrium and rushed from all directions toward the conductor. This produced a condition of withdrawal on the plate, or, in other words, showed the so-called negative phase of electricity.

It was then that Mr. Kinraide made another discovery. Not only did he secure photographs of the positive and negative phases, but there was revealed on some of the plates the existence of comet-like forms in which the positive and negative were seen to be united, base to base. The meaning of these comet forms was not at first understood, nor did Mr. Kinraide know how it was that they appeared on the plates. Former photographs had indicated a separation between the two phases; none had ever shown that they were united. These comet forms, therefore, presented a new field for investigation, and it was only after careful study and experimentation that their significance was discovered.

The comet structure Mr. Kinraide has called, by reason of the conditions under which it is created, the electric entity. It is a record of the entire activity of one small quantity of electric energy, an embodiment, as it were, of the force, and literally an entity

of energy, having a birth, a growth, and a subsequent death or dispersion. Its center, or body part, is plainly neither positive nor negative in character. Mr. Kinraide calls it the third or dynamic phase of electricity. His reasons for this will be apparent farther on.

In order to make clear the way in which the comet structure was secured, it may be well to explain first the development of the figure on Plate III. This is not one of the condenser series of photographs, but was secured from a very different and quite simple apparatus. It is introduced here to make clearer the interpretation of the other plates.

Without describing the apparatus in detail, it is sufficient to say that it presented a flat surface about twice as long as wide. This surface was divided by a narrow strip of dielectric or non-conducting material into two areas of equal extent, each of these being nearly square. The apparatus was so arranged that when the current was turned on, one of these areas would become positively, the other negatively electrified, the dielectric between them preventing the energy from reaching a state of equilibrium.

The photographic plate was placed in position on the flat surface, half of it on one side of the dielectric, half on the other. A metallic bar was then laid upon the plate at right angles to the dielectric. Thus its ends lay at the respective centers of the two areas which were to be oppositely electrified. By closing the current and then breaking it once, Plate III was obtained. The two ends of the photographic plate became oppositely electrified, like the areas over which they were superimposed. When the current was broken, the energy in the two oppositely electrified surfaces immediately rushed to an equilibrium, using the metallic bar as a conductor. From the positively electrified surface the energy shot into the bar, recording its withdrawal in the delicate plumes of the negative phase. Then it hurried along and finally shot out and dispersed itself over the negatively electrified surface in the filiciform streamers, which always indicate the outward rush of the current.

In the evolution of the comet structure, analogous conditions obtain, with the exception that the electric energy uses the air as a conducting medium instead of a metal conductor. This enables it to record the entire history of its action on the sensitive plate. Keeping this explanation in mind, the reader will be able to understand Plate IV, which is one of the condenser series.

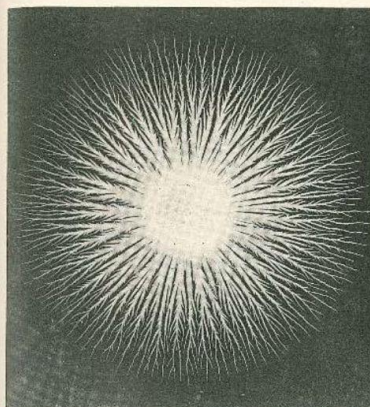


PLATE I. ANODOS.

A discharge of electric energy over the negative surface of a condenser from a two-inch sphere connected with the positive terminal.

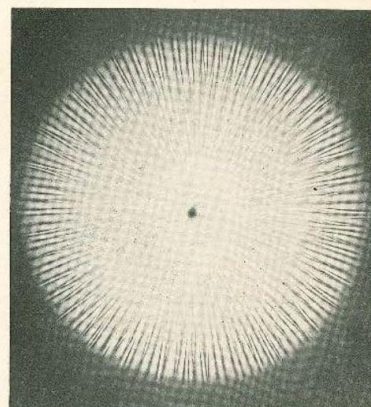


PLATE II. KATHODOS.

A discharge of electric energy over the positive surface of a condenser toward a two-inch sphere connected with the negative terminal.

In order to secure this, the condenser surface upon which the sensitive plate was to be placed was first highly charged with electric energy. Then the photographic plate was carefully placed upon it, film side up. A metallic discharger, fitted with an adjustable spark-gap, was now used. By means of this spark-gap it was possible to regulate the amount of energy to be withdrawn from the plate. After being connected with the negative terminal of the apparatus, the discharger was placed at the center of the plate, and a small quantity of the energy was permitted to escape. This created a circular, negative area on the plate, while surrounding it was a charged area.

As in the case of the two oppositely electrified squares previously referred

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to, the energy sought an equilibrium. Small quantities of it shot inward toward the

circular, negative area, and the onward rush was recorded on the plate in the filiciform streamers extending toward the center, while the withdrawal from the outer rim produced the soft plumous forms. All this took place before the discharger in the operator's hand could be withdrawn from its instant of contact with the plate.

The energy started from a condition of diffusion, and ended in a condition of diffusion, but at the instant of its greatest power it was focalized. This instant of focalization is represented on the plate by the slender spindle joining the plumous and the filiciform. This is what Mr. Kinraide calls the dynamic phase of electric energy.

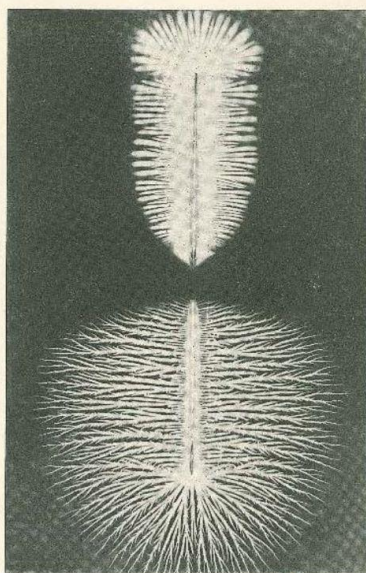


PLATE III. COMPOSITE ELECTRIC ENTITY.

A transfer of electric energy produced by placing a short, metallic rod across the line dividing two oppositely charged areas. The part of the plate upon which the plumous or negative phase is seen is the part which was at first positively electrified. The part upon which the positive streamers are seen was the negatively electrified areas.

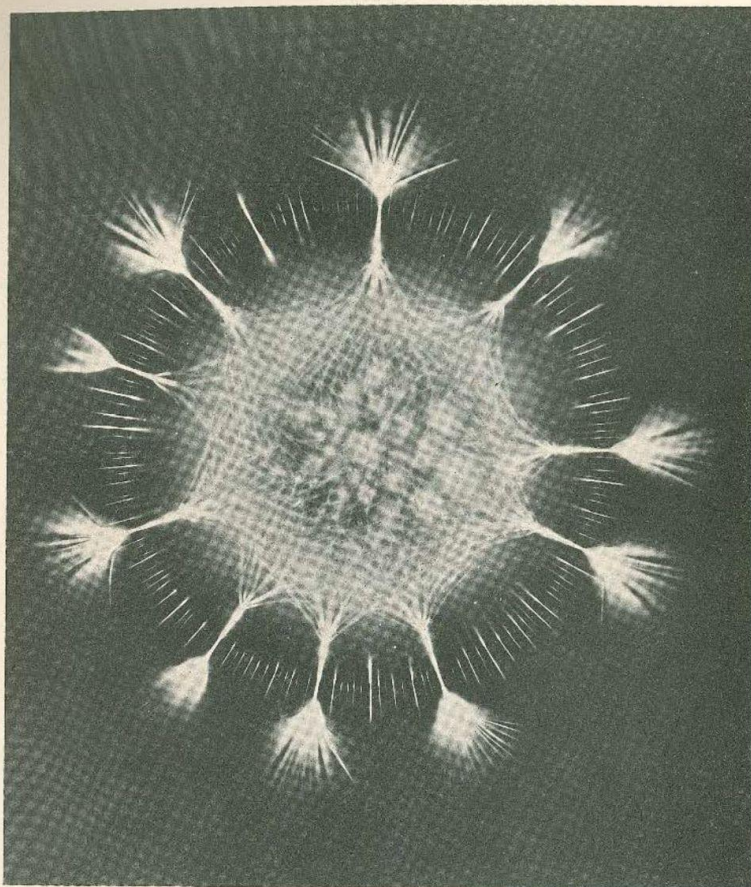


PLATE IV. SYMMETRICAL GROUP OF ELECTRIC ENTITIES.

Each comet structure in the group is a record of the entire history of a small quantity of electric energy.

In general terms, the spindle of one of these comet structures represents the dynamic center of a discharge, for each tiny comet records the entire evolution of an electric discharge, and the phases through which it passes are identical with those through which every uninterrupted discharge must pass.

That this spindle has never before been shown in any photographs of electricity is due to the fact that no apparatus has ever before been constructed whereby the entire action of an electric discharge through the air could be recorded. In the action of the energy in Plate III its moment of greatest

focalization was during its passage through the metallic bar. Hence its form could not be recorded.

Examine for a moment this spindle (see Plate V). It seems to be wound in a conical spiral, as if the lines of energy, which focalize at the point of greatest intensity, assume at once a spiral motion. This spiral whirl is at first very narrow, but as it passes away from the point of greatest intensity, it becomes wider, and its whirls are farther apart. Under favorable conditions they are far enough apart to be seen, forming a sharply pointed cone with a very small base. Thus it seems

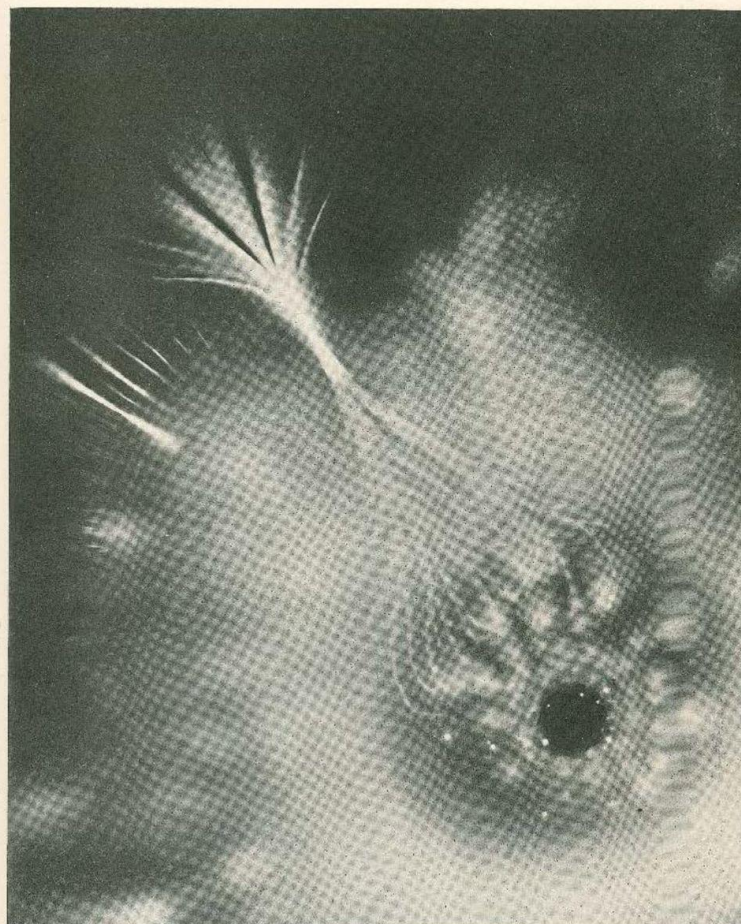


PLATE V. ELECTRIC ENTITY, OR EMBODIMENT OF ELECTRIC FORCE. (ENLARGED.)

that the electric energy focalizing at this point translates itself, by means of the electromagnetic action which takes place in the spindle, from its negative phase into a curiously interacting form, the positive phase.

Mr. Kinraide's conclusions may be summarized as follows: The plates here shown, especially those which record the action of the electric entity, form an electrographic demonstration of the meaning of the terms positive and negative electricity. When electric energy changes from a condition of diffusion to a center of focalization it is

passing through its negative phase. When it changes from a condition of focalization to a condition of diffusion it is passing through its positive phase. These two conditions may be correctly termed the anodos, or going in, and the exodos, or going out, of electric energy. They are unmistakably recorded on the photographic plates, which show that there are not two separate electricities, but one developing entity of energy. There is no photograph of the diffused condition in either case. It is only when the energy is passing through one or the other



PLATE VI. POSITIVE ENDS OF ELECTRIC ENTITIES.

A discharge from a metallic roller in its passage over the film side of a photographic plate placed upon the uncoated, negative surface of a charged condenser. The conditions of electrification here are the opposite of those in Plate VII.

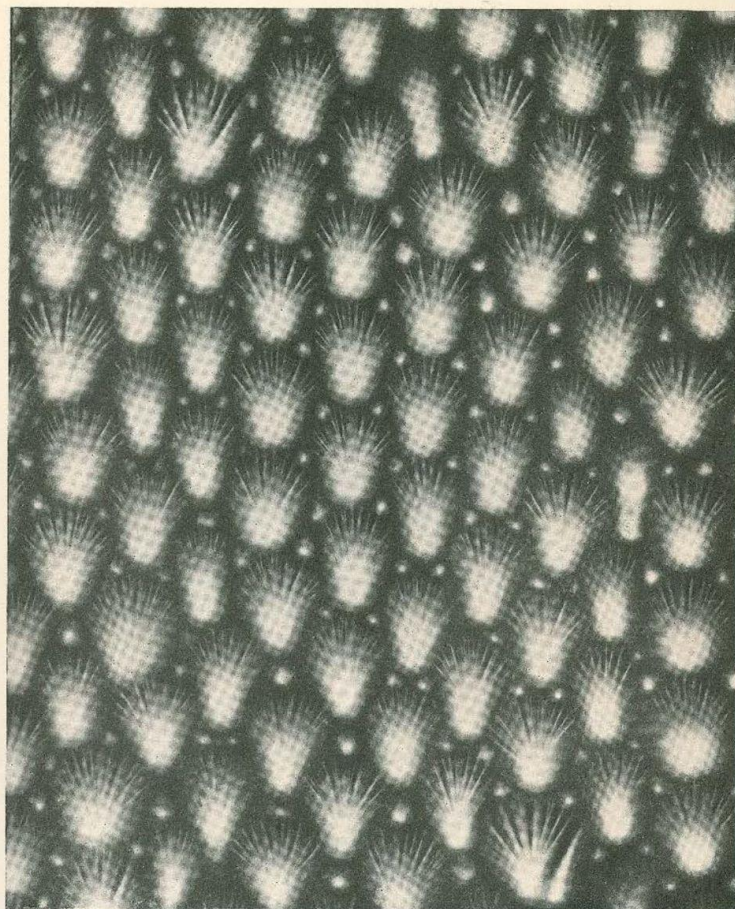


PLATE VII. NEGATIVE ENDS OF ELECTRIC ENTITIES.

A discharge from a metallic roller in its passage over the film side of a photographic plate placed upon the uncoated, positive surface of a charged condenser. This plate is a companion to Plate VI.



PLATE VIII. ELECTRIC ENTITIES IN SERIES.

A discharge between plates produced by the passage of a metallic roller over a photographic plate laid film side down upon a positively charged, uncoated condenser surface.

of its three phases that it becomes manifest upon the sensitive plate.

Plate V is an enlarged record of one small quantity of electric energy: its origin, or negative phase; its transformation, or dynamic phase; its final diffusion, or positive phase. In the negative phase the energy consists of numerous units of energy uniting to produce a single unit, which, after spiraling through a small space, is changed into a number of streamers to be again diffused.

Plates VI and VII, which show respectively the positive and negative ends of electric entities, belong to the condenser series. As explained in the lines under them, they were secured by means of a roller passing over the surface of the photographic plate. Plate VI shows the outrushing or positive ends of the tiny entities that shoot off from the roller on to the negatively electrified plate as the roller is passed over the plate. Plate VII shows the retreating or negative

ends of the entities that rush from the positive plate into the negative roller.

Plate VIII shows how comets in series are formed when the energy *between* condenser surfaces is permitted to escape into a metallic roller passed over the outer surface of the plate. This was secured by placing the photographic plate film side down.

The photographs here reproduced form a representative selection from many hundreds secured by Mr. Kinraide. They are much reduced in size, the negatives being eighteen by twenty-two or eight by ten inches. A set consisting of about fifty photographs has recently been presented to the Massachusetts Institute of Technology, where it is available to students and other interested persons.

The conclusions as to the nature of electricity reached by Mr. Kinraide through his study of its movement differ to a considerable extent from those reached by Lord Armstrong, the noted English scientist who

THE PASSING OF COCK-EYE BLACKLOCK.

385

has conducted experiments along similar lines. Lord Armstrong has secured some extremely interesting photographs of the phenomena resulting from discharges of electricity over dust plates. He has also experimented with photographic plates, and a number of the results secured in both cases bear an interesting resemblance to those obtained by Mr. Kinraide. Lord Armstrong has not, however, shown the development of the electric entity.

It may be interesting to add that, as a result of his study of electric energy as manifested in these plates, Mr. Kinraide inclines to the theory that every form of energy, as heat, sound, light, gravity, etc., has what he would term an entity of energy, corresponding in structure and function to the electric entity, and that it only requires

a knowledge of how to create conditions in order to demonstrate this.

He asks the interesting questions: "May it not be that the whirlwind and the waterspout proclaim the presence of entities of thermal energy, the whirlpool the presence of an entity of gravity, and the sound-waves recently photographed the presence of the entity of sound force?" He maintains, also, that if the conditions are constant, the entity will be constant. *A prime condition must be that the energy be able to mold the substance which is the medium of its manifestation into its own form.* Its power to do this demonstrates that it is a force-entity. Mr. Kinraide proposes to experiment with other forms of energy and to obtain, if possible, a complete demonstration of this theory.

THE PASSING OF COCK-EYE BLACKLOCK.

BY FRANK NORRIS,
Author of "The Octopus," etc.

"WELL, m' son," observed Bunt about half an hour after supper, "if your provender has shook down comfortable by now, we might as well jar loose and be moving along out yonder."

We left the fire and moved toward the hobbled ponies, Bunt complaining of the quality of the outfit's meals. "Down in the Panamint country," he growled, "we had a Chink that was a sure frying-pan expert; but *this* Dago—my word! That ain't victuals, that supper. That's just a' ingenious device for removing superfluous appetite. Next time I assimilate nutriment in this camp I'm sure going to take chloroform beforehand. Careful to draw your cinch tight on that pinto brone' of yours. She always swells up same as a horned toad soon as you begin to saddle up."

We rode from the circle of the camp-fire's light and out upon the desert. It was Bunt's turn to ride the herd that night, and I had volunteered to bear him company.

Bunt was one of a fast-disappearing type. He knew his West as the cockney knows his Piccadilly. He had mined with and for Ralston, had soldiered with Crook, had turned cards in a faro game at Laredo, and had known the Apache Kid. He had fifteen

separate and different times driven the herds from Texas to Dodge City, in the good old, rare old, wild old days when Dodge was the headquarters for the cattle trade, and as near to heaven as the cow-boy cared to get. He had seen the end of gold and the end of the buffalo, the beginning of cattle, the beginning of wheat, and the spreading of the barbed-wire fence, that, in the end, will take from him his occupation and his revolver, his chaparejos and his usefulness, his lariat and his reason for being. He had seen the rise of a new period, the successive stages of which, singularly enough, tally exactly with the progress of our own world-civilization: first the nomad and hunter, then the herder, next and last the husbandman. He had passed the mid-mark of his life. His mustache was gray. He had four friends—his horse, his pistol, a teamster in the Indian Territory Panhandle named Skinny, and me.

The herd—I suppose all told there were some two thousand head—we found not far from the water-hole. We relieved the other watch and took up our night's vigil. It was about nine o'clock. The night was fine, calm. There was no cloud. Toward the middle watches one could expect a moon.

CURIOUS ELECTRICAL FORMS. AS SHOWN IN MR. T. BURTON KINRAIDE'S RECENT PHOTOGRAPHS OF ELECTRICAL DISCHARGES. BY ANABEL PARKER. (The CENTURY magazine, July 1902)

THE remarkable photographs which it is the object of this article to explain constitute a graphic record, a genuine autobiography, of certain phases of one of the most wonderful and subtle of the great forces of nature.. They are the result of several years of experimenting by a Boston investigator, T. Burton Kinraide, and are the record of impressions made upon sensitive plates by discharges of electricity. These photographs show the form and character of the so-called positive and negative phases of electric energy, and of a third phase which has never before been revealed. They hint at an apparatus unique in its delicacy of control. Beyond this, they throw fresh light on the very nature and character of this great force. All the plates here shown were produced by discharges of minute quantities of electricity. From this point of view, they present a striking contrast to the plates published in THE CENTURY for June, 1900. Those were photographs of the phenomena resulting from discharges from electrical oscillators of great power. They recorded experiments made by that consummate genius of electrical investigation, Nikola Tesla, who delights in handling enormous quantities of electric energy. By a cursory glance at the different plates and at the explanatory lines under them, it will be seen that whatever may be the outline of the entire design on the plate, there is one unvarying structural form for the positive phase and one for the negative. These are so dissimilar in character that they need never be confused. The positive phase has always the branching, fern-like structure which Mr. Kinraide calls filiciform, while the negative invariably shows the soft and feathery appearance which is well described as plumous. Whether the plate shows a single large disk composed of exquisitely delicate forms radiating from a center, or a series of zigzagging comets, one can readily tell by noting the structure whether the discharge which printed itself on the plate was in its positive or its negative phase. This series of electrographs was, with a few exceptions, produced by means of a condenser apparatus, upon one surface of which the sensitive plate was placed. This surface can be electrified either positively or negatively at the will of the operator. Suppose it to be negatively electrified, and then touched at the center by a small brass sphere which is in connection with the positive terminal of the apparatus. The instant discharge from the sphere rushes out in all directions over the surface of the plate, and there is produced the beautiful figure shown in Plate I. Suppose, on the other hand, that the condenser surface on which the sensitive plate rests is positively electrified, and that a brass sphere connected with the negative terminal be brought in contact with it. The energy is gathered up, as it were, from the plate, and rushing toward the conducting sphere, leaves on the surface the print of its vanishing footsteps, as in Plate II. With one or two exceptions, all the plates here shown are based upon the existence of these two sets of conditions, i.e., a surface negatively electrified brought in contact with a positive terminal, and a surface positively electrified brought in contact with a negative terminal. The terminal may be connected with a single sphere, as already suggested, with a roller, or with tiny metallic balls or

needle-points. The deft manipulation of these mechanical devices produces the variety of design. The plates which were produced under conditions other than these will be noted farther on. It is now five years since Mr. Kinraide made the happy discovery which led him to experiment along the lines of electrical photography of which these beautiful plates are the result. The apparatus he at first used was quite unlike the one he is now using, and was without the condenser plates. Many of the results that can be obtained from the one now in use he was unable to obtain by means of the former, but untiring efforts to discover the causes of his failures finally brought a knowledge that enabled him to construct an apparatus capable of producing the perfect plates here shown. As in many other instances, failure lighted the way to success. It is necessary to touch briefly on the construction of the apparatus and on the experiments carried on by means of it in order to give a clear idea of the way in which Mr. Kinraide has arrived at certain important conclusions. The apparatus has, as an interesting feature, a unique kind of secondary induction-coil consisting of a circular disk of fine wire wound in about one thousand turns. The peculiarity of this coil is that it will discharge out into the air as easily as the Ruhmkorff coil discharges toward its other terminal. In other words, the electric energy, instead of discharging from two equal potential terminals, as is the case where the Ruhmkorff coil is used, passes into the air almost wholly from one terminal. The non-discharging terminal is connected to an earth-wire, and thus its influence is entirely removed. The coil has a superb insulation, and will easily withstand a pressure under which the Ruhmkorff coil splinters to atoms. Thus the apparatus controls a higher voltage for the quantity than any other so far made. It was while studying the discharge from this apparatus in the dark that Mr. Kinraide noticed peculiar, fern-like forms of a pale violet color radiating from the two-inch brass sphere which formed the discharging terminal. By manipulating the discharge, he could make a number of these beautiful, quivering forms appear. By using spheres of larger diameters and increasing the potential, he could increase the length and size of the light-forms until they would shoot out thirty inches beyond the sphere and reach an apparent thickness of half an inch. They looked like miniature forks of violet-tinged lightning, leaving the darkness of the laboratory. By balancing an ordinary photographic plate on the top of the spherical terminal, film side down, and opening and closing the circuit once, a photograph of the quivering light-forms was secured. They recorded themselves as the filiciform or positive phase of electric energy. This was a first effort, and a first success. Upon a reversal of the current, an entirely different phenomenon was observed. Instead of the branching outshoots of violet light, there appeared plume-like forms resembling the cattail of the meadow-flag. These seemed to be about an inch in diameter and seven inches long. An attempt to secure a photograph of these plume-like forms was made, but though the plate was as carefully adjusted and the current as skillfully manipulated as before, there was no record found upon the plate when it was developed. The experiment was repeated again and again, but with disheartening results. The plumous forms could not be induced to make any impression on the sensitive plates. For two years Mr. Kinraide experimented, sacrificing plates enough to build a greenhouse. Then he made a discovery. The plumous forms were not, as he had supposed, discharging outward from the sphere; they were discharging inward from the surrounding air. The discovery of this fact was of the greatest significance. It seemed to proclaim electric energy not a dual force with a dual activity, but a single force with a single line of direction for the sweep of its energy. Furthermore, it showed plainly that the so called positive and negative phenomena indicate, the one an accumulation or heaping up of electric energy, the other a corresponding withdrawal. It was through study of the plumous

forms that Mr. Kinraide was led to the discovery of the conditions necessary for the successful production of these photographs. He realized that, in order to secure on a photographic plate the record of the so-called negative electricity, the plate must represent the withdrawal of energy; in other words, it must be electrified and then made to discharge itself into some conductor. With the condenser apparatus, he found no difficulty in securing the record of the negative phase. A photographic plate placed upon the positively electrified surface of the condenser became in turn positively electrified. Then, when any conductor connected with the negative terminal was brought into contact with it, the stored-up energy immediately sought an equilibrium and rushed from all directions toward the conductor. This produced a condition of withdrawal on the plate, or, in other words, showed the so-called negative phase of electricity. It was then that Mr. Kinraide made another discovery. Not only did he secure photographs of the positive and negative phases, but there was revealed on some of the plates the existence of comet-like forms in which the positive and negative were seen to be united, base to base. The meaning of these comet forms was not at first understood, nor did Mr. Kinraide know how it was that they appeared on the plates. Former photographs had indicated a separation between the two phases; none had ever shown that they were united. These comet forms, therefore, presented a new field for investigation, and it was only after careful study and experimentation that their significance was discovered. The comet structure Mr. Kinraide has called, by reason of the conditions under which it is created, the electric entity. It is a record of the entire activity of one small quantity of electric energy, an embodiment, as it were, of the force, and literally an entity of energy, having a birth, a growth, and a subsequent death or dispersion. Its center, or body part, is plainly neither positive nor negative in character. Mr. Kinraide calls it the third or dynamic phase of electricity. His reasons for this will be apparent farther on. In order to make clear the way in which the comet structure was secured, it may be well to explain first the development of the figure on Plate III. This is not one of the condenser series of photographs, but was secured from a very different and quite simple apparatus. It is introduced here to make clearer the interpretation of the other plates. Without describing the apparatus in detail, it is sufficient to say that it presented a flat surface about twice as long as wide. This surface was divided by a narrow strip of dielectric or non-conducting material into two areas of equal extent, each of these being nearly square. The apparatus was so arranged that when the current was turned on, one of these areas would become positively, the other negatively electrified, the dielectric between them preventing the energy from reaching a state of equilibrium. The photographic plate was placed in position on the flat surface, half of it on one side of the dielectric, half on the other. A metallic bar was then laid upon the plate at right angles to the dielectric. Thus its ends lay at the respective centers of the two areas which were to be oppositely electrified. By closing the current and then breaking it once, Plate III was obtained. The two ends of the photographic plate became oppositely electrified, like the areas over which they, were superimposed. When the current was broken, the energy in the two oppositely electrified surfaces immediately rushed to an equilibrium, using the metallic bar as a conductor. From the positively electrified surface the energy shot into the bar, recording its withdrawal in the delicate plumes of the negative phase. Then it hurried along and finally shot out and dispersed itself over the negatively electrified surface in the filiciform streamers, which always indicate the outward rush of the current. In the evolution of the comet structure, analogous conditions obtain, with the exception that the electric energy uses the air as a conducting medium instead of a metal conductor. This enables it to record the entire history of its action on the sensitive plate. Keeping

this explanation in mind, the reader will be able to understand Plate IV, which is one of the condenser series.

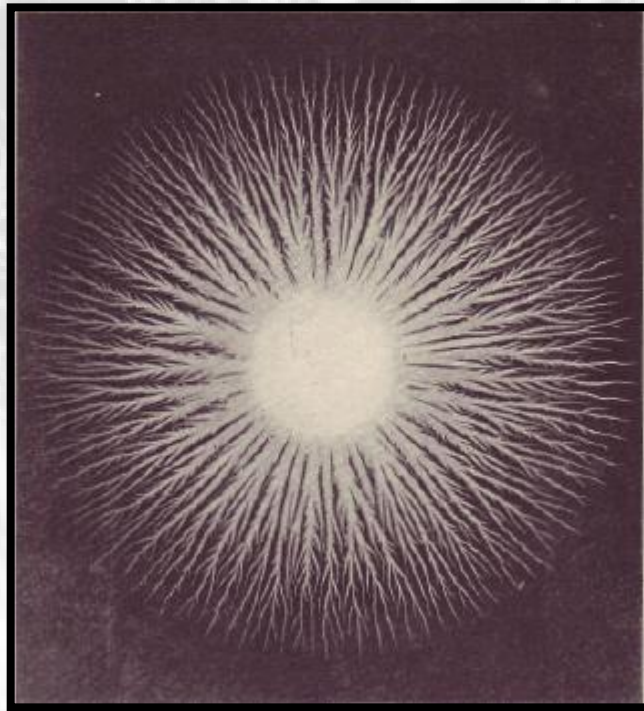


PLATE I. ANODOS. A discharge of electric energy over the negative surface of a condenser from a two-inch sphere connected with the positive terminal.

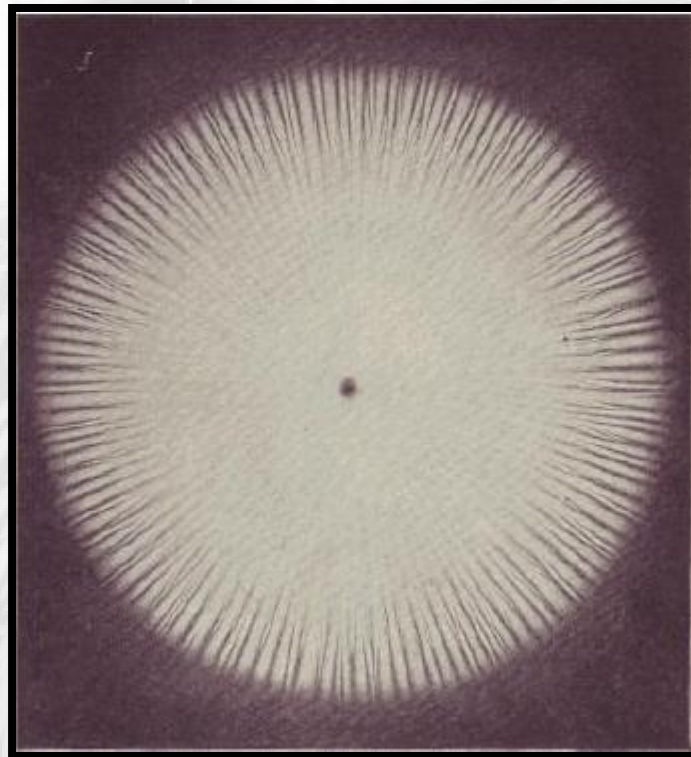


PLATE II. KATHODOS. A discharge of electric energy over the positive surface of a condenser toward a two-inch sphere connected with the negative terminal. In order to secure this, the condenser surface upon which the sensitive plate was to be placed was first highly charged with electric energy. Then the photographic plate was carefully placed upon it, film side up. A metallic discharger, fitted with an adjustable spark-gap, was now used. By means of this spark-gap it was possible to regulate the amount of energy to be withdrawn from the plate. After being connected with the negative terminal of the apparatus, the discharger was placed at the center of the plate, and a small quantity of the energy was permitted to escape. This created a circular, negative area on the plate, while surrounding it was a charged area. As in the case of the two oppositely electrified squares previously referred to, the energy sought an equilibrium. Small quantities of it shot inward toward the circular, negative area, and the onward rush was recorded on the plate in the filiciform streamers extending toward the center, while the withdrawal from the outer rim produced the soft plumous forms. All this took place before the discharger in the operator's hand could be withdrawn from its instant of contact with the plate. The energy started from a condition of diffusion, and ended in a condition of diffusion, but at the instant of its greatest power it was focalized. This instant of focalization is represented on the plate by the slender spindle joining the plumous and the filiciform. This is what Mr. Kinraide calls the dynamic phase of electric energy.

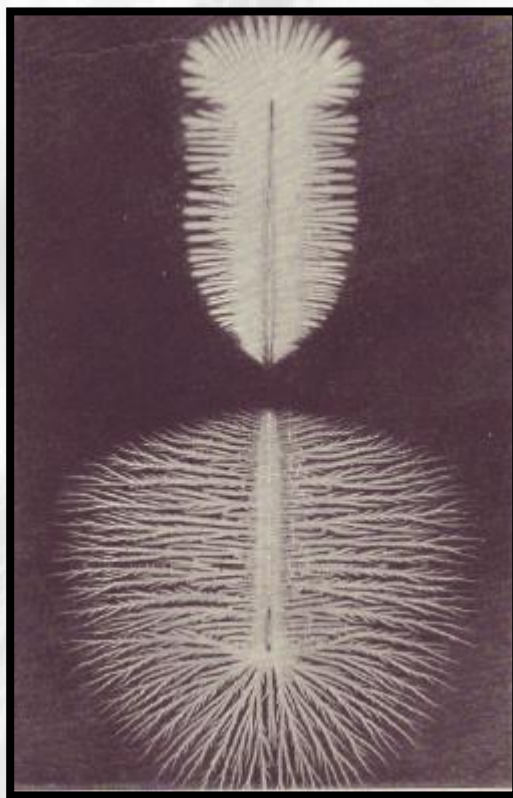


PLATE III. COMPOSITE ELECTRIC ENTITY. A transfer of electric energy produced by placing a short, metallic rod across the line dividing two oppositely charged areas. The part of the plate upon which the plumous or negative phase is seen is the part which was at first positively electrified. The part upon which the positive streamers are seen was the negatively electrified areas.

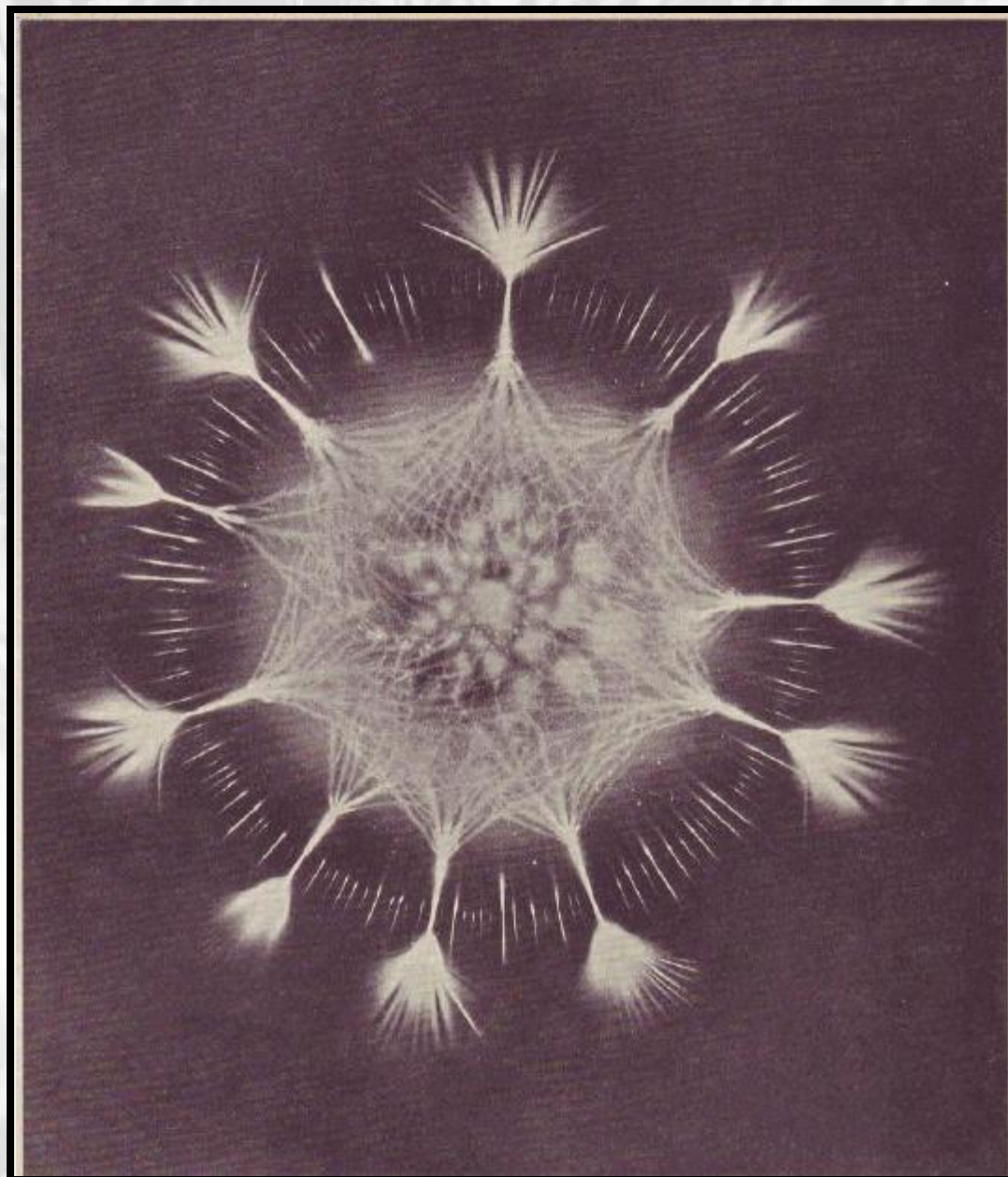


PLATE IV. SYMMETRICAL GROUP OF ELECTRIC ENTITIES. Each comet structure in the group is a record of the entire history of a small quantity of electric energy. In general terms, the spindle of one of these comet structures represents the dynamic center of a discharge, for each tiny comet records the entire evolution of an electric discharge, and the phases through which it passes are identical with those through which every uninterrupted discharge must pass. That this spindle has never before been shown in any photographs of electricity is due to the fact that no apparatus has ever before been constructed whereby the entire action of an electric discharge through the air could be recorded. In the action of the energy in Plate III its moment of greatest focalization was during its passage through the metallic bar. Hence its form could not be recorded.

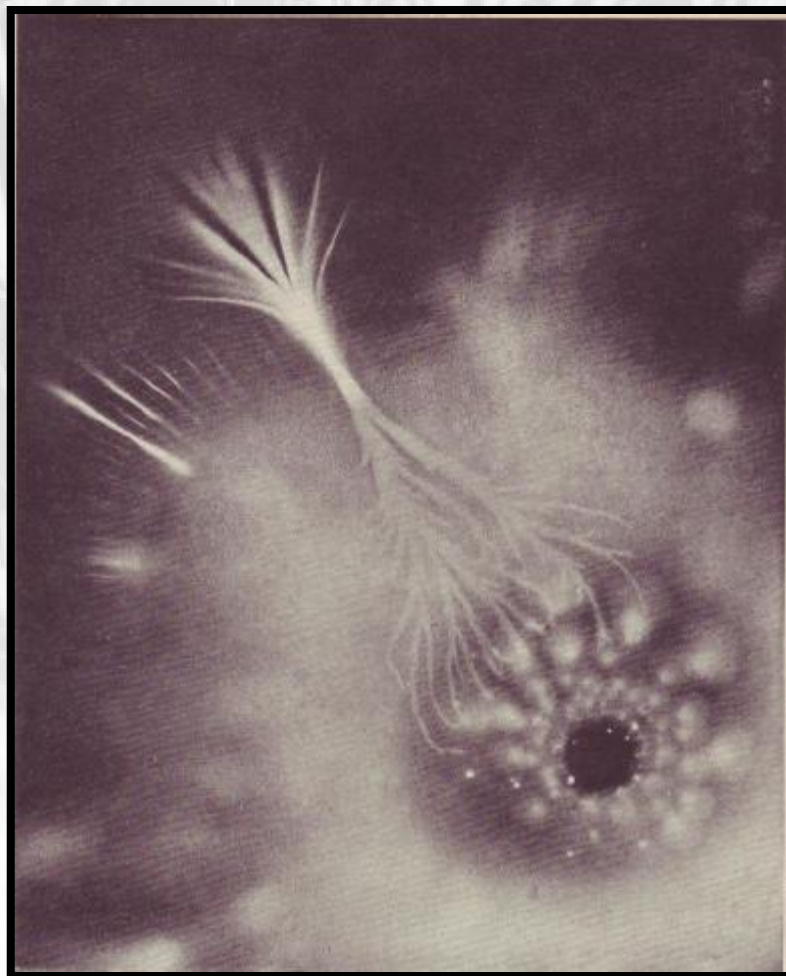


PLATE V. ELECTRIC ENTITY, OR EMBODIMENT OF ELECTRIC FORCE. (ENLARGED.)

Examine for a moment this spindle (see Plate V). It seems to be wound in a conical spiral, as if the lines of energy, which focalize at the point of greatest intensity, assume at once a spiral motion. This spiral whirl is at first very narrow, but as it passes away from the point of greatest intensity, it becomes wider, and its whirls are farther apart. Under favorable conditions they are far enough apart to be seen, forming a sharply pointed cone with a very small base. Thus it seems that the electric energy focalizing at this point translates itself, by means of the electromagnetic action which takes place in the spindle, from its negative phase into a curiously interacting form, the positive phase. Mr. Kinraide's conclusions may be summarized as follows: The plates here shown, especially those which record the action of the electric entity, form an electrographic demonstration of the meaning of the terms positive and negative electricity. When electric energy changes from a condition of diffusion to a center of focalization it is passing through its negative phase. When it changes from a condition of focalization to a condition of diffusion it is passing through its positive phase. These two conditions may be correctly termed the anodos, or going in, and the exodos, or going out, of electric energy. They are unmistakably recorded on the photographic plates, which show that there are not two separate electricities, but one developing entity of energy. There is no photograph of the diffused condition in either case. It is only when

the energy is passing through one or the other of its three phases that it becomes manifest upon the sensitive plate.

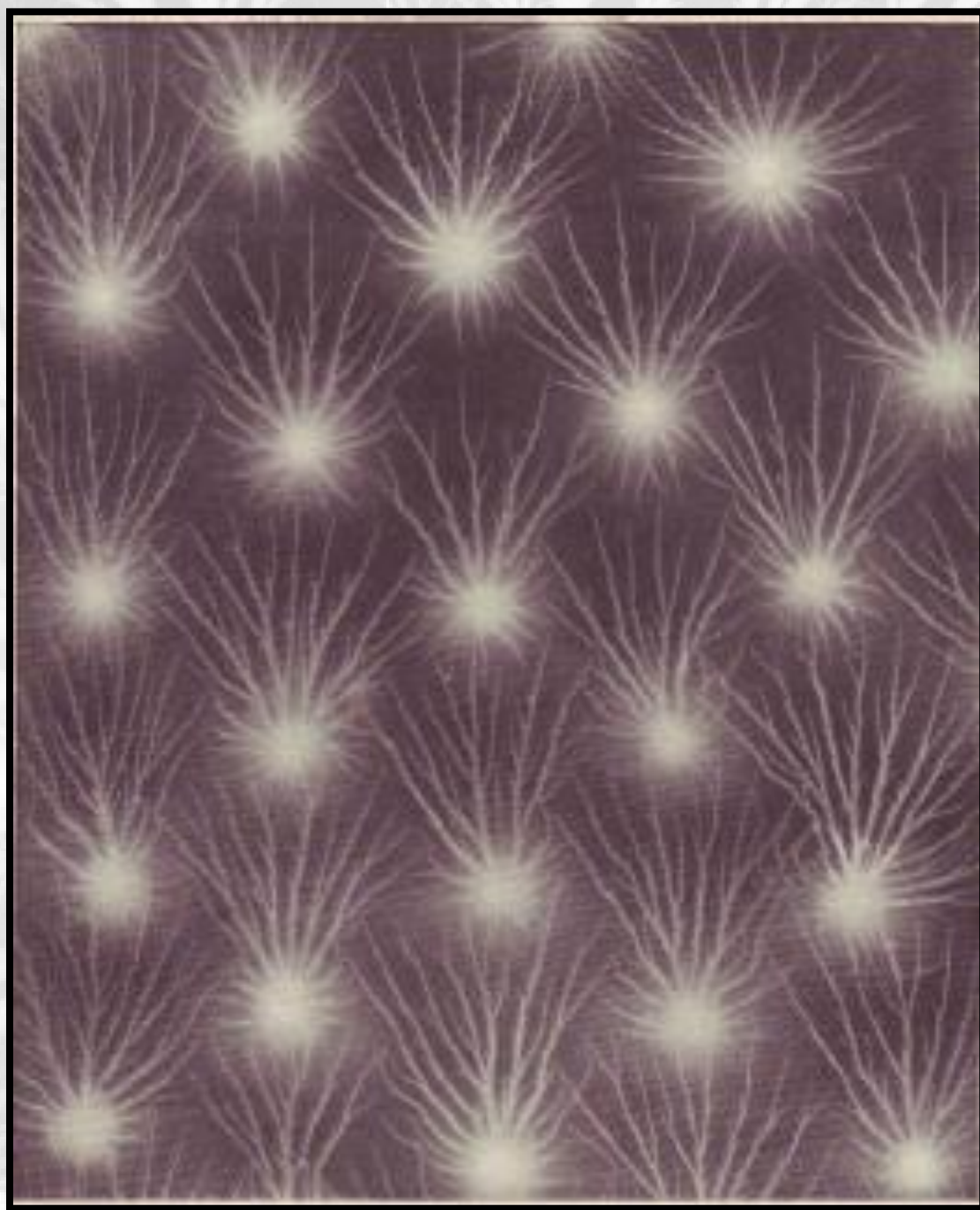


PLATE VI. POSITIVE ENDS OF ELECTRIC ENTITIES. A discharge from a metallic roller in its passage over the film, side of a photographic plate placed upon the uncoated, negative surface of a charged condenser. The conditions of electrification here are the opposite of those in Plate VII.



PLATE VII. NEGATIVE ENDS OF ELECTRIC ENTITIES. A discharge from a metallic roller iii its passage over the film side of a photographic plate placed upon the uncoated, positive surface of a charged condenser. This plate is a companion to Plate VI.

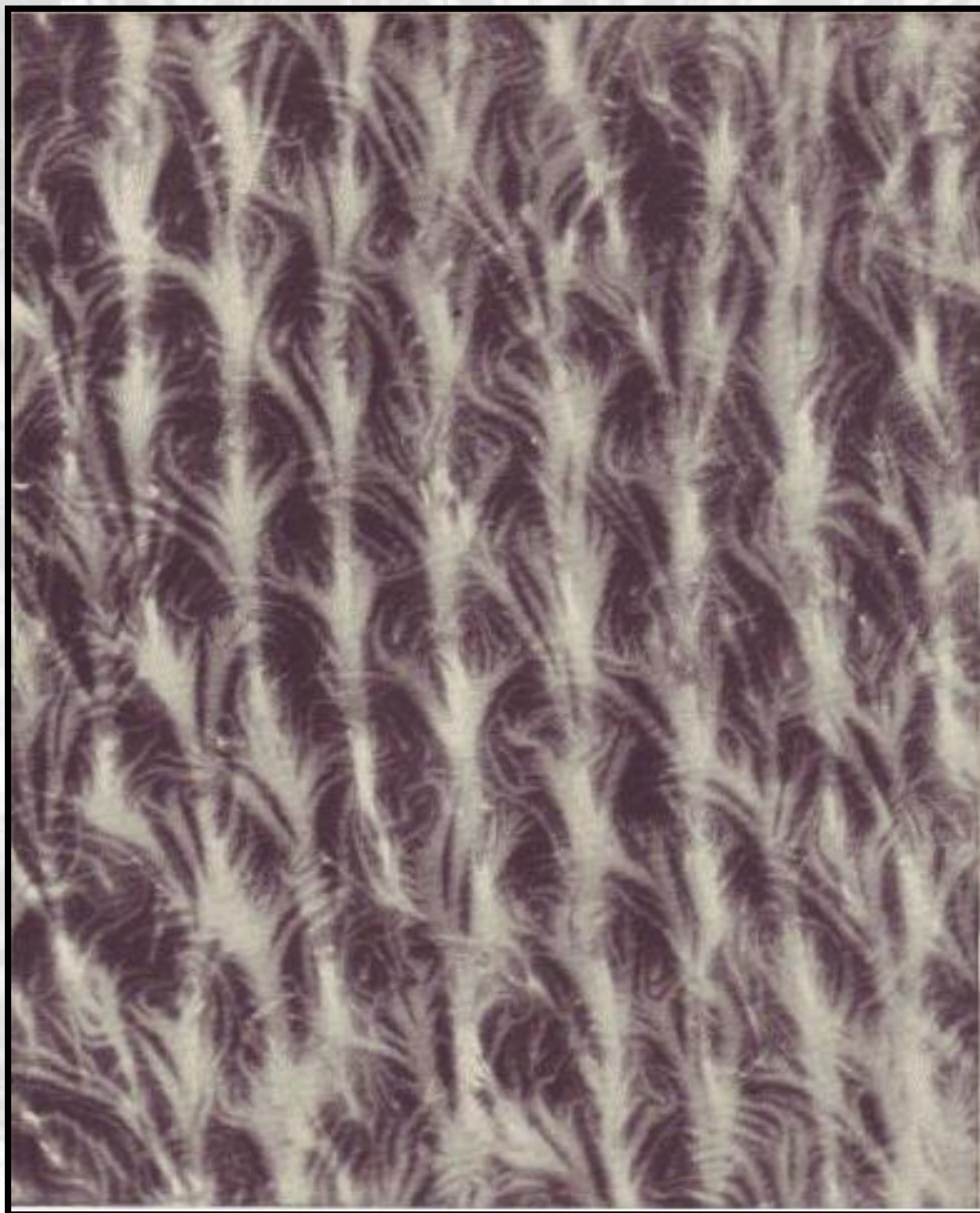


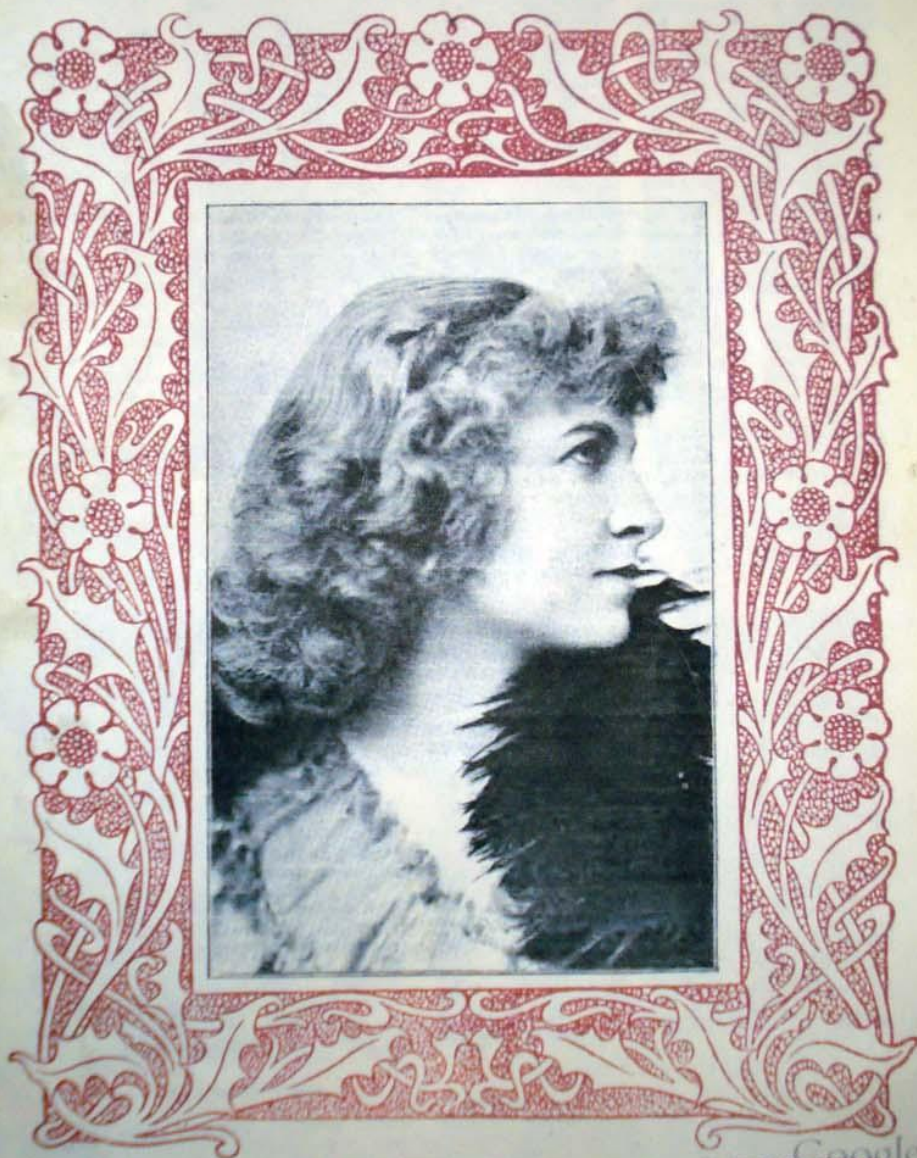
PLATE VIII.

A distance between plates produced by the passage of a metallic roller over a photographic plate laid film side down upon a positively charged, uncoated condenser surface. Plate V is an enlarged record of one small quantity of electric energy: its origin, or negative phase; its transformation, or dynamic phase; its final diffusion, or positive phase. In the negative phase the energy consists of numerous units of energy uniting to produce a single unit, which, after spiraling through a small space, is changed into a number of streamers to be again diffused. Plates VI and VII, which show respectively the positive and negative ends of electric entities, belong to the condenser series. As explained in the lines under them, they were secured by means of a roller passing over the surface of the photographic plate. Plate VI shows the outrushing or positive ends of the tinv entities that shoot off from the roller on to the negatively electrified plate as the roller is passed over the plate. Plate VII shows the retreating or negative ends of the entities that rush from the positive plate into the negative roller. Plate VIII shows how comets in series are formed when the energy between condenser surfaces is permitted to escape into a metallic roller passed over the outer surface of the plate. This was secured by placing the photographic plate film side down.

The photographs here reproduced form a representative selection from many hundreds secured by Mr. Kinraide. They are much reduced in size, the negatives being eighteen by twenty-two or eight by ten inches. A set consisting of about fifty photographs has recently been presented to the Massachusetts Institute of Technology, where it is available to students and other interested persons. The conclusions as to the nature of electricity reached by Mr. Kinraide through his study of its movement differ to a considerable extent from those reached by Lord Armstrong, the noted English scientist who has conducted experiments along similar lines. Lord Armstrong has secured some extremely interesting photographs of the phenomena resulting from discharges of electricity over dust plates. He has also experimented with photographic plates, and a number of the results secured in both cases bear an interesting resemblance to those obtained by Mr. Kinraide. Lord Armstrong has not, however, shown the development of the electric entity. It may be interesting to add that, as a result of his study of electric energy as manifested in these plates, Mr. Kinraide inclines to the theory that every form of energy, as heat, sound, light, gravity, etc., has what he would term an entity of energy, corresponding in structure and function to the electric entity, and that it only requires a knowledge of how to create conditions in order to demonstrate this. He asks the interesting questions: "May it not be that the whirlwind and the waterspout proclaim the presence of entities o.' thermal energy, the whirlpool the presence of an entity of gravity, and the sound-waves recently photographed the presence of the entity of sound force?" He maintains, also, that if the conditions are constant, the entity will be constant. A prime condition, must be that the energy be able to mold the substance which is the medium of its manifestation into its own form. Its power to do this demonstrates that it is a force-entity. Mr. Kinraide proposes to experiment with other forms of energy and to obtain, if possible, a complete demonstration of this theory.

ALREDEDOR DEL MUNDO

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Número 161

20 céntimos número

4 Julio 1902

KRINGSJAA.

REDAKTØR: CHR. BRINCHMANN.

BIND XX.

30. JULI 1902.

HEFTE 2.



Elektriciteten fotograferet.

(Efter Anabel Parker i *Century Magazine*.)

De mærkværdige fotografier, vi i denne artikel skal omtale, optegner grafisk visse faser af en af de vidunderligste og fineste af naturens mægtige kræfter. De er resultatet af flere aars forsøg, udførte af en natur-forsker i Boston, P. Burton Kinraide, hvem det er lyktes at optage afbildninger, der er frembragte ved elektriske udladningers virkning paa følsomme plader.

Disse fotografier viser formen og karakteren af de saa kaldte positive og negative faser af den elektriske energi, samt en tredje fase, som hidtil ikke er blet opdaget. Billederne kaster nyt lys over elektricitetens sande natur.

Alle de plader, som her vises, blev tagne under udladning af smaa elektricitets-mængder. Kaster man et blik paa de her fremstillede plader og de forklarende linjer under dem, vil man straks opdage, at der er en fremtrædende struktur-forskjel mellem den positive og den negative fase. Disse er saa ulige i karakter, at man aldrig kan blande dem sammen. Den positive fase viser altid en grenet, bregne-lignende struktur, mens den negative har et blødere, fjær-lignende udseende. Enten pladen fremviser en eneste stor skive, sammensat af yderst fine tegninger udstraalende fra et midt-punkt, eller en række siksak-formede kometer, kan man let ved at mærke sig strukturen komme paa det rene med, om den udladning, som har tegnet sig af paa pladen, var i sin positive eller i sin negative fase.

Denne række elektrogrammer blev med faa undtagelser frembragt ved hjælp af et kondensations-apparat, paa hvis ene overflade den følsomme plade blev anbragt. Denne overflade kan

The Daily Telegraph, St. John N. B., March 03, 1903

TWINS MAY BE SEPARATED.

Connected Korean Boys Put Under X-Ray and Surgeons Say They Can Successfully Be Cut Asunder.

Boston, March 2 - The father of the Korean twins, who are at present at Austin & Stone's museum, was made happy yesterday when he learned, at the conclusion of a somewhat remarkable X-Ray examination by three eminent physicists, that his boys could be safely separated and thus live the rest of their lives in freedom from the living bond that has held them together for 18 years.

They are splendid boys, and they went through the trying examination, which included the taking of two X-Ray photographs, with perfect equanimity. The examination was held on the stage of the museum, where it was possible to obtain a direct current of electricity to operate the Kinraide Coil, which was used. Besides the physicians, only the boys' father, Colonel Stone, James Macmahon, Quincy Kilby, Frank M. Ganong, and three newspaper men were present.

Dr. Charles Green Cumston, of Beacon Street, made the examination, assisted by Dr. W. A. Ralph, with Dr. Harry H. Hartung, of Huntington Avenue, directing the X-Ray machine. Dr. Cumston said at the conclusion of the examination that both the boys appeared to be perfectly healthy, about 18 years of age, and had only in common the flesh and cartilage connection which unites them at the base of the breast bone. He said:

"Their nervous systems are separate, and one of them has a stronger will than the other. Physically, they are equally strong. The union consists of the tip end of the breast bones, what is known as the phoid appendix, which is cartilaginous, and underneath this is a band about an inch in diameter, which in all probability is liver substance, connecting the two livers.

"It is also possible that the sac covering the heart, the pericardium, may communicate. That was what was found in a somewhat similar case operated on by Doctor Cumston of Rio de Janeiro.

"Regarding the prospects of separation, there is no doubt that it can be done, and in all probability with perfect success."

Prior to the X-Ray examination, Doctor Cumston examined the lungs and the connecting link with the stethoscope and found both boys sound. After the operation, the boys were stripped to the waist and laid flat on a mat, with a large photographic negative in an orange paper wrapper under the connection. Then the X-Ray apparatus was brought about a foot over the bodies, the power turned on, and a photograph taken. This was repeated. The plates were under the body, while the light was on the other side of the body. As has been said, the father of the

boy, Lin Hang Shang, was very much pleased with the result, and in all probability the operation will be performed, as he does not like to expose his boys. In fact, he does not need to, as he is comparatively wealthy in his own country. The boys have become so accustomed to their linked lives that they did not appear to be at all too pleased at the prospect of separation.

MAYNITS ILLS VANISH BEFORE WONDERFUL ELECTRIC RAYS.



DR. PROSEY

NO progressive step in recent years has attracted greater attention in the world of science and medicine than the development of the therapeutic properties of light, natural and artificial. Recent researches by renowned physicians and scientists have brought forth such marvelous results and wonderful cures that the possibilities of this comparatively new branch of medicine are almost unlimited.

In Denmark Vinsen has made experiments of such a successful nature as to lead him to the establishment of an institution where the "light cure" is used for the treatment of disease. The treatment has proved a popular one, and has resulted in investigations that have established the science of photo-therapy on a firm basis.

Despite the fact that attention was first drawn to photo-therapy through its use in Europe, it has reached a higher state of perfection and is under better control in America than elsewhere. It is probable that few Americans know that right here in Atlanta the science has reached its highest stage of perfection, and that the only institution in the south where the "light cure" is practiced is located here.

The Violet Ray, the technical term for the light cure as practiced in Atlanta, has proved, in experiments, to be a curative cure for tuberculosis and nervous prostration, and this in itself, even if the molecular vibrations did not possess curative powers for other diseases, are sufficient to attract the attention of all humankind. The system is an interesting one and combines three features, each one of which is used separately by different authorities. Naturally, different patients are subjected to a different form of treatment. In a case of tuberculosis much depends upon the advancement of the disease. In nervous prostration the treatment is varied according to the condition of the patient.

Prosey's treatment is confined almost to local photo-therapy and the patients are mostly persons suffering from cancer and lupus. In Berlin Count Dr. Kollage uses the electric arc light bulb exclusively, while in Boston Dr. Williams uses the

dermal. That, at times, becomes a comparative non-conductor, just as it also offers greater resistance to the action of light waves.

One of the most interesting features of the violet ray treatment is the electric light bulb. The patient is placed in a specially constructed cabinet which contains two arc lights. The cabinet is so arranged that the field of the patient is on the outside. It has been found through various experiments, that the best results are obtained when the head is not exposed to the strong light. The body of the patient is perfectly nude during the bath. On each side of the cabinet is an arc light. Another lamp is covered with glass and they are placed at a sufficient distance from the body not to cause undue heat. Sitting quietly in this cabinet the patient gets the full effect of the electric rays and absorbs the energy that is released. The rays penetrate every tissue of the body and the blood stream is the cause. The nature and advancement of the disease control the period of the bath and when the patient leaves the cabinet the progress of the disease, even a cure is not effected.

Dr. J. Douglas Prosey, of Atlanta, is an authority on the violet ray, and has probably secured more practical results from it than any other living man. When asked to tell of the violet ray treatment, he said:

"By the violet ray treatment the color, size and number of the red blood cells is increased, probably due to the presence of some in greater quantity and the white blood cells increase in proportion. The percentage of hemoglobin in the blood of those suffering from tuberculosis is always low. Dyspnea is, perhaps, in much due to this cause as to the impairment of the absorption of the lungs. Oxygenation takes place more in the tissues than in the blood. The tension of the blood is always greater than that in the chief regulator of respiration. Hence if the oxygen carrying capacity of the blood is increased, it follows that the patient breathe easier. An accurate record in numerous cases shows reduced respiration after each treatment. The residual air within the lung is the barrier against penetration of antiseptic vapors in an effective manner into the true respiratory system. In order, therefore, to sterilize the lungs thoroughly, I decompose the residual air, also, by molecular vibrations; the molecules of oxygen are reworked into their atoms, and reconstructed into a new group, O_3 , in essence form. Thus we have a powerful antiseptic, produced where needed, in the very seat of the disease, acting as oxygen in its atomic and triatomic forms, at the moment of its appearance from its previous chemical union. 'Naught oxygen is a very general germicide agent.' (Bastier's Bacteriology). The form of electricity I employ is void of all disagreeable physiological effects. It follows, therefore, that it is free from all injurious action on the system that probably results when currents are employed that produce shock, or pain, at which nature revolts. The ordinary forms of electricity, galvanic, faradic, or static, are often times productive of more harm than good; frequently irritating the nerve centers, disorganizing or producing spasms of protoplasm, that assumes a spasmoid form. The currents I employ are rich in ozone-forming and fine, and sooth in their influence; yet a gentle nerve and tissue stimulant, promoting cell development. For local anæsthesia, a glass vacuum electrode fitted with bromine is employed. The current can be perfectly regulated at will. The shape of the different electrodes is such as to conform to that of the organ for which it is intended; oscillations are passed through the seat of the disease, and nascent oxygen, in its triatomic form, is produced in situ, thereby destroying germ life, and stimulating the reparative processes. This is proved."

"By the characteristic odor and taste of ozone, have proved of little value in this connection. The behavior of the tissues to light and electricity in health and in disease is interesting. Healthy tissues are transparent to light rays and most conductors of electrical waves. Diseased tissues become comparatively opaque, in proportion to the extent and nature of the disease, and also offer more electrical resistance. The action of light on the human body decreases its resistance in electrical oscillations, just as light waves increase the conductivity of the metal medium. A study of the anatomy in the light of electricity clearly reveals the condenser nature of the human structure, owing to the relative conductivity of the various tissues, made up, as it were, of comparative insulators and conductors. Thus, in using the violet ray it is not possible to measure the resistance of almost every portion of the human organism. It has been found that the layers of the skin, the spine of the vertebrae, arteries, lymphatic, intonation, and every organ, including the coating of the brain, lungs, kidneys and the bones themselves have a varying degree of resistance. In disease this difference in electrical resistance is more marked, especially in the eye."



QUEEN ALEXANDRA

or comes on apparent to the person through whom chest the oscillations are passed.

Other proofs might, if necessary, be adduced.

And just as H is formed in the lungs, so, too, it is produced in the other tissues—the effects being manifested by microscopic and chemical examinations of the blood that is richer in O_3 , as indicated by a blue ring.

In speaking of the electrically decomposed atmosphere, perhaps a word may not be out of place on the subjects of decomposition. The exact nature of which cannot as yet be definitely determined. There can be no question about the formation of large quantities of O_3 . The characteristic odor and chemical tests place this beyond dispute. Now can there be any question but a small quantity of ozone of vitriol is also formed. All the amount is reduced to a minimum by apparatus that produces a very faint antiseptic spray, by which the healing effects are avoided to any appreciable degree; and thus chemical union with oxygen is, to a great extent, avoided. This is evident since the resulting compound may be inhaled for long periods, without causing any irritating effects upon the air passages, when they are diseased, when coughing is subsides when the treatment ceases. It is necessary to regulate the strength of the inhaled products of decomposition according to the degree of inflammation present in proportion to which the resulting will be more or less severe. But the inflammation gradually subsides with each treatment, and the restoration of the diseased air passages increases, permitting a much more concentrated atmosphere of nascent O_3 pounds to be inhaled, for longer periods, with gradually decreasing cough, that finally cannot be provoked. In cases of consolidation, resolution rapidly takes place, and inflation of the consolidated area quickly follows. The catarrhal processes are soon arrested, as shown by diminished expectoration. In addition to ozone and the oxide of nitrogen, there are also occasionally present free oxygen, nitric oxide, and probably some of the other chemical products of this electrical decomposition. On some days electrical decomposition is of a pure form; on rare occasions it is like the mingled breath of the rose and the violet; at other times it has a faint, sulphureous odor, but it always differs to the product of static electricity, or phosphorus. This treatment attunes the functions of the skin. Through the open pores the hungry blood drinks in the vivifying ozone; the tissues are bathed therewith and nourished; the chemical changes upon which life depends are hastened; respiration of tissue is promoted by the stimulating action of these molecular vibrations on the sensory nerves of the skin, as well as by the increase of temperature due to the more rapid addition and retention in the atmosphere of the oxygen.

HUMANITIES ILLS VANISH BEFORE WONDERFUL ELECTRIC RAYS

DR. PROSSER

NO progressive step in recent years has attracted greater attention in the world of science and medicine than the development of the therapeutic properties of light, natural and artificial. Recent research by renowned physicians and scientists has brought forth such marvelous results and wonderful cures that the possibilities of this comparatively new branch of medicine are almost unlimited.

In Denmark, Finsen has made experiments of such a successful nature as to lead him to the establishment of an institution where the "light cure" is used for the treatment of diseases. The treatment has proven popular and has resulted in investigations that have established the science of phototherapy on a firm basis.

Despite the fact that attention was first drawn to phototherapy through its use in Europe, it has reached a higher stage of perfection and is under better control in America than elsewhere. It is probable that few Atlantans know that right here in Atlanta, the science has reached its highest stage of perfection, and that the only institution in the south where the "light cure" is practiced is located here.

The Violet Ray, the technical term for the light cure as practiced in America, has proven, in experiments, to be a certain cure for tuberculosis and nervous prostration, and this in itself, even if the molecular vibrations did not possess curative powers for other diseases, is sufficient to attract the attention of all humankind. The system is an interesting one and combines three features, each of which is used separately by different authorities. Naturally, different patients are subjected to a different form of treatment. In a case of tuberculosis, much depends upon the advancement of the disease. In nervous prostration, the treatment is varied according to the patient's condition.

Finsen's treatment is confined almost to local phototherapy, and the patients are mostly people suffering from cancer and lupus. In Battle Creek, Dr. Kellogg uses the electric light bath exclusively, while in Boston, Dr. Williams uses the X-Ray and high-frequency currents. In Atlanta, Dr. J. Dempsey Prosser combines these three branches, and his treatment is the most advanced of its kind in any institution yet established.

In England, Queen Alexandra has taken a deep interest in the light cure. She has watched its progress closely and has given it her official endorsement by purchasing apparatus for several hospitals. The queen is known as a friend to the suffering and afflicted, and throughout her life has taken every opportunity to advance scientific research in the medical world. She has been present during experiments with the light cure and has seen the successful manner in which cancer and lupus have been cured when every other method of treatment has failed. Her faith in the process was established, and she did not hesitate to give it the seal of her official approval. Involving as it does the use of technical terms and the description of an almost unknown

quantity, an explanation of the practical uses of the violet ray is necessarily difficult. A patient under treatment experiences no inconvenience or pain, and the process seems simple.

Neither one form of light, nor one form of apparatus, nor one dosage, nor one technique constitutes the whole of phototherapy. To ensure the many degrees of effect, several mechanical devices are needed to alter the latest energy of light into an agent of *materia medica*. These mechanical devices form an important part of the physicist's work, and through constant study and experimentation, Dr. Prosser has developed his to a high state of perfection. The arc light is used to a large extent and is necessary for intense local photochromic effects. The reason for using artificial light in preference to incandescent light is that the latter has no chemical rays and is enclosed in glass, which is a greater barrier to ultraviolet rays and most of the visible chemical rays. To secure chemical rays for active therapeutic effects of certain kinds, a total light of 30,000 to 40,000 candlepower has been required, and the only mechanical device that can currently provide this without dangerous heat is the arc lamp. It has been found that artificial light, rich in actinic rays, yields results similar to those attained by sunlight. X-Rays, how-ever, have proven of little value in this connection.

The behavior of tissues to light and electricity in health and in disease is interesting. Healthy tissues are transparent to light rays and good conductors of electrical waves. Diseased tissues become comparatively opaque, in proportion to the extent and nature of the disease, and also offer more electrical resistance. The action of light on the human body decreases its resistance to electrical currents, just as light waves increase the conductivity of metal silence. A study of the anatomy in the light of electricity clearly reveals the condenser nature of the human structure, owing to the relative conductivity of the various tissues, made up, as they were, of comparative insulators and conductors. Thus, in using the violet ray it has been possible to measure the resistance of almost every portion of the human organ. It has been found that the layers of the skin, the walls of the veins, arteries, lymphatics, intestines, and every organ, including the coating of the brain, lungs, kidneys, and the bones themselves, have varying degrees of resistance. In death, this difference in electrical resistance is more marked, especially in the epidermis. Epidermis, that, at times, becomes a comparative non-conductor, just as it also offers greater resistance to the action of light waves.

One of the most interesting features of violet ray treatment is the electric light bath. The patient is placed in a specially constructed cabinet containing two lights. The cabinet is arranged so that the patient's head is on the outside. It has been found, through various experiments, that the best results are obtained when the head is not exposed to the strong lights. The patient's body is perfectly nude during the bath. On each side of the cabinet is a light. Neither lamp is covered with glass, and they are placed at a sufficient distance from the body not to create undue heat. Sitting quietly in this cabinet, the patient receives the full effect of the chemical rays and absorbs the ozone that is produced. The rays penetrate every tissue of the body, and the blood drinks in the ozone. The nature and progression of the treatment control the duration of the bath and when the patient leaves the cabinet.

In the body is aglow and nature's natural forces have been restored.

The violet ray is applied to the body of a patient through an instrument technically known as vacuum electrodes, made of glass. The instrument is held by the patient or the attendant and is applied to the naked body. In the case of tuberculosis of the sulcus, the application is on the chest. The sensation experienced by the patient is pleasant, and the ozone created by the ray has a delightful odor. Through these electrodes, the patient is able to receive a current of 1,000,000 volts.

Formerly, light therapy required as much time as two years to cure an ordinary case of tuberculosis, but with the violet ray, the cure was accomplished in a few months, and immediate improvement is invariably noted. Where the disease has reached such an advanced stage that it is incurable, the violet ray treatment brings relief from pain to the patient checks the progression of the disease, even if a cure is not effected.

Dr. J. Dempsey Prosser, of Atlanta, is an authority on the violet ray, and has probably secured more practical results from it than any other living man. When asked to tell of the violet ray treatment, he said:

"By the violet ray treatment, the color, color, and number of red blood cells are increased, probably due to the presence of a greater quantity of ozone, and the white blood cells increase proportionally. The percentage of hemoglobin in the blood of those suffering from tuberculosis is always low. Dyspnea is perhaps much due to this cause as to the impaired absorption of the lungs. Oxidation takes place more in the tissues than in the veins. The oxygen tension in the tissues is always greater than in the venous blood. Hemoglobin is therefore the chief regulator of respiration. Hence, if the oxygen-carrying gap in the blood is increased, it follows that the patient breathes easier. This has been observed in numerous cases."

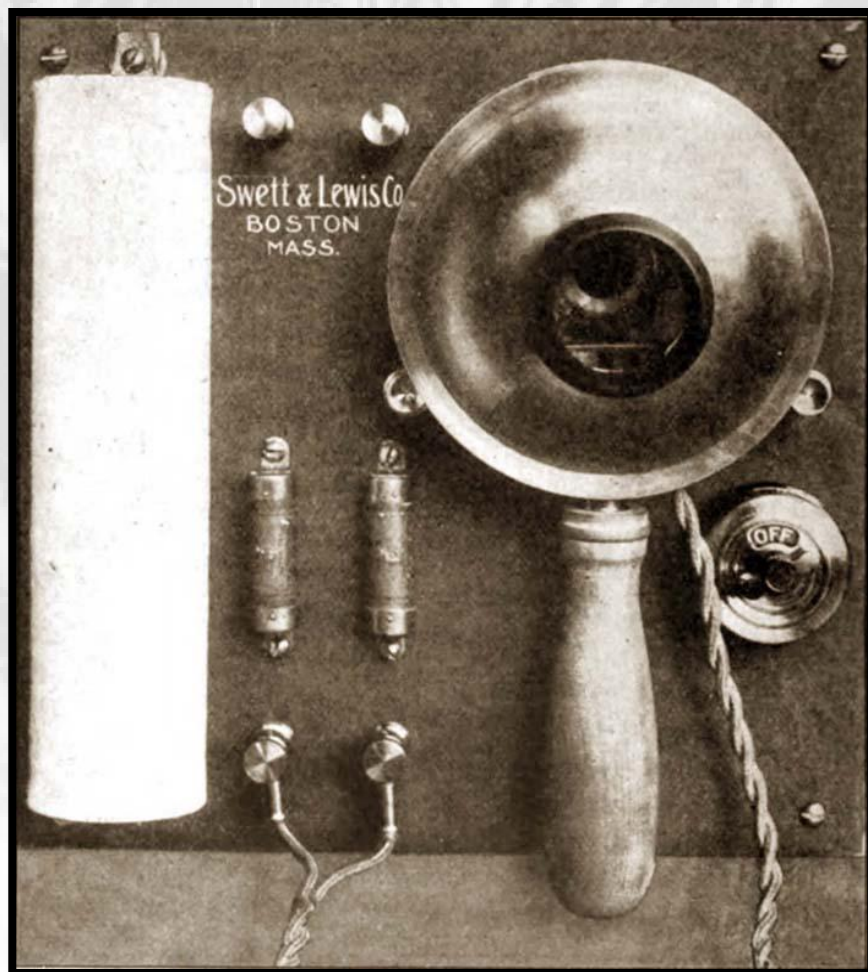
Shows reduced respiration after each treatment. The residual air within the lung acts as a barrier against the introduction of antiseptic vapors into the respiratory system. In order, therefore, to sterilize the lungs thoroughly, I decompose the residual air in situ by molecular vibrations; the oxygen molecules are resolved into their atoms and reconstructed into a new group, O_3 , in nascent form. Thus, we have a powerful antiseptic, effective where needed, at the very site of the disease, acting as oxygen in its atomic and triatomic forms at the moment of its recomposition from its previous chemical union. 'Nascent oxygen is a very potential germicidal agent.' (Sternberg's Bacteriology.) The form of electricity I employ is free of all disagreeable physiological effects. It follows, therefore, that it is free from all harmful action on the system that probably results when currents are employed that produce shock or pain, to which nature revolts. The ordinary forms of electricity—galvanic, faradic, or static—are often productive of more harm than good; frequently irritating the nerve centers, disrupting or producing spasms of pre-existing plasma, which assumes a spheroidal form. The currents employed are rich in ozone-forming qualities; anodyne and soothing in their influence, yet a gentle nerve and tissue stimulant, promoting cell development. For local asepsis, a glass vacuum electrode filled with bromine is employed. The current can be perfectly regulated at will. The shape of the different electrodes is such as to conform to that of the organ for which it is intended; oscillations are passed through the site of the disease, anesthetic oxygen, in its triatomic form, is produced in situ, thereby destroying germ life and stimulating local reparative processes. This is proven.

- By the increased elimination of currents void
- By the characteristic odor and taste of ozone is apparent to the person through whose chest the oscillations are passed.

Other proofs might, if necessary, be added.

And just as it is formed in the lungs, no, too, it is produced in the other tissues—the effects being manifested by microscopic and chemical examinations of the blood that is richer in ozone, as indicated by a blue ring.

In speaking of the electrically decomposed atmosphere, perhaps a word may not be out of place on the products of decomposition, the exact nature of which cannot yet be definitively determined. There can be no question about the formation of large quantities of ozone. The characteristic odor and chemical tests confirm this beyond dispute. Nor can there be any question that a small quantity of nitrogen oxide is also formed. But the amount is reduced to a minimum by apparatus that produces a very finely subdivided spray, by which the heating effects are avoided to any appreciable degree; Thus, chemical union with oxygen is largely avoided. This is evident since the so-called sutting compound may be inhaled for long periods without causing any treating effects on the air passages, unless they are diseased, when coughing is temporarily produced, which, however, subsides when the treatment ceases. It is necessary to regulate the strength of the inhaled decomposition products according to the degree of inflammation present—in proportion to which the cough will be more or less severe. But the inflammation gradually subsides with each treatment, and the tolerance of the diseased air passages increases, allowing a much more concentrated atmosphere of ozonated compounds to be inhaled for longer periods, with a gradually decreasing cough that finally cannot be provoked. In cases of consolidation, resolution occurs rapidly, and inflation of the consolidated area quickly follows. The catarrhal processes are soon arrested, as shown by diminished expectoration. In addition to ozone and nitrogen oxide, free oxygen, atomic oxygen, nitrogen, holfen, argon, erythritol, and probably some of their compounds are also necessarily present. The product is a powerful oxidizer and lung and brain stimulant. Atmospheric conditions materially affect the chemical products of this electrical decomposition. On some days, the odor resembles that of a pine forest; on rare occasions, it is like the mingled breath of roses and violets; at other times, it has a faint, sulfurous odor, but is always different from the product of static electricity, or phosphorus. This treatment stimulates the functions of the skin. Through the open pores, the hungry blood drinks in the invigorating ozone; the tissues are bathed and nourished; the choroidal changes upon which life depends are induced. Tissue respiration is promoted by the stimulating action of these molecular vibrations on the sensory nerves of the skin, as well as by the increase in temperature due to the more rapid oxidation and resistance to the actions offered by the tissues.

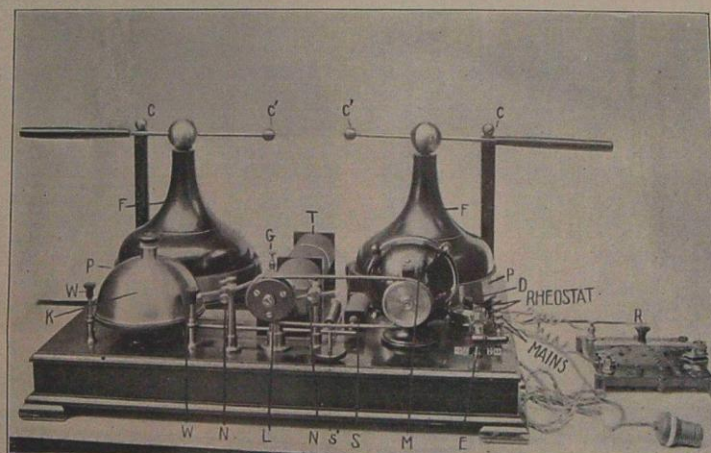


THE BOSTON LAMP.

The lamp shown in the cut above is designed to run from any direct-current lighting circuit and is used for ultraviolet work. The instrument is simple, compact, and substantial. It is mounted on a piece of slate twelve inches square. At the extreme left is a resistor tube, which regulates the current and allows the proper amount to pass. The wires from the incandescent lamp socket are attached to the binding posts, just above the name in the illustration. To operate, the lamp is removed from the slate, the crystal lens brought into direct contact with the area to be treated, and the lens used as a compressor. The electrodes used are made of iron. They last for hours, either constantly or intermittently running. It is only a matter of a moment to insert new electrodes. The rays given off by the lamp are rich in ultraviolet, and almost all light rays are excluded. It is not necessary to use water or any other cooling device. There is absolutely nothing about the lamp to get out of order.

The price of the complete outfit is thirty dollars.

The manufacturers are Swett & Lewis Co., 18 Boylston Street, Boston, Mass.

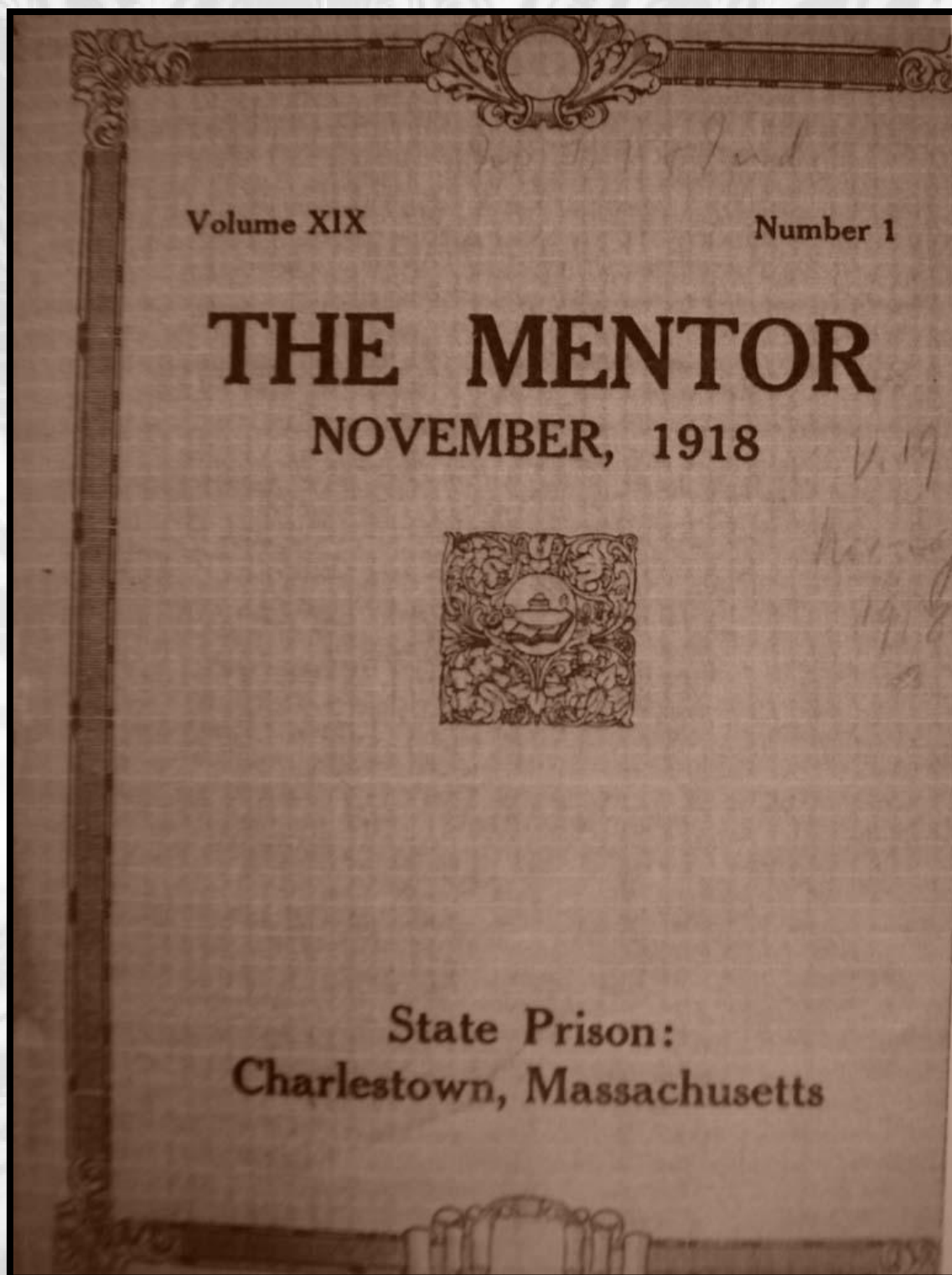


The Kinraide High Frequency Coil, Direct Current

For adjusting spark gap plate.
Break wheel
 WW — Thumb Screws.
 D — Starts motor.
 E — Starts current through Coil.
 R — Rheostat.
 G — Post for ground connection.
 NN — Brushes.

L — Break Wheel.
 T — Transformer.
 FF — Secondary Coil Cases.
 M — Motor. *for break wheel*
 C'C' — Poles for discharge of secondary.

CC — For attaching wires of tubes and electrodes.
 K — Water Pot, for cooling plates.
 S' — Adjusting Screw.
 S — Solenoid. — *and dash not to adjust spark gap plate (cover)*
 PP — Primary.



In November 1918 Thomas Burton Kinraide donated many of his scientific books and journals to the Massachusetts State Prison



Library Department

SUPPLEMENTARY CATALOGUE

TITLE	AUTHOR	NO.	DONOR
Scientific American.....	Jan.-June, 1896.....	X 500	T. Burton Kinraide
Scientific American & Supplement	do Sup.....	X 501	do
do do do	July-Dec., 1896.....	X 502	do
do do do	do Sup.....	X 503	do
do do do	Jan.-June, 1897.....	X 504	do
do do do	do Sup.....	X 505	do
do do do	July-Dec., 1897.....	X 506	do
do do do	do Sup.....	X 507	do
do do do	Jan.-June, 1898.....	X 508	do
do do do	do Sup.....	X 509	do
do do do	July-Dec., 1898.....	X 510	do
do do do	do Sup.....	X 511	do
do do do	Jan.-June, 1899.....	X 512	do
do do do	do Sup.....	X 513	do
do do do	July-Dec., 1899.....	X 514	do
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do do do	July-Dec., 1900.....	X 518	do
do do do	do Sup.....	X 519	do
do do do	Jan.-June, 1901.....	X 520	do
do do do	do Sup.....	X 521	do
do do do	July-Dec., 1901.....	X 522	do
do do do	do Sup.....	X 523	do
Electrical Review.....	Jan.-June, 1896.....	E 800	do
do do	July-Dec., 1896.....	E 801	do
do do	Jan.-June, 1897.....	E 802	do
do do	July-Dec., 1897.....	E 803	do

TITLE	AUTHOR	NO.	DONOR
Electrical Review.....	Jan.-June, 1898.....	E 804	T. Burton Kinraide
do do.....	July-Dec., 1898.....	E 805	do
do do.....	Jan.-June, 1899.....	E 806	do
do do.....	July-Dec., 1899.....	E 807	do
do do.....	Jan.-June, 1900.....	E 808	do
do do.....	July-Dec., 1900.....	E 809	do
do do.....	Jan.-June, 1901.....	E 810	do
do do.....	July-Dec., 1901.....	E 811	do
The Evidence in the Case.....	Beck, James N.	B 680	Col. Walter Scott
The Patrol of the Sundance Trail.....	Connor, Ralph.....	C 777	do
The Sky Pilot.....	do.....	C 438	do
The Foreigner.....	do.....	C 418	do
The Man from Glengarry.....	do.....	C 426	do
Glengarry School Days.....	do.....	C 422	do
The Straight Road.....	Chambers, C. E.	C 778	do
The Man Thou Gavest.....	Comstock, H. T.	C 779	do
The Glory of the Trenches.....	Dawson, Coningsby..	D 530	do
Nobody's Child.....	DeJeans, Elizabeth..	D 524	do
Then I'll Come Back to You.....	Evens, Larry.....	E 213	do
The Quitter.....	Fisher, Jacob.....	F 286	do
The Horsemen of the Apocalypse.....	Ibañez, Vicente B. ..	I 54	Miss H. G. Readon
The Tin Soldier.....	Bailey, Temple.....	B 753	do
The Land of Deepening Shadow.....	Curtin, D. Thomas..	C 776	do
A Minstrel in France.....	Lauder, Harry.....	L 419	John Scott
The Syrian Christ.....	Rihbany, A. M.	R 333	do
The Red Lane.....	Day, Holman.....	D 414	Inmate

TABULATION FOR THE MONTH OF MAY

Total vols. issued.....	2436
Largest one day.....	153
Smallest.....	67
Average for month.....	94

The writer was for nearly two years one of the librarians, engaged in classifying a new vocational department so he is using one of the privileges of an ex. Altho there is no regular fund for the purchase of popular novels and textbooks, we surely get the opportunity, if we watch this page each month, to read the best of the current fiction, for there are friends who know our needs and fill them as they are able to.

Today there are three fields of opportunity that offer a great future to young men with ambition—electrical engineering, forestry and cement construction, and there are no textbooks that present the history, development, and prophecy of these scientific and useful arts in a more readable, entertaining manner than the bound volumes of magazines given to us by Mr. T. Burton Kinraide. It will be a mental feast for any of us to

consult these books that offer claims, and descriptions, and formula which, tho ridiculed at the time have worked out so gloriously to our good. Scientific facts and truth are always more convincing when considered in retrospect. We thank the friend who donated this living record of the dreams that came true.

Right here it may be fitting to recommend three books that, if read, marked and inwardly digested, would alter in the right direction the plans of every man who thinks crookedly—Conscious Control (Alexander), Character Analysis (Blackwood), and Efficient Living (Purinton). This the Holy Trinity for anyone who wants this to be his last bit.



WHAT IS LIFE?

By Grandpa

What is Life?

We know not when, nor whence it came,
We know not if it's joy or shame;

Quite varied fates,
Our life partakes—

Some, high in fame, with riches blest,
Some, cooped in walls, as sorrow's guest;

What is Life?

What is Life?

We boast its joyous, pulsing tide,
We boast *our* lot, in scornful pride;

The wide world o'er
Is prime to score

The other chap's whose ways obscure,
The other chaps don't like for sure;

What is Life?

What is Life?

Within these pages we may find,
Within these tales unless we're blind,
Deep down, or high

True life espy;

Where Hope doth beckon point before,
Where past is blotted from the score;

What is Life?

What is Life?

Sentenced to life when we are born,
Sentenced, do time, in joy, forlorn;

A common ground

Our rhyme has found;

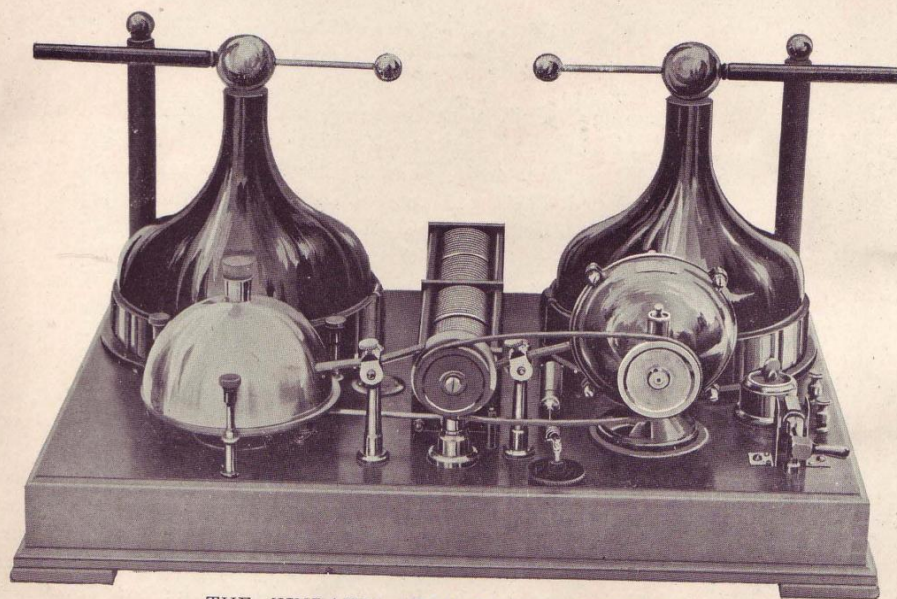
'Tis not just how or where we live,

'Tis trust and effort, life may give;

What is Life?

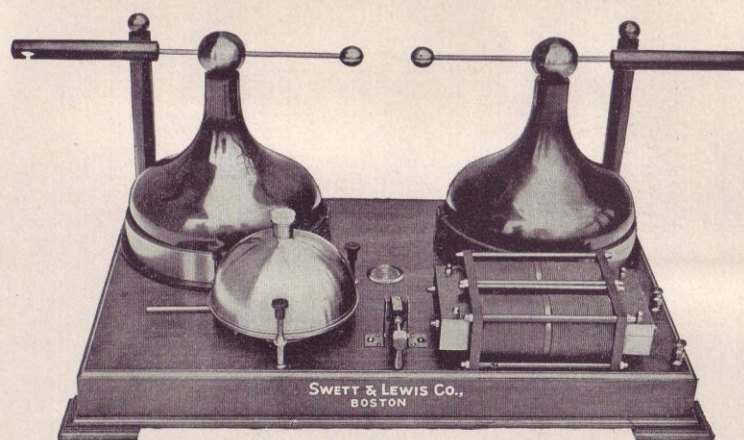


Inventions of Thomas Burton Kinraide



THE KINRAIDE HIGH FREQUENCY COIL

4

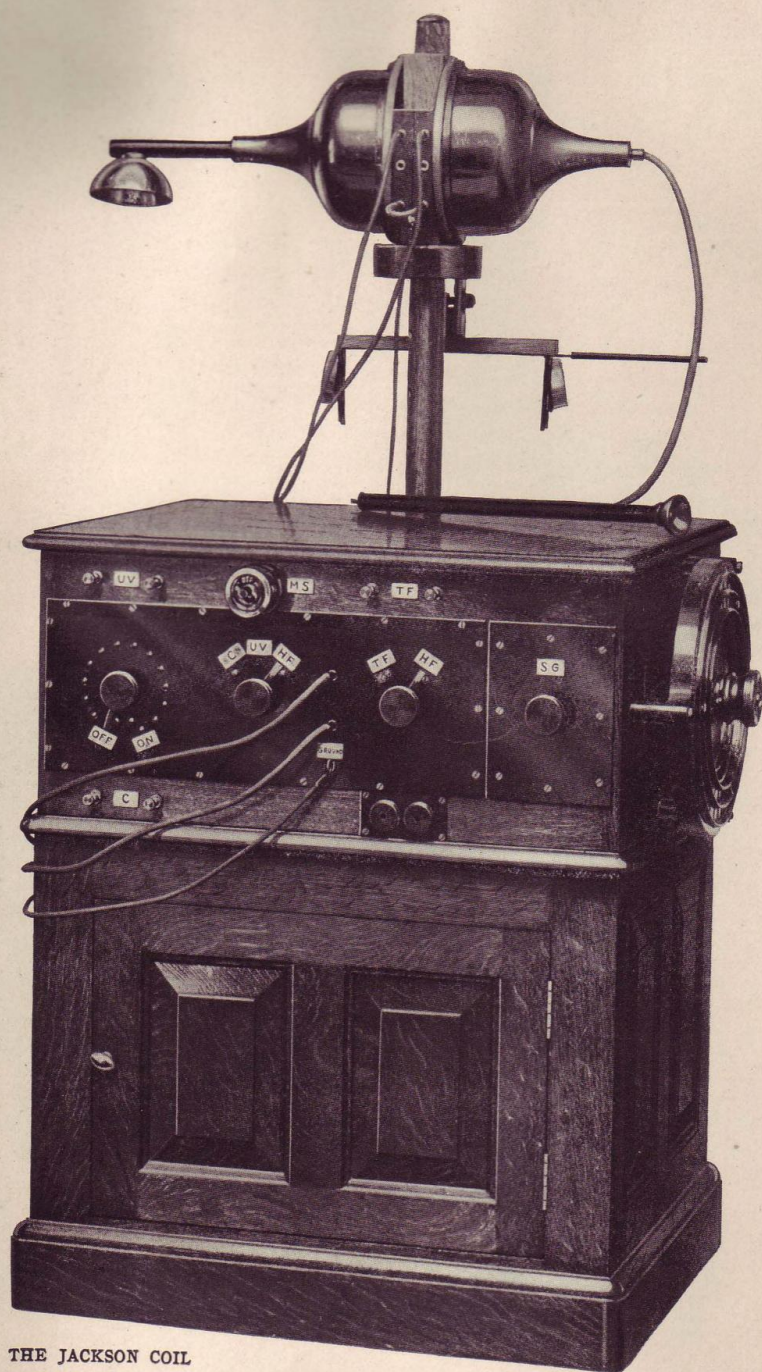


SWETT & LEWIS CO.,
BOSTON

THE KINRAIDE HIGH FREQUENCY COIL, ALTERNATING CURRENT

SWETT & LEWIS COMPANY

[22]



THE JACKSON COIL



THE JACKSON SPECIAL COIL

14

The Jackson Special Coil



THIS cabinet was designed especially for those who wish to make an elaborate display in their office with a minimum of floor space. The wood work is of beautifully quartered oak, finely finished. The cabinet is about six and one-half feet high and well proportioned. The door or doors forming the front of the top section of the cabinet are of heavy bevelled plate glass.

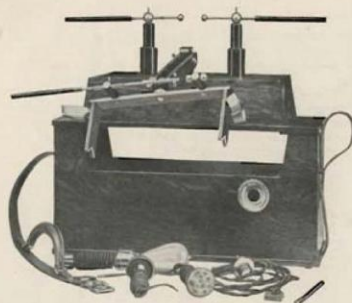
As shown in the cut, the electrodes are mounted on a fine piece of velvet and make a very rich and handsome display. This arrangement makes them all easily accessible and protects them from injury. Brackets for two tubes are provided at the top.

The cabinet is built in two pieces as a matter of convenience in shipping and handling. In the lower section a sliding shelf is provided which will be found of great convenience. Below this is a large and deep drawer, so that an extra tube and fluoroscope may be placed therein. At the bottom of the cabinet is a door, back of which is a space sufficiently large to take a motor generator, if the coil is to be run on direct current, or which may be used for storage if the alternating current is used.

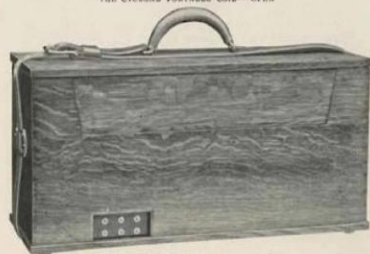
As shown in the cut, the spark gap, rheostat, and starting switch are located on the side of the cabinet out of the way but easy of access. The same design of portable secondaries is used as in the regular Jackson Coil, for only by this method can the entire output of the coil be delivered to the patient without leakage. It is a well-known fact that currents of extremely high frequency, as generated by this Coil, cannot be carried for any distance without great loss. The treatment by these portable secondaries is an important feature embodied in no other coil and fully covered by our patents.

All currents, High Frequency, Sinusoidal, X-Ray, Thermo-Faradic, and D'Arsonval, which are obtainable from the regular Jackson Coil, may be procured from the Jackson Special Coil. The ultra violet and cautery attachments cannot be included.

15



THE CYCLONE PORTABLE COIL—OPEN



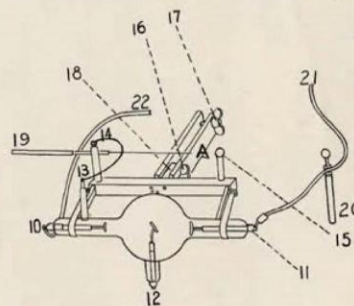
THE CYCLONE PORTABLE COIL—CLOSED

THE CYCLONE COIL

5

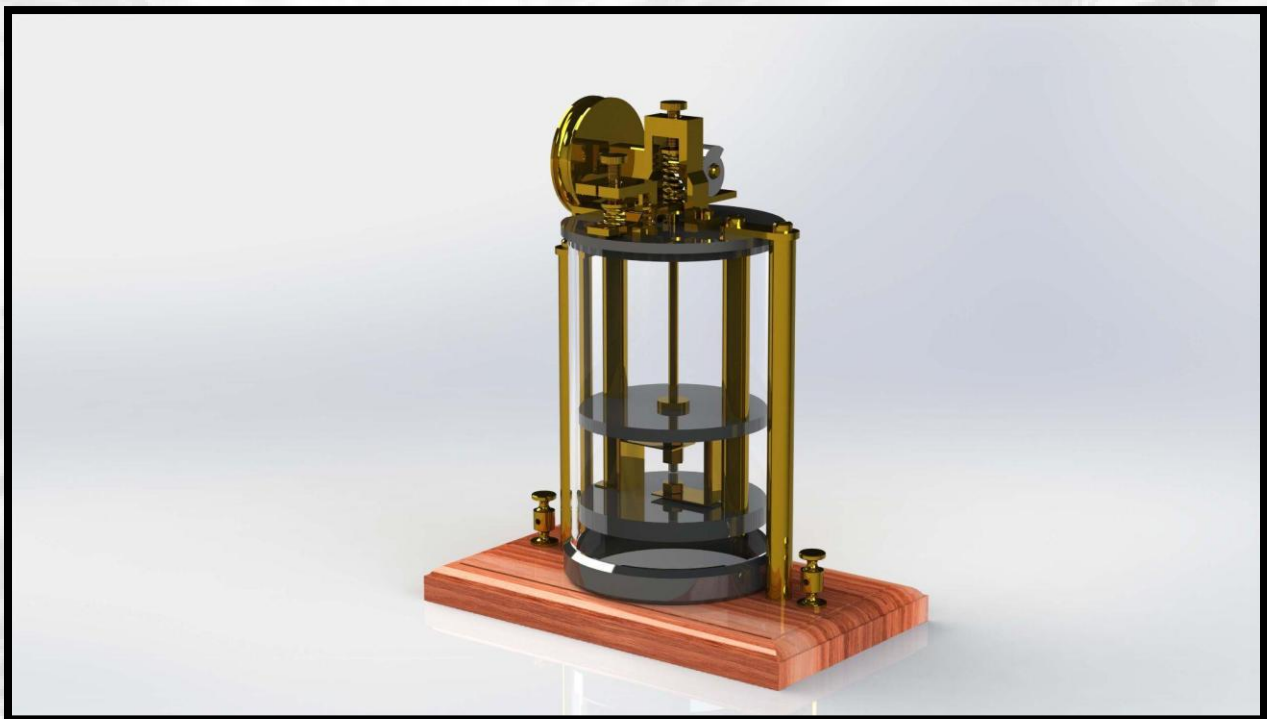
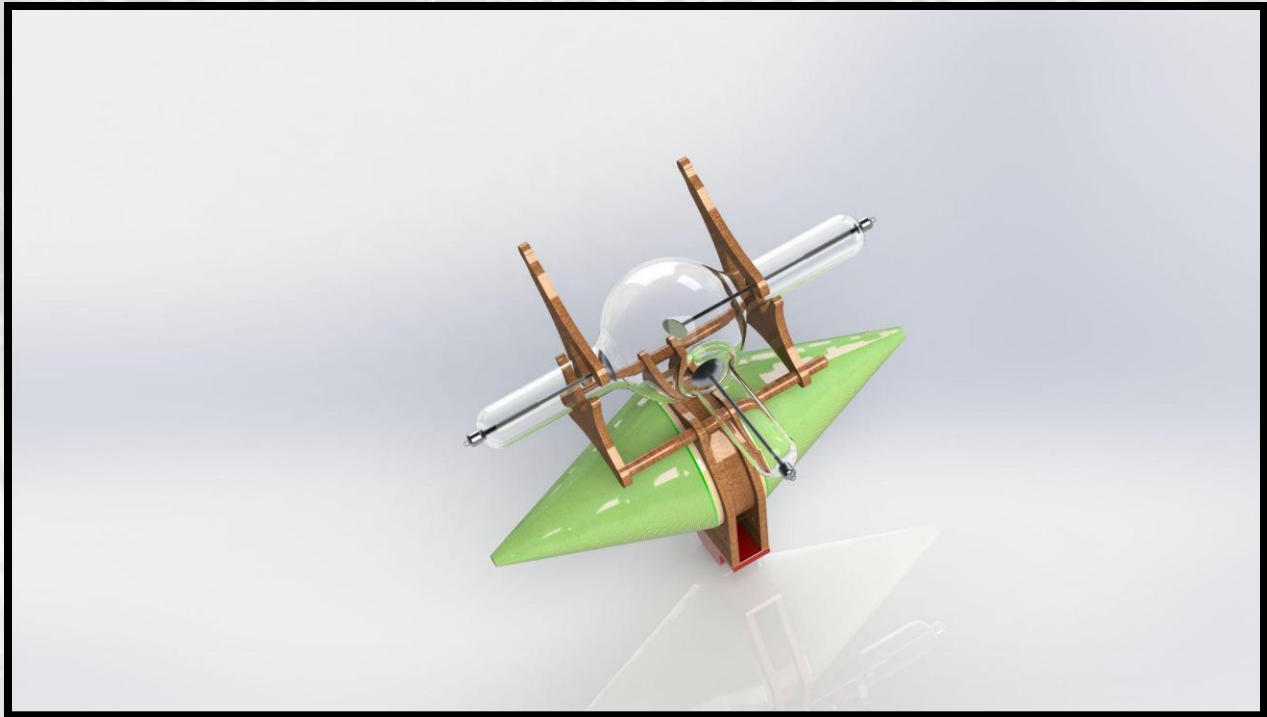
obtained from the tube. In working either an X-Ray tube or vacuum electrode, the switch pins must always be in hole marked High Frequency.

Should the vacuum in the tube be too high, bring handle No. 20 up to ball No. 13, and allow it to remain in contact as long as sparks pass across at A. When they cease, the tube will be found low enough. Shortening the distance at A in connection with



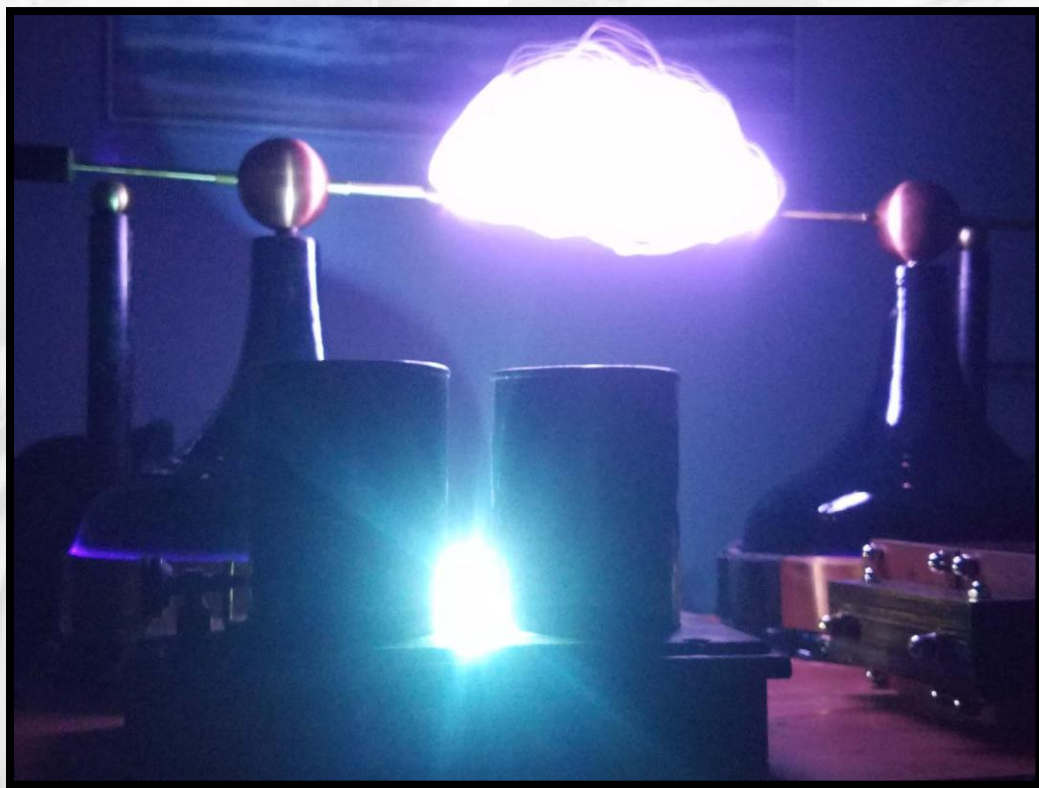
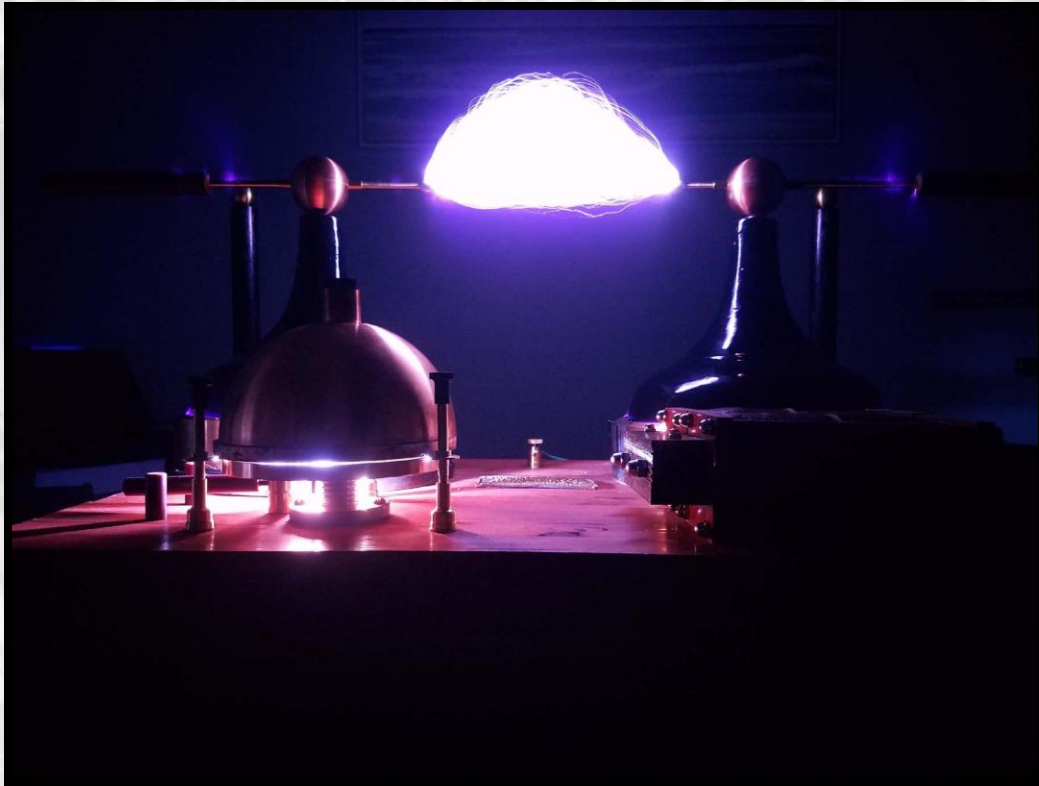
handle No. 20 will lower the vacuum, lengthening it will raise the vacuum.

To obtain a maximum X-Ray effect, the spark gap should be opened gradually until just before it ceases to operate. If the sparking at the gap stops, turn it back until it begins again, then open once more as far as possible. Perfect control may be obtained by the spark gap and by moving the square connector to the dif-

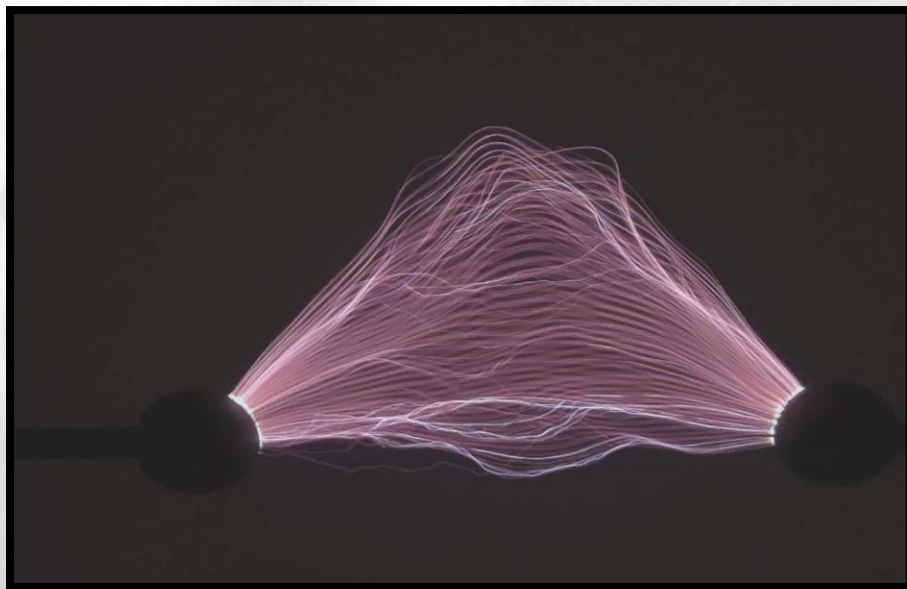


Series of CAD renderings from Burton's patents drawings for Kinraide Coil spark gaps later used in wireless telegraphy





Replica Kinraide Coils built by author



Original Kinraide Coil



Original and early prototype Kinraide Coils from Ravenscroft to make electrographs



Direct Current Kinraide Coil from Boston Grogan Auction

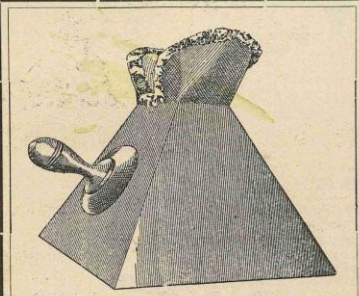


Author with Donald and Beverly Harris and Lita Tirak – X-RA*DIANCE Exhibit of Kinraide and author's work.



Rebecca and Tom Kinraide with gift of appreciation to Thomas Burton Kinraide from the Williams Club

FLUOROSCOPES AND SCREENS



of the recently discovered Fluorescent Crystals are being used by a large number of physicians, hospitals and experimenters, in place of tungstate of calcium and other salts, as they accomplish the result of showing each image undimmed by previous exposure or phosphorescence, make clear the most vague shadows which can not be traced when calcium of tungstate is used, and are absolutely instantaneous in effect.

A leading scientist says: "I find the Fluoroscopes and Screens of this Crystal an improvement over all others that I have used."

MADE ONLY BY THE

Spring Park Laboratory,

JAMAICA PLAIN, MASS.

Also, Complete X-Ray Apparatus, Scientific and Electrical Instruments.



Photograph of Kinraide family with John Grzywacz and Jeff Behary

SENSATIONAL STORY

BY MRS KINRAIDE

Admission Involves Her Husband and Mother



MRS RACHEL FORD (LEFT), MOTHER OF MRS KINRAIDE, AND
MRS ETHEL S. KINRAIDE, WHO SEEKS SEPARATE SUPPORT.

Mrs Ford Tells of Relations With Man Who Wed Daughter

By JOHN J. DONOVAN

BARNSTABLE, Dec 7—The ghost of Ravenscroft, the impressive, wireless equipped mansion of 25 rooms, high on a hill on Spring Park av, Jamaica Plain, stalked through the courtroom today and the rattling bones made public marital secrets which will surprise and shock residents of Boston and the Jamaica Plain district as well as the Barnstable Summer colony, to whom the Hermitage, the Summer home of the owner of Ravenscroft, is known.

Rarely has there been a baring of a secret similar to that which was listened to by a handful of townspeople, mostly witnesses when today, a daughter seeking separation from her husband told the court that she left her husband because of a revelation made to her by her mother of the latter's relations over a period of 28 years with the man who, 15 years ago, became her son-in-law.

Two hours later, on the same witness stand, the mother told her life story, and as her daughter had done earlier,



THOMAS B. KINRAIDE.

stepped to the bench and privately told the Court the secret.

Testimony a Surprise

It is doubtful if anyone in the courtroom other than the immediate parties

Continued on the Tenth Page.



MRS. ETHEL S. KINRAIDE.
Plaintiff in the suit being heard at
Barnstable for separate support.



MRS. RACHEL FORD.
Mother of Mrs. Ethel S. Kinraide who
is suing for separate maintenance.

MRS. KINRAIDE ASKS SEPARATE SUPPORT

Hearing of Action Begun in Barnstable Court

Special Dispatch to the Globe

BARNSTABLE, Dec 6 - A case involving two prominent persons, one whose city home is in Jamaica Plain and the other whose summer residence is a beautiful estate on Spectacle Pond, Sandwich, was given a special hearing before Judge Hopkins of the Probate Court this afternoon. The plaintiff is Mrs. Ethel S. Kinraide, who petitions the court for separate support from her husband, Thomas Burton Kinraide.

Mrs. Kinraide alleges excessive intoxication on her husband's part for a period of 10 years, from 1910 to 1920.

Mrs. Kinraide testified that she became acquainted with Mr. Kinraide when she was four years old at the home of her mother, Mrs. Rachel Ford, who ran a boarding house in Boston.

She testified that in 1899, when she was a small child, she and her mother went to live at Kinraide's home, her mother having accepted a position as housekeeper. When she was 15, she testified that Kinraide proposed marriage.

Her mother, she said, favored the marriage, and in February 1905, when she was 16 years old, she was married to Kinraide, who was then 40, in Savannah, Georgia.

Her husband was intoxicated about three days a week most of the time from 1910 to 1920, she said, with an occasional letup.

Once, a dictaphone was found in her mother's room at the Jamaica Plain house, according to a witness.

She also testified about her husband's purchases of liquor from a wholesale house, describing how she used to empty some of the liquor into the sink and refill the bottle with water, and how she found earlier this year a complete copper still in full operation in the Jamaica Plain house.

The plaintiff said her husband had never taken her to the theatre more than a dozen times, and never to public motion picture shows; that he would never allow her to attend dances, but that when Kinraide took her out to supper, his conduct was generally noisy and disturbances often followed.

Mrs. Kinraide further testified that her husband used abusive language towards her and made unfounded remarks about her character.

The plaintiff testified that she was in constant fear of being attacked by her husband. Once, she took a large hunter's knife from his pocket, she said. She felt obliged to have a hardwood stick at the head of her bed or under her pillow. Once, she said, he came into her room with a big searchlight, and another time hunted all over the house for her in Jamaica Plain, but as she had hidden it in a closet, her husband failed to find her.

Several times during the hearing, the testimony became so spicy that the plaintiff, through her attorney, William Adams, begged leave to be heard in private.

Didn't Love Husband When She Married Him

Mrs. Ethel S. Kinraide of Jamaica Plain Testifies in Separate Support Suit at Barnstable

BARNSTABLE, Dec 7 - Attorney William A. Morse, counsel for Thomas B. Kinraide of the Spring Park Laboratory, Spring Park Ave., Jamaica Plain, who is being sued for separate support, this morning cross-examined Ethel S. Kinraide.

Mrs. Kinraide, yesterday, in her direct testimony, charged her husband with gross and confirmed habits of intoxication and cruelty.

The couple is well known in Jamaica Plain society and in the Summer Colony in this district. Kinraide maintained a large and luxurious home on Spring Park Ave., Jamaica Plain, as well as a popular summer place on Spectacle Pond in Sandwich. Mrs. Kinraide is 33 years of age and her husband is past 55. They have four children, three of whom are in private schools. Mr. Kinraide is prominent in Masonic circles of Boston, while Mrs. Kinraide was prominent in women's clubs.

In the course of the examination, Mrs. Kinraide said that her husband had an income of \$20,000 from one source and \$5,000 from another.

"Didn't Love Husband"

Mrs. Kinraide is represented by attorney William Adams of Boston. Attorney Edwin U. Upton of Boston is associate counsel with Mr. Morse for Kinraide.

Mr. Morse offered a large batch of letters written by Mrs. Kinraide to her husband, and after being admitted, he proceeded to question the plaintiff regarding them.

He asked Mrs. Kinraide why she pretended to love her husband when she did not, drawing her attention to the letters, which were of a loving nature, and her own admission that she did not love her husband.

She said she did it to make things smoother and happier. Mrs. Kinraide said she did not love her husband at the time she married him, but her mother, who had long been acquainted with Mr. Kinraide, urged her to become his wife.

Her mother, Mrs. Ford, had been Kinraide's housekeeper since 1899. She admitted that her home at 38 Spring Park Avenue was well-furnished with servants. She said that she had had the money she needed, but it wasn't until five or six years ago that she had a separate bank account, the funds for which were supplied by her husband. She said that prior to a short time before she married Mr. Kinraide, she always called him "uncle," but after it was understood that he was going to marry her—that was about when she was 16—she signed her letters, "Honey Bud."

"Packs of Love; Quarts of Kisses"

She was questioned regarding the allegation that her husband was drunk about three times a week since 1910. She said that it did not mean three times every week, because some weeks he only got drunk once, and other weeks he was drunk more than three times in the seven days, but it was an average which was struck. Her letters contained references to packs of love and quarts of kisses, which she said was not intended, except that she loved him as a child would love an uncle. She said her love for him was like a niece for an uncle, or a daughter for a father.

She said she didn't think that she ever agreed to marry him, but that she knew she was going to get married when she started on a trip in 1905. Someone, she said, stated that she was going to marry Mr. Kinraide, but she didn't remember who said it

She was asked if, when she sent letters, writing in them about packs of love and quarts of kisses, she didn't believe that Mr. Kinraide took her love sincerely, and she said she supposed he did.

The winter place, in Jamaica Plain, is known as Ravencroft and the summer place as Hermitage. Mrs. Kinraide said that she had her own car and that her husband also had a car.

SENSATIONAL STORY BY MRS. KINRAIDE

Admission Involves Her Husband and Mother

Mrs. Ford Tells of Relations With Man Who Wed Daughter

By JOHN J. DONOVAN

BARNSTABLE, Dec 7 - The ghost of Ravenscroft, the impressive, wirelessly equipped 25-room mansion high on a hill on Spring Park Ave., Jamaica Plain, stalked through the courtroom today, and the rattling bones made public marital secrets which will surprise and shock residents of Boston and the Jamaica Plain district, as well as the Barnstable Summer Colony, to whom the Hermitage, the summer home of the owner of Ravenscroft, is known.

Rarely has there been a baring of a secret similar to that which was listened to by a handful of townspeople, mostly witnesses, when today, a daughter seeking separation from her husband told the court that she left her husband because of a revelation made to her by her mother of the latter's relations over a period of 28 years with the man who, 15 years ago, became her son-in-law.

Two hours later, on the same witness stand, the mother told her life story, and as her daughter had done earlier.

THOMAS B. KINRAIDE stepped to the bench and privately told the Court the secret.

Testimony a Surprise

It is doubtful if anyone in the court-room other than the immediate parties to the suit and their counsel from Boston, had any inkling of the sensational testimony that was to be spread upon the court records in an action by Summer residents in what purported to be a simple separate support case, in which the allegations were gross and confirmed habits of intoxication and cruel and abusive treatment.

It was the second day of the case, which opened yesterday before Judge Hopkins in a special session of the Barnstable County Probate Court. The plaintiff in the action is Mrs. Ethel S. Kinraide, aged 33, and the defendant, her husband, Thomas B. Kinraide, 56, scientist, inventor, and research worker. Mrs. Kinraide is widely known in the women's clubs of Boston and Jamaica Plain, while her husband has a national reputation in the X-Ray and wireless world. During the war, Mr. Kinraide was engaged in research work in the wireless field for the United States Government. His work was done at their winter home, Ravenscroft, which is equipped with the most modern laboratories, operating rooms, and equipment, including a private wireless connection.

It was testified today that more than 10 years ago, Ravenscroft was built for Mr. Kinraide by a Mrs. Reed, who died many years ago, but who provided in her will for an income of \$20,000

yearly for Mr. Kinraide to carry on his research. It is understood that she adopted Mr. Kinraide. The income, it was testified, comes from stock of Tiffany's, New York, London, and Paris jewelers. According to Mrs. Kinraide, her husband's income is now an additional \$5,000, or \$25,000 in total.

Mrs. Kinraide, in her direct testimony yesterday, which was directed by her attorney, William Adams, told of instances where her husband was intoxicated, saying that these averaged three times a week. She also told of being struck with a magazine by her husband and added that he threw water at her.

Asks Woman About Letters

Suddenly, Attorney William A. Morse of Boston, trial counsel for Mr. Kinraide, dropped the bombshell and startled nearly every person in the court.

Mr. Morse, in a calm and deliberate manner, had been reading extracts from letters written by Mrs. Kinraide to her husband, letters in which she expressed great love and affection; letters in which she had sent "packs of love" and "quarts of kisses" and which, on the witness stand, she said were merely the kind that a niece would send to her uncle or a daughter to her father. An alleged illegal operation in which the name of Dr. Jane Bishop had been mentioned was denied by Mrs. Kinraide, when suddenly Mr. Morse said: "As of March 11 or 12, 1920—at that time did your mother tell you what her relations had been with your husband?" Mrs. Kinraide answered "No," only to have Mr. Morse ask another question on the same line: "Do you remember the occasion when your husband and mother were present that your husband asked you if your mother had told you of her relations?" Mr. Morse asked. "It was not until July 1920," responded the witness. Mrs. Kinraide denied that her husband had asked her the question on March 12 and said that day statements had been made against her mother's and father's previous history, but that nothing said about her mother had influenced her. The father of Mrs. Kinraide, according to her mother, Mrs. Rachel Ford, died many years ago.

Tells Story to Court

Pale and with a drawn face, but in a clear and trembling voice, Mrs. Kinraide said that the statement was made on July 21 and that her husband, her mother, and her husband's sister, Mrs. Carpenter, were present. She hesitated for an instant and, looking at Judge Hopkins, said in a slightly lower voice with a faint hint of tremor, "I would like to make that statement privately." Mr. Morse replied that he had no objection and, accompanied by his associate counsel, Edwin U. Upton, he stepped to the bench, where they were joined by Mrs. Kinraide, Atty Adams, and the court stenographer. The courtroom was still as still as a tomb while Mrs. Kinraide, in a voice that could not be heard beyond the bench, said what she had to say. The spectators with one accord looked toward the bench in the center of the courtroom where Mrs. Ford was seated.

The face of the plump, gray-haired woman did not betray the slightest emotion, but she had dropped the knitting that had been receiving her attention previously during the hearing.

Concluding her repetition of the statement, Mrs. Kinraide stepped down from the bench and resumed her seat.

The witness stood. "Did you believe it?" asked Mr. Morse. "I did," said the witness. She then said that she went to Boston that day with her mother, but denied that her mother told her to go and get a divorce or that divorce was even discussed.

Pressed regarding any previous knowledge, she said that many circumstances had influenced her.

Attached Husband's Property

Mrs. Kinraide said that after leaving the house, she consulted attorney Adams regarding having all her husband's property attached. In order that her husband might not know of it, she returned to the house but lived in a separate apartment until August 6, when her husband came home and told her that he had been attached. She left the house the next day. Mrs. Kinraide told Mr. Morse that her reason for returning was "to deceive him regarding the proceedings she intended to take." She denied that there was any talk of him having his property put in her name. She was asked regarding a trip to Philadelphia, where she talked with a Mr. Tuttle, a cousin of Kinraide, regarding the alleged drunkenness of her husband and a "wild look" in his eyes. She denied that she said she would not return to her husband unless he turned his property over to her.

She admitted that her mother, in her presence, had declared that Mr. Kinraide "was a figurehead." Asked why, she replied, "That was the role he played." She said that three times her husband had thrown water in her face and once he struck her with a magazine during the 15 years they had been married. She admitted that on the night of August 5, she had a hammer and a club near her bed and, for two or three years prior, kept a bed slat nearby. She said she kept it as a means of self-defense but never had to use it. After leaving home on July 21, she said her husband followed her down the road and, after asking her if she "hadn't made enough fools," said he wanted to put them on the right path. She denied any conversation urging her to return home. Asked if he had offered to leave himself if it would make things happier, Mrs. Kinraide said that was after the "Hell-cat scene" on December 27, 1917, at Ravenscroft. On that occasion, she said there was a party in the house; that her husband was intoxicated and that she went and hid in a closet. She said he searched for her, saying he was looking for that "Hell-Cat." Asked to explain, she said he told the guests that he meant his wife, according to a witness.

Took Pride in Scientific Work

A witness said her husband took great pride in the scientific workshop that was set up in the house. She said she knew that Mrs. Reed had built the house for him and that he had inherited money from her for the express purpose of devoting his time to scientific pursuits. She admitted that there was a washing machine in the laboratory and said that he did not object to her

sleeping in his library. She was asked about an accident that happened to her when she was 12 years old. Mr. Kinraide experimented on her with an X-Ray machine and, through her clothes, she was severely burned. She was asked if he wasn't greatly worried because he feared serious injury and possible future consequences. "Did he want to make all possible reparations in his power, and for that reason offered to give his fortune, or was he willing to marry you and provide for you?" said Mr. Morse. Mrs. Kinraide said she knew such a conversation had taken place, but did not hear it. Her mother had told her about it recently, she said. She denied that when she married Mr. Kinraide at 17, she took the X-Ray into consideration. She admitted that during a 10-day illness of her husband last February, she did not enter his room, saying that he had not spoken to her for some time. Then followed the questions that caused the sensation at the hearing, after which she was excused. "Mrs. Rachael Ford," called attorney Adams. The gray-haired mother of the previous witness then took the stand. She said that she met Mr. Kinraide in Philadelphia in 1892. Her husband was living at the time but died in Denver a few months later. She said she next saw Mr. Kinraide at the funeral. In July, she went to Bass Rocks at his invitation. She and her little girl stayed there for three weeks. She said he called on her afternoons, evenings, and mornings. From Bass Rocks, she said that Mr. Kinraide was going to visit his home in Moncton, NB, and invited her to go along. A witness said she took her child to New York, returned, and went to Moncton for three weeks.

Tells of Kinraide's Visits

Later, she went to New York for the child and then spent a few weeks in the Catskills, after which she said Mr. Kinraide invited her to come to Boston, which she did in September. For six weeks, she and her child roomed on Tremont Street, and then she hired a rooming house on Columbus Avenue on November 16, 1892, and ran it for seven years "What was the relationship?" asked attorney Adams. "He was a very devoted lover," she said. Kinraide was accustomed to visiting the house each day, she added. In 1899, he showed signs of breaking down and needed help with his work, and "the only thing to cure his head was for me to go to his house," said Mrs. Ford. One day she heard he was building a house and she was surprised, because when she came to Boston he had told her he wasn't wealthy. It was in 1899, after being urged day after day, that she went to the Jamaica Plain house, taking her child with her. She said she never left there until July of that year. For two years, she said, her sister acted as housekeeper. Later, the witness said, she took charge and hired, fired, and paid the bills, with Mr. Kinraide signing the checks. The witness remarked several times that she always sat at the head of the table. She also opened and read his mail, and in many cases answered it. She said that in the early days, about three or four times a year, things would get unpleasant and she would depart, only to return quickly.

She told of ordering cases of whisky, as there was always a supply in the house.

On March 12, she said, Mr. Kinraide called us in the operating room and said that he had picked me up in the streets and tried to reform me. Other things were said. She said that later he went to her daughter and said, "Ethel, so help me God, everything I said was a lie." She said, "Go in and tell my mother," and he did.

Friends From 1892 to 1920

She then told of an incident when, she said, while he was under the influence of liquor, it was necessary to threaten him with the police to get him to bed. His nephew put him to bed, a witness said. She said that she had a row with Mrs. Carpenter, Mr. Kinraide's sister, on July 21, and that she finally said, "Daughter, do you want Mother to end her relationship with Burton Kinraide? I will. I did."

She then asked permission to tell her story in private, and her request was granted.

"Our friendship started in '92 and ended in January 1920," said Mrs. Ford. Court then adjourned until tomorrow morning.

Mrs. Kinraide, at the morning session, had said that she did not love Kinraide at the time she married him and that it was after marriage that she cared for him. She said that she had written him loving letters before and after marriage, but that her love was merely the love of a niece or a daughter. Other letters, she said, were merely to keep things smooth.

Witness said that she had never agreed to marry her husband, but that it just happened because someone said she was going to marry him. She said her mother wanted her to marry him and had urged it. Up to a year before the marriage, she called him "uncle" and signed her letters "Honey Bud."

She said she had a luxurious car and a bank account of her own. She said that many times she avoided him, and there came a time when she grew tired of his kisses. "I did not like them to excess—not too often," said the witness.

MRS. KINRAIDE FOUND DICTAGRAPH IN HOME

Traced Wires to Kinraide's Shop, Tore Them Down Mrs. Ford Says Kinraide Threw Powder at Her

BARNSTABLE, Dec 8 - The separate support action of Mrs. Ethel S. Kinraide against her husband, Thomas B. Kinraide, scientist and inventor of Spring Park Avenue, Jamaica Plain, was resumed this morning before Judge Raymond Hopkins in the Probate Court.

At the close of yesterday's hearing, Mrs. Rachel Ford, mother of Mrs. Kinraide, had not been dismissed from direct examination. She was the second witness today.

The first was Dr. Bush, family physician for about 14 years. Dr. Bush testified that he had been called to treat Kinraide and found him in a condition apparently caused by excessive drinking

Mrs. Ford then resumed the stand and told of her daughter, Mrs. Kinraide, discovering a dictagraph in the house and that last March they traced the lines to Mr. Kinraide's shop and tore them from the wall.

She also said that there was a copper kettle with a hose attached to it, from which a fluid was dripping, sometimes pale in color, sometimes cloudy. She said that in the laboratory there were also three 10-gallon tanks of molasses.

Threw Powder at Her

On direct examination, Mrs. Ford said that on one occasion, Mr. Kinraide threw a can of powder at her, the contents of

which scattered all over her clothing. When this incident happened, Mrs. Ford said, "Shame on you," to Kinraide, who in reply told her to "get out of there..." She said, "Which I did."

Asked if she had heard Kinraide call his wife any names, she repeated a number of them, some of which followed: "Hell cat," "she-devil," "bone and hank of hair," "vampire," "low," and "the sun should not shine on her, but she should go out at night."

Witness was then turned over to Atty Morse for cross-examination, who asked her if, during the 30 years that she knew Kinraide, she had heard him call his wife any other names.

Mrs. Ford answered, "Haven't I told you enough?"

Atty Morse then asked Mrs. Ford if it wasn't true that the first time she met Kinraide, she was in a place resorted by men for immoral purposes.

Judge Hopkins then ordered the time on the examination and said that he could see no reason for going back over 30 years. Mr. Morse said that he proposed to show the facts, as this was his case, and he proposed to show Mrs. Ford's relationship with Kinraide.

Mrs. Ford denied that she was in a hotel with Kinraide when she was found by her sister to notify her that her husband had committed suicide. She said that she had been to a theater that evening with Kinraide. Attorney Ford then asked her how old Kinraide was when she first met him. The witness replied that she was 35 and that Kinraide was about 27. Attorney Morse said, "Wasn't he about 22?" and she said, "No, 27."

Pressed again as to where it was she met Kinraide, Mrs. Ford said that it was at the headquarters of the Keeley Motor Company.

Kinraide Was Good to Witness

Keeley was supposed to have invented a perpetual motion motor, which amazed experts and on which investors lost thousands of dollars. The witness said she was there to watch a demonstration of the motor. During further cross-examination, she admitted that Kinraide had advanced her \$150 to help bury her husband, but never asked her to return the money. Mr. Morse then referred to the time when Kinraide, while experimenting, burned the 12-year-old girl, who later became his wife. She admitted he was regretful over the accident, and that in order that the young girl might be protected from future suffering, he offered to marry her.

Asked if the daughter did not want to marry him, why she desired it, Witness answered: "Because Mr. Kinraide wanted her."

Pressed for the real reason, Mrs. Ford replied that she thought Kinraide would be better to her daughter than anyone else on earth, as he was remarkably good to her, giving her everything she needed.

Mr. Morse then asked how reconciliations could be made and why Kinraide complained that only two 17-cent loaves of bread were on his butcher's bill when \$30 were spent on mushrooms. Ford replied she didn't know.

KINRAIDE PRINCE, MRS. FORD SAID**Mother-in-Law Continues Testimony of Relations****Dictagraph in Jamaica Plain Home Discovered by Wife****Nurse Among Witnesses in Separate Support Case****By JOHN J. DONOVAN**

BARNSTABLE, Dec 8 - Marrow-bones and mushrooms, a dictaphone, a copper contrivance that was alleged to be a still, and the fourth dimension were injected into the testimony in the Kinraide separate-support action in the Probate Court before Judge Raymond Hopkins today. Thomas B. Kinraide, Jamaica Plain inventor, scientist, and research worker, who is being sued by his wife, Ethel S., prominent in Boston and Jamaica Plain club circles, was severely arraigned in the testimony offered by witnesses for his wife.

Several witnesses were heard, but the greatest interest was manifested in the continued direct testimony as well as the cross-examination of Mrs. Ford.

Rachael Ford, 63-year-old mother of the plaintiff, who yesterday admitted the existence of a relationship with her son-in-law, that his wife alleges is the reason that she left him last July.

She apparently made not the slightest effort to dodge the issue, and though on a few occasions she matched wits and tongue with attorney William A. Morse, counsel for her son-in-law, for the most part the story was told with a frankness that was startling.

"Too much vague innuendo in this case so far," protested attorney William C. Adams, for Mrs. Kinraide. "Nothing vague in your wit," replied attorney Morse, when Mr. Adams objected to a line of cross-examination conducted by Mr. Morse of a witness from Philadelphia for the plaintiff

For the most part, the testimony concerned allegations of drunkenness and cruel acts of throwing three glasses of water and striking Mrs. Kinraide with a magazine, and the continuation of the life story of Mrs. Ford.

Bread and Mushrooms

The commissar of the Kinraide household came into the case early when a witness said that the respondent raised a question about two loaves of bread at 17 cents each, yet during the week the sum of \$30 had been spent on mushrooms. On another occasion, he was alleged to have placed a kettle of marrowbones on the dining-room table and was abusive when other members of the family would not partake of the delicacy.

Testimony was given to the effect that Kinraide would become enraged and scowl and glare when members of his household failed to appreciate and understand a learned exposition on the "Fourth Dimension," a subject upon which Mr. Kinraide was rated as an authority. It was declared that last March, Mrs. Kinraide discovered some sawdust behind a radiator, and investigation showed that a dictaphone had been installed. Following an alleged stormy scene in Ravenscroft, Mrs. Kinraide traced the wires to her husband's laboratory and ripped out the contrivance, it was stated.

The laboratory was mentioned in testimony today when Mrs. Kinraide's mother was asked about a "still." She said she saw a copper kettle steaming on a gas stove and liquid dropping into a glass container. Some of the liquid was cloudy at times and clear at other times. She was not permitted to give an opinion on the mixture but said there were three 10-gallon tanks of molasses in the laboratory.

Dr. Bush, the Kinraide family physician, was the first witness called today. His testimony was short. He admitted he had been called to the house to treat the respondent and found him suffering from overindulgence. On cross-examination, the physician said that he had always found Mr. Kinraide to be a courteous gentleman and kind to his family. "He was extremely fond of his wife," said Dr. Bush. Regarding the use of liquor, he said that he thought Mr. Kinraide "took too much."

Mrs. Rachel Ford was then called and took a chair on the witness stand. She had a vinaigrette in her hand and from time to time, during the recital of the story of her life after meeting Mr. Kinraide, she inhaled the smelling salts. In the course of her statement regarding abusive language, she told about the defendant gesticulating and grinding his teeth. Halted by Mr. Morse, she inquired if that was not abusive language. The attorney waived the question. She told the court that the respondent had thrown a china powder box at her; that it dented the casement of the door and the powder was scattered all over her. Regarding the water-throwing incident, she said it occurred after Mrs. Kinraide complained about her husband following her when she left the house. According to the witness, he said he did it to protect the honor of his house, and when Mrs. Kinraide told him not to do it again, it is alleged the water was thrown.

Various Names Alleged

Various names such as "Hell-Cat," "She-Devil," "Bone and a hank of hair," and "Vampire" were, according to the witness, a few used by the husband to refer to his wife. Then came a scorching cross-examination by attorney Morse, with whom Eugene Upton is associated

The witness denied that it was in a house of bad character that Mr. Kinraide first met her and then took her from. She denied that her sister found her in a Philadelphia hotel with Mr. Kinraide when the sister was searching to notify her that her husband, Robert H. Ford, had committed suicide in Denver. She said that she was at a theater. She said she was 35 years old when she met Mr. Ford in 1892 and that he was 27.

Mrs. Ford said that she met Kinraide for the first time at the Keeley Motor headquarters in Philadelphia. Keeley was the famous perpetual motion motor wizard who swindled hundreds of thousands of investors out of their money by a clever contrivance that made a motor appear to run on its own accord. He was almost 30 years ahead of the modern 50 percent wizard, Charles Ponzi. The witness said she was there to witness a demonstration for scientists

She admitted that while she lived in the Columbus-av house she had an operation performed, and named Dr. Jane Bishop, but maintained that all arrangements had been made by Mr. Kinraide.

The incident of the experiment in the early days of X-Ray that resulted in her daughter being badly burned was then brought up. She said, "He offered to marry Ethel," and the witness said that, "I didn't care, because he wanted her." "But why, if she didn't love him, even though he wanted her, did you advise her to marry him?" "I thought that he would be better to her than anyone else on earth. He was to me." Asked if she had said that Mr. Kinraide was a "prince," the witness admitted it and said she still thought so. She said he was a walking philanthropist for the people of the town of Sandwich. She was then pressed hard by her interrogator about her relations with the respondent up until last January, a month after her daughter had locked her door on her husband, "I hate to say these things about Mr. Kinraide," parried the witness. Mr. Morse persisted, persisted, and witness said that Mr. Kinraide followed her to the woodshed, the workshop, the small room and other places. Asked how she knew that Mrs. Kinraide had ceased marital relations with her husband, witness said Mr. Kinraide told her.

Didn't Think She Could Be Spared

She was asked by counsel why she did not leave the Kinraide house, and the witness answered, "I did not think I could be spared." She said it was table talk that Mrs. Kinraide was not a wife. On redirect examination attorney Adams introduced several letters and a postcard written many years ago to Mrs. Ford by the respondent. Several were written from Savannah. In them, he called her "Dear Sweetheart" and twice referred to a blank check that he had left with her, instructing her to fill it in and cash it immediately if anything happened to him. In one letter, he said to fill it in for \$5,000 instead of \$3,000, as he had previously directed. He said that he was lonesome without her and sent her lots of kisses and love. An accident policy dated 1904 for \$6,000, endorsed by Mr. Kinraide and made payable to Mrs. Ford, was offered in evidence. The witness was then excused. William Tuttle of Philadelphia, a cousin of Mr. Kinraide, was the next witness. He and his wife had been summoned by Mr. Kinraide, but in order to permit them to return home without unnecessary delay, Mr. Adams allowed them to testify today. Mr. Tuttle said that Mrs. Kinraide telephoned him in Philadelphia after her separation last summer from her husband. He met her and she told him that Mr. Kinraide was acting brutal and was "practically insane." He said that he went to Atlantic City, where Mr. Kinraide was, expecting to see a wild man, but found Mr. Kinraide otherwise. There was nothing to indicate drinking or insanity.

Failed to Effect Reconciliation

He said that Mrs. Kinraide talked to him about the Tiffany stock held by her husband and he told her to forget about the financial part and think about a reconciliation. She said that was not all of it.

For, as far as reconciliation was concerned, all she had to do was unlock her door. She said that she was trying to effect a settlement and that if there was a reconciliation, it would spoil the settlement.

The witness said that he tried to get Mrs. Kinraide to have lunch with himself and Mr. Kinraide the next day, to effect a reconciliation, but she told him that she had heard the other side: that blood was thicker than water; that "Burton" (Mr. Kinraide) had twisted him around his finger as he did every - attend the one, and she refused to have lunch and returned to Boston.

On cross-examination, the witness said that he had been at Ravenscroft in Jamaica Plain three times in 10 years and was never in the hermitage, the summer home in Sandwich, until after the trouble this summer. His visits to Jamaica Plain were only a matter of "calls."

Up until the time of the trouble, he said, his wife had never been at the Jamaica Plain home, only once in Sandwich, and that for a period of 10 days.

He admitted that he had said that unless there was a reconciliation, "the situation for her would be intolerable." He also admitted saying, "Well, Ethel, of course you are a handsome woman. You still have your life before you."

Wanted House and Half of Stock

Mrs. Tuttle's testimony was short. She said that Mrs. Kinraide told her that her "husband had turned against her"; that she ought to have one of the two houses and half of the Tiffany stock. Witness said that Mrs. Kinraide said there had been no marital relations for some time; that her door was locked and that she would maintain the stand until a settlement was effected. There was no cross-examination. Mrs. Edna Y. Brown, a witness for Mrs. Kinraide, admitted that she did not like Mr. Kinraide and explained why. Little appeared to be gained by the rigid cross-examination.

She said that she was a school teacher, married two years ago. She said that she was at the Hermitage every summer from 1906 to 1916 or 1917. In 1918 she went to Jamaica Plain and was a member of the family from October 1917 to January 1919, when she married. She said she saw the respondent drunk many times and that there were always cases of whisky and beer at both places.

She introduced the marrowbone story into the testimony. The witness said that Mr. Kinraide came into the dining room laughing and staggering and, after placing a kettle on the table, he insisted that everyone eat marrowbone and was angry when some people refused to eat. She also mentioned the discourses on the fourth dimension.

Says Kinraide Snubbed Her

On December 27, the witness said, she went into the Jamaica Plain house and there were Christmas trees all over the place for decoration. She was accompanied by a friend. The witness stated that Mr. Kinraide ignored them. Suddenly a loud gong started ringing and it continued until her friend decided to go.

Witness said she saw Mr. Kinraide hiding among the greenery; that there was something shining in his hand and that there was a glare and terrifying look in his eyes. She said she went to the third floor, where she found Mrs. Kinraide trembling, and she brought her into the room. Mrs. Brown said she could hear him going through the house saying he was looking for "that hell-cat." He fell, and she saw him carried upstairs, and his face was cut. The next day, witness said, a nurse was called and took charge of him.

Cross-examined, she said that she was a second cousin of Mrs. Kinraide. She admitted receiving sums of money from Mrs. Kinraide. She said there was an understanding that she would do her share of the work for her board. Witness said she worked harder than she ever did at home and presumed the money was gifts in consideration of the same.

She admitted that she did not like the respondent very well; that he had never invited her to the house; that he was never pleasant to her; had snubbed her and walked by her. "I don't like a drunken man, and I love Mrs. Kinraide," said Mrs. Brown. She was excused.

Nurse and Witness

Jessie H. McDonald of 150 Huntington Avenue, a trained nurse, now in the drug business, was on the stand when court adjourned. She said that she had lived at Ravenscroft both professionally and as a member of the family. The respondent, according to the witness, was drunk two-thirds of the time the witness was at the house. She said that she took care of him on many occasions and that she had called Dr. Bush to attend to Mr. Kinraide. She was questioned regarding tablets prescribed for emergencies, and there was a secret consultation at the bench.

Court then adjourned to Friday morning.

WITNESSES TELL ABOUT KINRAIDE

Mother-in-Law Completes Testimony - Scenes of Violence in Jamaica Plain House

BARNSTABLE, Dec. 8 - Nothing was left to the imagination of the crowd that packed the courtroom of the Barnstable county probate court today to hear the sensational testimony in the case before Judge Hopkins in which Mrs. Ethel S. Kinraide is seeking separate support from her husband, Thomas B. Kinraide, a nationally known X-Ray and wireless expert, of Jamaica Plain.

MRS. FORD CONTINUES

Mrs. Kinraide is suing for separate support on the grounds of gross and confirmed habits of intoxication and cruel and abusive treatment. But the court proceedings have brought out

Some of the most startling and sensational testimony that has ever been heard in these parts in years. Following testimony yesterday dealing with the alleged relations between Kinraide and his mother-in-law, Mrs. Rachel Ford, Mrs. Ford was placed on the stand today to tell further of her relations with Kinraide.

Mrs. Ford admitted on the stand that her relations with Kinraide had been carried on for a period of 14 years before Kinraide married her daughter. Furthermore, she testified that the relations had continued since Kinraide had become her son-in-law.

Operation in 1892

During the morning session, she denied that she had consulted a physician regarding her condition; but during the afternoon, when she was recalled to the witness stand, she admitted that in 1893 she had an operation performed.

"I told him of my condition," testified Mrs. Ford. "Of course, marriage was not possible."

All through the testimony, the gray-haired woman seemed unmoved, and her answers were given clearly and without the batting of an eyelid.

Questioned as to Kinraide's habits, Mrs. Ford testified that Dr. Charles Bush, the family physician, was often called in to fix Kinraide up after spells of drunkenness and testified that he had called the Kinraide house both at Sandwich and at Jamaica Plain. It was brought out that he had come to the Kinraide home in the role of the Dove Peace in the hope that something might be done to reconcile the pair. But according to the testimony, the olive branch was apparently lost somewhere along the Cape.

He testified that Kinraide was drunk nearly all the time when he was at the house, and stated that he was abusive to Mrs. Kinraide and called her vile names.

Mr. Tuttle admitted that he had told Mrs. Kinraide that she was still young and handsome, and if her husband would make a settlement, she would be able to make a fresh start.

Tales of "Hell Cat Scenes"

Mrs. Tuttle, wife of Charles Tuttle, was then called. She stated that Mrs. Kinraide had called her home in Philadelphia and told her about Kinraide's relationship with Mrs. Ford, his mother-in-law. She also testified that Mrs. Kinraide had told her about all her troubles and about Kinraide's alleged continuous drunkenness. Tales of the "hell cat scene" at the Jamaica Plain home of the Kinraide family; of wild scenes when Kinraide was supposed to be drunk; of Kinraide's attempt to go to bed on the front lawn in the middle of winter, clad only in a thin nightshirt, and the wintry blasts, were told by ours, Edna Y. Brown, of 749 Pitman Street, Philadelphia

Mrs. Brown stated that she had previously been a school teacher and had stayed at the Kinraide summer home in Sandwich every summer from 1915 to 1918. She also stated that from October 1, 1919, to July 1920, she had been at the Kinraide home.

Love Letters to Mrs. Ford

She stated that she often feared for the safety of her daughter—Kinraide's wife—during these spells, and was told of how he would raise his hands toward Mrs. Kinraide when drunk. At times during these spells of alleged drunkenness, she testified that Kinraide would deny his wife the paternity of the children

Then came a series of endearing love letters, alleged to have been sent to Mrs. Ford by Kinraide. Love and endearment were expressed in the notes, and affection for Mrs. Ford was contained therein. On top of the letters came Mrs. Ford's testimony to the effect that Kinraide had at times worked himself into a rage and had ordered her (Mrs. Ford) to get out of the house.

Heard Abuse of Wife

Charles Tuttle of Philadelphia

Called Wife "She Devil"

At those times, Mrs. Brown testified, Kinraide would not eat, worked himself into a peculiar state, and raced through the house calling his wife a she-devil, a polecat, and other vile names

The "Hell Cat Scene," Mrs. Brown said, was staged on the night of December 27, 1917. She stated that when she arrived at the house at 9 o'clock, she found Kinraide standing in the hall in a sort of dazed condition. His eyes were glassy, she said, and he seemed to be staring right into space. A witness then stated that she went upstairs and found Mrs. Kinraide badly scared and

hiding on the fourth floor. About that time, a witness stated, Kinraide began to ring the gong in the dining room violently.

Roosting in a Tree

She said that she went downstairs and found Kinraide outdoors roosting in the branches of a tree. She stated that he was holding something shiny in his hand. A short time later, he came in and went to the telephone, Mrs. Brown testified, and shouted to someone that "Ethel is rotten ash-." Following the telephone call, Mrs. Brown stated that Kinraide ran through the house shouting "Where is the hell-cat?" He then rushed out of the house, the witness stated, and a short time later was brought in by some men. When he returned, Mrs. Brown stated that he had been cut between the eyes as though he had been hit.

Paid by Mrs. Kinraide

In the cross-examination, Mrs. Brown asked if she had committed her money to memory and if Mrs. Kinraide had paid her from \$5 to \$150 at different times. Witness at first could not remember whether or not Mrs. Kinraide had given her money, but a canceled check served to refresh her memory, and she testified that she had possibly received sums of such size at times. She said that she had stayed at the Kinraide's home and had received her board for the assistance she rendered. Any sums she received from Mrs. Kinraide must have been in the form of presents. Mrs. Brown admitted that she did not like Mr. Kinraide.

KINRAIDE SAYS HE MARRIED WIFE BECAUSE OF X-RAY BURNS

Jamaica Plain Man Testifies in Separation Suit That He Told Her Mother He Felt It His Duty

BARNSTABLE, Dec 11 - Referring to the time, in his X-Ray experiments, he had burned Miss Ethel Ford, who later became his wife, Thomas Kinraide of Jamaica Plain, in direct examination in defense against the separate support proceedings brought by her, today said that he told her mother regarding the proposal to marry the girl, the following:

"In short, as I have burned Ethel badly and as a result it is liable to develop very seriously in a number of years, two cases having caused death and in another the skin was stripped to the bone and great suffering caused. I feel that it is my duty to devote my money and life to care for her and the only way I can do it unhampered would be to marry her."

The putting on of Mr. Kinraide before court adjourned today came as a surprise, as it was believed that the character witnesses, residents of Sandwich, would take up the best part of the day. Their examination, however, was short. With few exceptions, they testified that they had never seen Mr. Kinraide under the influence of liquor. Some of them testified that they had drunk with him, but had never seen him under the influence of liquor, that is, intoxicated.

Tells of His Inventions

Kinraide, under direct examination, said his regular residence was Sandwich and that he is 56 years old. He said his occupation is scientific research, that it has always been his life's work. He said the scientific work he did was mostly laboratory research and the study of vibrations. He said he had developed the system for measuring audible sounds probably beyond anything ever produced by anyone else. He said he had done much work in X-Ray and had made notable inventions and improvements on the spark gap, and that telefunken, the best form of spark gap, was an invention that he had sold several years ago. He said he had several patents, some of which are used now in X-Ray. In the early days of X-Ray, he said, there was great trouble from coils breaking down. In 1893, Ravenscroft was built in Jamaica Plain and it was built especially for scientific research. He said it was fitted with a machine shop, apparatus for a complete laboratory, and equipment and darkroom for photographic work, and furnaces for use in chemistry.

Where He Met Mrs. Ford

Then he was asked when he first met Mrs. Ford. He replied that it was in 1892, at a house on North 22nd Street, Philadelphia, sometime in February. He said he was 26 years old and that he went down there with some other men, but that he was the only one who went in. He said women were sitting around and that Mrs. Ford was one of them. Asked if he had talked with her, he testified he didn't think it was a place a woman like her should be in.

The next time he met her, he said, was May 22, when he went with her to the Colonnade Hotel, Philadelphia, where they registered as R. S. Ford and wife.

While there, he said, Mrs. Ford's sister came in with a telegram announcing that Mrs. Ford's husband had committed suicide in Denver. The telegram had asked what would be done about the body. He said he offered to help and advanced the money for Ford's burial.

Got Lodging House

He lived in the same place until Fall, he said. Mrs. Ford wanted to get a boarding house in Boston. She had received \$10,000 from her husband's estate. She came to Boston and took a room at a house on Tremont Street, near Worcester Street. After a few weeks, she found a house at 550 Columbus Avenue and in the spring of 1893 got the place for a lodging house, he said.

Kinraide said he called upon her while there and also assisted her financially. He said his Jamaica Plain house was built in 1893-94. It was in 1899 that Mrs. Ford came to the house. In 1897, Mrs. Ford's sister was housekeeper for a considerable period, he said.

When Mrs. Ford left the Columbus Avenue house, a witness said, Mrs. Parmenter took up the Columbus Avenue house, and Mrs. Ford came to Kinraide's Jamaica Plain house.

He denied he knew Dr. James Bishop and that he had made any arrangements with him for an operation on Mrs. Ford or that he had paid the bill.

Mr. Kinraide said that it was in 1899, when he was taking X-Ray photos and testing apparatus which he was developing in hope of securing a machine capable of more penetrating qualities, that he had used his nephew, Mr. Davidson, Mr. Kendall, or anyone he could get.

In fact, he used anybody he could who would volunteer to be experimented on. He said the apparatus developed power and, after repeated exposure, caused a bad burn on Mrs. Ford, who in 1905 became his wife. He said he knew he had burned her severely, but that it was not until later that experimenters learned of the great danger of X-Ray, especially considering the reckless way in which it had been used in the early days. He said he was advised, at the time he burned Miss Ford, by Dr. Dodd, X-Ray expert at the Massachusetts General Hospital, that the burn sustained by her might be serious. He was then asked if at that time there was any conversation regarding his marrying the girl. He replied, as has been quoted early in the story. He said that after offering to marry the girl, he told Miss Ford and her mother that they could see him in court and would probably recover a large sum of money, but that he was willing to give them whatever money he had and he would leave or he would marry Ethel.

Kinraide then said: "Mrs. Ford told me she was perfectly willing I should marry Ethel if Ethel would have me."

He said that was six or eight months before he married her.

Nurse Concludes Testimony

The last witness today for the plaintiff was Mrs. Jesse H. McDonald of Boston, registered nurse in the Kinraide family. Direct testimony by Mrs. McDonald was not completed on Wednesday and was continued this morning.

William C. Adams, counsel for Mrs. Kinraide, questioned Mrs. McDonald about her being called to Ravenscroft, the Jamaica Plain home of the Kinraides, the morning after the famous "Hell-cat" scene. She said she was called professionally and found him suffering from the after-effects of intoxication. She said that often when Mr. and Mrs. Kinraide returned from a Ladies' Night at the Williams Club, Mr. Kinraide was angry and that he slammed doors and would not speak to anyone.

Said Wife Did Not Love Him

That Kinraide spoke to anyone about the possibility that his wife might care for someone else was introduced into the case for the first time today. Mrs. McDonald said that on numerous occasions Mr. Kinraide had told her that he loved his wife, but that she did not love him, "and there must be someone else." Continuing, Mrs. McDonald said that the respondent told her that his wife "was a beautiful woman and all that any man could desire, but she does not love me." The witness said she remonstrated with him and said that he was doing everything in direct opposition to her, and Kinraide replied that she (Mrs McDonald) was taking his wife's part. That Mr. Kinraide became indignant when Mrs. Kinraide and the witness objected to the children eating delicatessen food brought in by Mr. Kinraide was testified to by Mrs. McDonald. She also said that on several occasions when baby Robert, 2 years old, happened to speak at the dinner table when a letter was being read, the respondent got angry and said he was going to throw Robert out of the door. She said that Mrs. Kinraide was nervous and excited many times.

At that point the counsel and witness gathered at the bench and private testimony was given by the witness to Judge Hopkins. The direct examination was concluded at 11 o'clock

Under cross-examination by Mr. Morse, the witness said she went to the Kinraide home in 1908 and stayed three months. She returned in 1910 and remained for seven years, and was on a salary the entire time. She said there was much company at both houses, in Jamaica Plain and Sandwich, and that on numerous occasions there were as many as 24 people at the table. They were the friends and relatives of both Mr. and Mrs. Kinraide.

Mrs. Ford Knitted in Court

During Mrs. McDonald's testimony today, Mrs. Ford sat in court and constantly knitted. Mrs. McDonald denied that she ever stayed in the house alone with Kinraide. She also denied that she ever knew that rather than being in the house with Mrs. McDonald, Mr. Kinraide always sent for someone to stay with him. She said she left the house because of an argument over the washing of clothes. She was asked if she did not receive \$150 from Kinraide to come back.

She said she received a check for \$100 from him and stayed away for three weeks before returning. She was asked if it wasn't true that Kinraide was willing to give his family every luxury he could. She said that in some ways it appeared so, but that his actions toward Mrs. Kinraide made it appear as if he didn't mean it. The witness said that at times Kinraide and his wife had arguments and words, but that Mrs. Ford only intervened when "the safety of Mrs. Kinraide was concerned." Mrs. Ford's appearance on the scene, according to the witness, "often cleared the atmosphere." She said that on several occasions Kinraide put his hand on his wife's shoulder and pushed her, and many times stood and glared at them for 10 to 25 minutes.

KINRAIDE TELLS HIS LIFE STORY

BY ROY ATKINSON *Post Staff Correspondent*

BARNSTABLE, Dec. 11. While scores of female spectators leaned forward in the Probate Court to catch every word he uttered, Thomas B. Kinraide, scientist and X-Ray expert, laid bare his life today, going into the most intimate details, both before and during his married life, saying that he had married the woman who is now bringing action against him for separate maintenance because he wished to make amends to her in this manner for burning her while conducting an experiment with his electrical apparatus.

SENSATIONAL TESTIMONY

This has been a day of testimony of the most sensational nature, as Kinraide, whose admitted income is not far from \$25,000 yearly, described his first meeting with his mother-in-law, Mrs. Rachel S. Ford, in a Philadelphia house where he found her surrounded by young women whose morality he questioned, and the receipt of a telegram the next night while he was with her at a hotel, that contained the news that her husband had committed suicide.

It was a story that commenced when Kinraide, a 25-year-old man, wandered into the Philadelphia house where he met Mrs. Ford and asked her if she thought it was a nice place for a girl to stay. Then, Kinraide said, Mrs. Ford asked him if he was attending a funeral. He added that the woman who owned the house had told him he could take out one of the girls, whereupon he had announced that he would take the young woman who asked him if it was a funeral he was attending.

Came to Boston

Then, for hours, the story ran on. Mrs. Ford's first appearance in Boston came at the time she left Philadelphia and took up her residence in the South End of Boston on Tremont Street.

Kinraide's testimony had been preceded by that given by many witnesses from Sandwich, where his summer home is located. Among these men were several who are prominent in the business life of that little hamlet. They said that they had never seen Kinraide under the influence of liquor, although one witness testified that he had returned from Boston on one occasion in a very talkative condition.

This was the sum and substance of these character witnesses, who were brought to the front by the defense for the sole purpose of refuting the statements made by Mrs. Kinraide, Mrs. Ford, and others, that Kinraide drank to excess and was frequently in a drunken condition.

Seated among the spectators, not far from the witness stand, was Mrs. Ford, while Mrs. Kinraide was by the side of her counsel, William C. Adams, of Boston. Kinraide was dressed in a well-fitting brown suit and wore a blue tie. Although a large part of his income is said to come

from stock of what is perhaps the largest jewelry firm in the United States, the only sign of gold noticeable was from a chain of the metal across his waistcoat front.

Kinraide Tells Story

It seemed apparent that he was telling his story with extreme reluctance. Now and then his voice would drop so low as to be barely audible. Two or three times he gave his testimony, before Judge Raymond A. Hopkins and attorneys grouped about the bench, it being deemed of such a nature that it should not be made public. It was shortly after noon today that Kinraide was called to the witness stand. His appearance there had been long anticipated, and there was a distinct stir in the courtroom as he took his place by the side of the judge's bench. Quietly, he testified that he was 56 years old, that his winter home was in Jamaica Plain, and his summer residence in Sandwich at "The Hermitage." Kinraide devoted his life to scientific research, in which he said he had been interested since boyhood. It was in 1892-93 that he took it up as a life's work. His most notable achievement, he said, was the development of a system for recording inaudible sounds running up to 400,000 vibrations per second. He was also the inventor of the "French Gap" for the wireless apparatus.

His Jamaica Plain house, Kinraide said, was built by him with the idea of using it as a place for scientific research. He described it in detail, saying that it contained a machine shop, a fully equipped laboratory, rooms for several men, a darkroom for photographic purposes, and furnaces in the cellar for fusing alloys.

Meeting Mrs. Ford

It was then that Attorney William A. Morse asked Kinraide about his first meeting with Mrs. Ford, his present mother-in-law. He described this event in the Philadelphia house in detail and added that he had registered with the woman the next night at a hotel as "R. S. Ford and wife." It was that night that Mrs. Ford's sister came to her with a telegram stating that her husband had committed suicide. Kinraide declared that he did not know until that time that Mrs. Ford was married. He sadly said that he would not have been in the hotel with her if he had known the true facts.

The following summer, Mrs. Ford came to Boston and finally took a house in the spring of 1893 at 550 Columbus Avenue. He called her there from time to time. In 1897, she came to live with him in Jamaica Plain.

It was through an altercation with her, Kinraide stated, that he learned of an illegal operation Mrs. Ford had undergone. He had chided her for not "acting properly," and she had flown into a rage.

Then Kinraide described the burns he inflicted on Mrs. Ford's daughter, the girl who would later become his wife. It was while he was experimenting with his X-Ray machine, and she acted as a subject. He believed it was in 1899.

Kinraide said the burns caused by the X-Ray were very serious, but he added that he did not know at the time that they were so dangerous.

"I told Mrs. Ford," he said, "that I had burned Ethel and that in one or two similar cases death had resulted." Kinraide then said that a suit for damages might be brought against him. He also offered to settle his fortune with her and finally suggested marriage. Mrs. Ford stated that she had no objection to this, and so this event took place.

Loved Wife Very Much

Attorney Morse referred to letters which Kinraide had written to his wife, which have been read in court, and asked him if they were his true sentiments.

"They hardly expressed them," he replied.

"Did you love your wife?" persisted Attorney Morse.

"Very much," quietly replied the witness.

"In all the letters you wrote, did you express a desire for your wife's companionship?"

"Yes," he replied.

Then Kinraide explained how his household was financed. He stated that he usually looked over the bills and signed checks for their payment. Sometimes checks were signed in blank.

Kettles and Stills

In the testimony that had been given, reference was made to a copper kettle. Kinraide explained that this utensil was purchased about 20 years ago in connection with other equipment.

Kinraide said that in all, from 15 to 20 stills used for different purposes and of all sizes were in his possession at one time. They were largely used for the extraction of alcohol from essential oils, a sort of reclamation process.

The witness denied that he had ever used any of this reclaimed alcohol for beverage purposes and added that he generally kept a case of liquor in the house. At the time he entertained the Williams Club, of which he is, and has been for 12 years, president, he provided alcoholic refreshments.

Referring to his children, he said that his first daughter, Cecil L., was born in 1906.

"Are you very fond of her?"

"I am," replied Kinraide.

July 26, 1908, Robert was born.

Kinraide said that his relations with his wife had been pleasant up to 1910 with the exception that he did not have her company often. "You, did not see so much of your wife as you desired?" asked Attorney Morse.

"No," replied the witness

Then Kinraide, in a very low tone of voice, described an incident from his home life with much apparent reluctance. Regarding a visit from a doctor, he said he threatened that if his wife and Mrs. Ford did not tell him what had happened, he would take the matter up with the district attorney and make them tell him. He was then told that an abortion had been performed on Mrs. Kinraide. Asked by Attorney Morse to state his feelings toward Mrs. Ford from that time on, he said, "I absolutely distrusted and feared her and hated her after that time."

Mrs. Kinraide's Companion

Kinraide then referred to testimony given by Miss Jessie H. McDonald, a trained nurse and companion of Mrs. Kinraide. He said that he had met her in the rooms occupied by a Back Bay physician in 1908. He had gone there at the request of this man's son to try to get him to reform in regard to the excessive use of liquor.

He said he asked Miss McDonald if she was doing right by being in such close quarters with the doctor. He denied ever having made any improper advances to Miss McDonald. Kinraide then described an occasion in his own home in which Miss McDonald became enraged at something Mrs. Ford had said, at which time she threatened to have this woman prosecuted for libel and slander.

"I begged her to forget it," said the witness, "and gave her some money. I don't remember whether it was \$100 or \$150."

Tears nearly came to the witness's eyes when he referred to his children. He said he had absolutely no power over them, and that if he was tempted to rebuke them for some childish fault it would provoke a storm. "If I spoke to one of the children crossly I was looked upon as a brute," he said.

"That about the 'brute' may be scratched out," said Judge Hopkins. Kinraide deplored the fact that his children were not allowed to play with other children, and that, although he had fixed up a large place for them to coast and skate on, they were not allowed to use it. On one occasion he went upstairs and found his eldest son reading a book. He asked him why he wasn't out skating, and Mrs. Kinraide interrupted with a remark that it was by her orders he wasn't doing so.

It was then, he said, that his wife rushed at him and thrust her face toward him. He said that he was obliged to hold up a magazine to protect himself.

Then Kinraide described another incident in which he had thrown water at his wife because she had called him a "coward," "sneak," and other names. She had refused to stop using this language, which he gave as his reason for throwing the water.

"Was there ever any time during your life that you ever laid hands on your wife or struck her?" he was asked. "No, sir," replied the witness.

Then Kinraide described an automobile trip he took when he said he was so ill he did not feel able to complete the journey, but did so when bothered by the women in his family. He denied that he was under the influence of liquor on this occasion, although he had taken a highball before starting the trip.

On December 27, he returned late one night and asked his wife if she would get him something to eat. Kinraide said he found her in the nursery at the time, and as she did not answer him at first, he remarked that she might give him more attention if he gave her a new automobile. At that, he said, she threw a calendar at him and remarked that he should not use such language. Kinraide said that he had never denied the paternity of his son Tom, as Mrs. Kinraide claims, and then stated that he had responded to a toast at the Massachusetts Yacht Club, Atlantic Avenue, Boston, in honor of the birth of his son and heir.

"Marrow Bone" Episode

The now-famous "marrow bone" incident was described in detail by the witness. His wife claimed that he came home drunk and cooked the bones. Kinraide denied this today, saying that he was very fond of marrow from large beef bones and that his children liked it too. They were in the habit of cooking the bones for 20 minutes and spreading the warm marrow on bread, like butter.

Kinraide explained that tobacco makes him mortally ill, which is the result of exposure he underwent at the time of the Yale Bowl's opening. Since that time, he has been unable to remain in the company of smokers for any length of time without becoming ill. Kinraide was still on the stand when court adjourned until Monday morning.

Said Kinraide Was Jealous

Miss Jessie H. McDonald was the last witness of the morning for the plaintiff. She said that it was a common occurrence for Kinraide to follow his wife, and he often told her that he was sure there was another man she was interested in.

Miss McDonald testified that she told Kinraide that he had an "ideal wife." At the table, according to Miss McDonald's testimony, Kinraide would "glare" at his wife for from five to 25 minutes at a time, with his fists "clenched." She said that as a result, Mrs. Kinraide was kept in a state of very nervous tension. This testimony Judge Hopkins ordered stricken out of the record.

Under cross-examination by Attorney Morse, Miss McDonald said she did not recall Kinraide ever saying that she was compromising herself by being in the rooms of a Beacon Street physician. She also denied that she had left the Kinraide house in a fit of anger because Mrs. Ford had said that she was intimate with the Beacon Street doctor. Kinraide, according to Miss McDonald, had asked his wife to go out for a car ride shortly after the birth of a child, but that she (Miss McDonald) had forbidden her to do so. Rachael Stanley Carpenter, who said

that she is a teacher, testified that she is a niece of Kanraide, and that she had never seen him under the influence of liquor. She also said that he was kind to his wife and children. Among those from Sandwich who testified as to the sobriety of Kinraide were George T. McLaughlin, postmaster; J. Frank Giles, Dr. Edward S. Talbot, George A. Gibbs, George E. Stephens, George L. McCann, Jerome Holway, James H. Kelliher, Fletcher, Clark, and others.

WIFE INDIFFERENT TO HIM, SAYS KINRAIDE

"I Never Had One Evening's Conversation With Her In All My Married Life"

BARNSTABLE, Dec 13 - Frederick M. Durkee of York Terrace, Brookline, real estate dealer and formerly an automobile man, was the first witness when the Kinraide divorce action was summoned before Judge Raymond Hopkins in the Probate Court today.

He denied he ever saw Kinraide under the influence of liquor while he was engaged in experimental work at Technology during the war. Witness said he needed a large coil for use on a submarine detector and secured the coil from the respondent. He said he had great confidence in Mr. Kinraide, that the latter had a wonderful laboratory, was a great man for work, and a deep thinker.

He told of photographic work done by Mr. Kinraide, his pictures being, according to the witness, absolutely stereoscopic, standing right out. Witness said Mr. Kinraide was a "kindly daddy" to his children.

According to the second witness, Gustave E. Wicksall of Roslindale, president of a business men's club in that district, he had drunk with Kinraide on several occasions.

Neighbor Never Saw Him Intoxicated

John E. Callahan of Adelaide Street, Jamaica Plain, automobile salesman and next-door neighbor of Kinraide at Jamaica Plain, was next called. He was asked to make a diagram of the location of the Kinraide Winter home as it was in relation to its proximity to Callahan's. Kinraide's driveway, it was shown, was in open view from the window dining room. Witness said he saw Kinraide every day and never saw him under the influence of liquor.

Delia King, a bashful girl who had considerable trouble speaking loudly, said that she never saw Kinraide under the influence of liquor. In 1918 she was a kitchen maid in the Kinraide household. Now she is employed by Charles Curtis of Jamaica Plain.

Katherine Tracy of 86 Howard Street, Roxbury, was employed as a maid at the same time Delia King was. When she testified, she corroborated Delia King's story.

Benjamin A. Cook, in the automobile business, was called regarding the testimony concerning an auto incident at Randolph, which figured in the testimony of the plaintiff that her husband, Mr. Kinraide was unable to drive the car home because he was under the influence of liquor.

Witness said he was driving for Mrs. Belcher of Randolph at the time and was engaged to bring Mr. Kinraide's car back. Cook said Kinraide was sick on the way home, but he did not notice any odor of liquor and was willing to swear to this. He said there were two occasions when he had driven Mr. Kinraide's car and he had seen Kinraide under the influence of liquor, but not on that occasion.

Anita Stanley, 21, of Newark, NJ, niece of Mr. Kinraide, brought a ray of sunshine during her testimony for the respondent. She testified to the fine conduct and appearance of Mr. Kinraide in her presence.

Harold L. Bickett, formerly a Sandwich resident, said he never saw Kinraide under the influence of liquor and that the respondent seemed very fond of his family, was lavishly generous with his gifts, and provided many toys for the children. Witness said his visits were occasioned by an interest in Mr. Kinraide's research.

Kinraide Takes Witness Stand

Thomas Burton Kinraide, scientist, of Jamaica Plain, in direct testimony today denied it was last July that his wife first learned of his affair with her mother. Kinraide said on March 12, 1920, he invited her and her mother, Mrs. Ford, into his laboratory, and there he asked her if she intended to divorce him.

She answered yes. According to the witness, he learned from Mrs. Kinraide that her mother had given her considerable information about her relationship with Kinraide. He felt it was his duty to tell her what she didn't know because he felt she had better protect herself and be guided thereby. At this point the court declared a recess.

Wife Wanted Half of His Stock

It was after 11:30 that Mr. Kinraide was called to the stand to resume his direct testimony. He told of being ill for two weeks from influenza last February at his home, Raven's Croft, and that although other members of the family visited him during that time, his wife never did.

Witness said that many times his wife wanted him to make over his property to her. He said there were talks in the presence of Mrs. Ford, beginning in 1910, when he was urged to make over some of his Tiffany stock to Mrs. Kinraide because, in the event of his sudden death, this action would reduce the amount of inheritance tax.

The last conversation was in the spring of that year, following a misunderstanding. At that time, he told Mrs. Kinraide to forget the trouble. She said she would forget it if he would make half of the Tiffany stock over to her. Kinraide said he had told her he would make over half of the Tiffany stock if she would live as his wife for a year.

"She told me I could not buy her with money."

Since December 25, 1919, the witness said, there had been no marital relations.

When His Wife Was Operated Upon

Regarding the incident when he was related to having become very angry with Mrs. Kinraide because she had an operation on her ear, he said he had been putting ice packs on her ear for several nights and, on account of the children being ill for a long time, he was in a state of

physical collapse. He was under the impression that a mastoid operation ought to be performed, but the doctor had promised him he would not perform the operation without a consultation.

In order to get some rest, he said, he went to the Hotel Somerset in the morning and slept there until night, and he found that his wife had been operated on in the meantime. He was provoked, because he was under the impression that there had been a serious operation, but he found later that the operation was simply a matter of puncturing the eardrum.

He was then asked what his wife weighed in those days. "Two hundred and twenty-five pounds," was the answer. She had been taking physical culture to lose weight.

His wife was extremely indifferent to him at all times, he said. She never came near him. "I never had one evening's conversation with my wife during all my married life," said Kinraide.

Regarding her attitude when he would return after a long absence, Kinraide said she always received him indifferently.

Kinraide said he had a large assortment of firearms because he hunted in New Brunswick and Northern Maine every year.

Concerning Kinraide's power to restrain his own children, he said there was nothing he could do. Mrs. Kinraide would not let him interfere with their conduct.

When He Got Up to Remove Boy

Regarding the incident when he is alleged to have threatened to throw his son out of the dining room, he said that a Mr. Kingsbury was trying to read a letter from Elbert Hubbard of East Aurora, NY, written shortly before the time of the Titanic disaster. He said that Robert, then six years old, repeatedly interrupted, and he thought that the best thing to do would be to remove Robert from the room. He said he started to get off the chair to get the boy out of the room when Mrs. Kinraide came at him. He said he never started to throw the child out of the door. He also denied that he ever got angry when the children didn't take the proper interest in talking about the fourth dimension.

Kinraide declared that he always took great pleasure in the company of his children and spent a good deal of time with them. If they cried in the night, he said, he took care of them, while his wife rarely woke up. When the children were teething, he often walked the floor half the night with them, he said. Mrs. Kinraide, in her testimony, declared that many times he would not speak to her. Asked today if it was true, he said, "Yes, and there were many times she would not speak to me."

In fact, it was about 50-50. Concerning the liquor allegation, he said he always had liquor in the house and that it was ordered by Mrs. Ford, and nothing was ever said about it. He said he had seen his wife and Mrs. Ford drink liquor at the table in the presence of the children.

Regarding the powder-puff box pitching. Mr. Kinraide said he had aimed and did hit the powder box at the door, but that some of the powder got on Mrs. Kinraide.

Tirades by Mother-in-Law

Then about Mrs. Ford's attitude when-ever he had any trouble with his wife, he said he never was about to try to have a conversation with his wife unless he first looked behind the doors to see that Mrs. Ford wasn't hiding there. And he said whenever he did talk with

Mrs. Kinraide, Mrs. Ford usually broke into the conversation and would begin a savage tirade so that he would get out of the room.

Because the children were so young, he had installed a motion picture machine in the house, he said, and would give them their own show two or three times a week.

As to the July 21st incident, on which day he is alleged to have separated from his wife, he said he was working on a sailboat for his little boy when he heard loud talk and found his sister and others in a terrible row. As he came along, he said he heard Mrs. Ford say, "Yes, I have been his mistress."

Kinraide said he couldn't seem to realize what was being said at the time. Then his sister turned to her and said, "You told me you had met him at a theosophical society."

Kinraide was on the scene by then and said, "No; I met her in a house in Philadelphia." His wife had shaken her fist in his face and demanded, "Why didn't you marry my mother?" "I said I could not do it: she has too terrible a temper. I absolutely could not."

He Told Mrs. Ford to Leave House

Kinraide's sister, Mrs. Carpenter, said that she had believed in him all those years. According to testimony, Mrs. Ford then said their relationship had continued ever since his married life.

"I denied it and said it was an absolute lie and told her she must take her things and leave the house immediately."

Kinraide's wife didn't want to go, but her mother insisted she go too and told her to go to Boston right away, as the court was in session and she could get a divorce. His wife said she couldn't think of it, on account of the disgrace, Kinraide testified, but she went away with her mother

"I followed them on foot down the road and tried to set them right. They wouldn't pay any attention and they got lost. I went back, got the car and searched for them, but in the meantime a local taxi came along and drove them away." At this point, the court adjourned for luncheon.

KINRAIDE WOULD TAKE WIFE BACK

Makes Offer in Court, but Bars Mother-in-Law---Breaks Down While Giving Testimony

BY ROY ATKINSON Post Staff Correspondent

BARNSTABLE, Dec. 13. Thomas Burton Kinraide, widely known X-Ray expert, inventor, and scientist, who is being sued by his wife, Ethel Kinraide, for separate maintenance in the Probate Court, testified late this afternoon that he is willing to forgive and forget and take into his home again the woman who has accused him of cruelty and drunkenness. But he absolutely refuses to have anything further to do with his mother-in-law, Mrs. Rachel Ford.

KINRAIDE BREAKS DOWN

Again today, Kinraide has been the central figure in a hearing in which sensation has followed sensation. Once he broke down so completely while giving testimony that Judge Hopkins ordered a recess to give him an opportunity to recover his usual composure. Several times, indeed, his voice trembled with emotion as he described events which he said took place during his troubled marital life, culminating once in his wife's announcement that she was aware of his relationship with her mother and again when he was beaten in his own bed by Mrs. Ford and Mrs. Kinraide as he lay there in a state of simulated intoxication.

How his wife pounded him at the time, assisted by her mother, Mrs. Ford, Kinraide described in detail, saying that he had finally fled from the room with his nightshirt partially torn from him by the enraged women.

There were tears in the inventor's eyes at times as he went on with his story, which has brought the family skeleton into a prominence that he said today he did not desire.

Feared Divorce Odium

That he feared the odium attached to a divorce case, Kinraide admitted when he testified at one time that he had begged his wife not to take such action and then went on to say that she had laughed with glee when she told him that she had brought the suit against him, as well as attaching his property, without his knowledge.

One of the closing sensations of the day was Kinraide's flat denial that he had ever had any improper relations with his mother-in-law, Mrs. Ford, after his marriage to her daughter.

Witness after witness, some of them relatives of Kinraide, testified today that they have never seen him under the influence of liquor. Several of these witnesses admitted, under the grilling cross-examination of Attorney William C. Adams, that they had taken drinks of alcoholic liquor

with him. But to one man they were agreed on the statement that he had never been drunk, to their knowledge.

Throughout the testimony today, which has largely centered about the defendant, there have been frequent references to "high balls," which Kinraide admitted that he took on occasion, sometimes with guests at his home in Jamaica Plain or at Sandwich.

An echo of the world war was heard in the courtroom when Kinraide told of a device he invented for detecting hostile aircraft. He said it was a large device—not a dictaphone, as his wife alleged in her bill of complaint—capable of picking up conversations and making them audible at a long distance. He gave this bit of testimony to contradict Mrs. Kinraide's statement that he had spied on her with a dictaphone.

Denied Kinraide Was Drunk

The first witness of the morning was F. M. Durkee of Brookline, who testified that he had never seen Kinraide under the influence of liquor. He was followed by Dr. Gustave B. Wicksell of Roslindale, president of the Business Men's Club of that locality, who gave similar testimony. Then came John E. Callahan of Jamaica Plain, a neighbor of Kinraide's, who also said that he had never seen him drunk. Miss Delia King and Miss Katherine Tracy, former maids in the Kinraide household, said that they had never seen Kinraide under the influence of liquor, but they admitted under cross-examination by Attorney Adams that they had not mingled with the family, spending most of their time in the kitchen.

Miss Anita K. Stanley of Newark, N. J., a niece of the defendant, also testified to his habits of sobriety, as did the Rev. Harold L. Pickett, who had often visited Mr. and Mrs. Kinraide at both their winter and summer homes.

It was exactly 12:25 o'clock this afternoon when Kinraide again took the stand on his own behalf, telling at first of the attack of influenza he had in February, which lasted two weeks, during which time his wife only called on him once. Kinraide said that it was some time after the first of February that he was able to get up.

Says Wife Wanted Property

It was at this point in the testimony that Attorney William A. Morse asked him if Mrs. Kinraide had requested him to make over his property to her, to which he replied: "Many times." Kinraide said that this subject had been discussed by both his wife and his mother-in-law many times in his presence

"They thought, in case of my death, it would lessen the charges on the estate if some of the stock (Tiffany & Co., New York) was made over to Mrs. Kinraide," the witness explained. He then went on to say that this was a subject of repeated conversations for several years, the last time, he recalled, being in the spring "after one of our misunderstandings." "I begged Mrs.

Kinraide to forget all the differences that had arisen and she said she would if I turned over some of the Tiffany stock to her, and I said that I would if she would live with me as a wife should, and then she replied that she could not be bought with money."

Asked by Attorney Morse to tell what happened on March 12, 1920, he said that his wife had returned from a visit to an attorney's office and that he had asked her that evening, in the presence of her mother, if she had decided to get a divorce—such was the case, he turned to Mrs. Ford. Then, after being informed that Ford had told her daughter about the relationship they had had, she said that she had.

Kinraide paused a moment and then went on, with evident difficulty. He was referring to his wife this time. "I then told her that I felt it was my duty, even if I lost my home, to tell her what she did not know so that she would be guided—"

Told Wife About Mother Kinraide then broke down completely and Judge Hopkins ordered a recess to give him an opportunity to recover his composure.

Returning to the witness stand apparently much more composed, Kinraide said that he unfolded to his wife the story of his meeting her mother in the house in Palladelphia, where she was surrounded by numerous young women, and told her frankly and freely what had taken place that night.

On the day of the Joffre parade, given in honor of the Marshal of France, June 20, 1918, Kinraide said that he took his family to the city, having secured a window in the Thorndike.

July 4, 1920, his wife asked him for permission to go to Sandwich to get her cousin, Mrs. Brown. He refused because she had not allowed him to entertain the Williams Club, of which he is president, at his home. Later, he revoked his decision, and she took her car and drove away. He said that he was not under the influence of liquor on that occasion or at the time of the Joffre parade.

Mrs. Kinraide seemed much interested when her husband said that she had weighed 225 pounds but that she had started a weight-loss program whereby she lost so much weight that her physician ordered her to discontinue it.

Saw Man in House

Today, Kinraide repeated that he was never allowed to reprimand his children. He said that his wife would never go to them at night unless they disturbed her comfort by crying, but that he went to their room at the slightest sound.

On one occasion, he saw his wife being entertained in a room in his home after he had retired, he said, which finally resulted in him ordering the man who was present at the time to leave the place.

Referring to what has come to be known as the "powder box" incident, he admitted that he hit his mother-in-law with a puff of powder, but that the box he threw missed her. He did this because Miss Ford had put her head through the door of his room on one occasion, "glaring" at him and "making faces" with a "sort of fierce looking grin" on her countenance.

READY TO HAVE WIFE GO HOME

Mother-In-Law Barred, Says Kinraide

Inventor's Testimony at Barnstable Ends

Denies Story Told by Mrs. Rachel Ford

By JOHN J. DONOVAN

BARNSTABLE, Dec 13 - Thomas Burton Kinraide, Jamaica Plain inventor, today told the Probate Court that he is willing to have his wife, Ethel S. Kinraide, who is suing him for separate support, return to his home, and said he will maintain her and treat her courteously and with respect, but not if her mother, Mrs. Rachel Ford, attempts to return with her.

The declaration came at the end of the direct examination by his chief counsel, William A. Morse. Kinraide had been on the stand practically a full court day, though his examination was interrupted from time to time by the placing on the stand of character witnesses anxious to get home

Attorney William C. Adams created a slight ripple of excitement when, at the close of the long examination of Mr. Kinraide, he announced that there would be no cross-examination.

Denies Charges Made by Wife

Many denials were made during the morning session by Mr. Kinraide of all allegations made by his wife. Among other things, he declared that since his marriage, he had never had improper relations at any time or place. Although the action for separate maintenance was based on charges of cruel and abusive treatment, his wife did not leave him, according to her own testimony, until after she had been told by her mother of alleged relations with Kinraide, before and after his marriage to Mrs. Ford's daughter. Mrs. Kinraide told the court in her examination, both direct and cross-examination, that she believed her mother's story. Today, Kinraide denied its truth.

Another important feature of the testimony today was Kinraide's denial that it was not until July 21 of this year that his wife first learned of the intimacy that existed between him and his wife's mother.

The scientist and research worker told the court that in March, after a visit to his attorney by Mrs. Kinraide, who was threatening divorce, he told her the story of his meeting her mother and all that followed up to the time he married.

Kinraide told how his wife and mother-in-law left the house on July 21. He said that he was in his shop at the Hermitage in Sandwich, fixing a boat for his son, when he heard loud voices.

The respondent said that he went into the house and found Mrs. Kinraide, Mrs. Ford, and his sister, Mrs. Carpenter, in a "terrible row."

Tells of Row at Sandwich

Going in, he said he heard Mrs. Ford declare, in a loud and angry voice, "Yes, and I have been his mistress." The witness said he was so shocked and surprised that he was unable at first to realize what was going on. He heard his sister say, "You told me you met him in a theosophical meeting."

Kinraide said that he then entered the row and said to his sister, "I met her in a house in Philadelphia."

At that point, the witness declared his wife rushed in front of him and, shaking her fist, shrieked at him, "Why didn't you marry my mother?" Kinraide said he told his wife the reason he never married her mother was that "she had a terrible temper, and I absolutely could not do so."

According to the respondent, Mrs. Ford then declared that the relationship continued throughout their married life, and Kinraide told the court that he told Mrs. Ford, "It is an absolute lie, and you must pack your things and leave the house immediately."

With a malicious grin, Kinraide said, "Mrs. Ford jeered at me, saying, 'Now you have lost your wife, what are you going to do about it?'" She then said, "Let's go."

Witness said he announced that Mrs. Kinraide was not included in the orders to leave the place and that, in fact, he did not want her to go and told her so. Mrs. Ford, however, said the witness, ignored him and told his wife to go and put her clothes on right away and leave for Boston, where the court was in session, and that Mrs. Kinraide could get a divorce.

Mrs. Kinraide, according to the witness, was reluctant to do so. He said he visited Mr. Adams at the Daniel Webster Inn, where the latter told him that he had been engaged by Mrs. Kinraide and had already begun proceedings by placing an injunction on his property and an attachment on his bank accounts.

Thought Action Ill - Advised

Witness said he told his wife he thought that court action was ill-advised, that no good would come of it, and that it was not necessary to go to such extremes. "I told her," said Kinraide, "that it was a treacherous thing to do, to come back home and deceive

us. According to Kinraide, his wife told him she was glad she had fooled him and that she had played her part perfectly. "Since then," said Kinraide, "she has been away." If given control of the children, he said he would devote all his means to their education. At that point, he was asked if he would take his wife home. He left the witness stand and resumed his seat behind his counsel. His head was bent down, and his wife, half-turning in her chair, stared long and hard at him.

Her face appeared strained and troubled. Kinraide earlier in his testimony admitted he allowed himself to be put to bed, but at the same time he said that he received a beating from his wife and Mrs. Ford. He said that the night after the incident in March, when he told his wife about his relationship with her mother, he tried to get her to talk to him or let him into the room where she was with Mrs. Ford. She wouldn't answer him, and he said he went to the shop to have a drink. He said he might have had one high ball and then returned. He said he induced the women to go upstairs. He said they were under the impression that he was drunk, and on account of the strained situation, he said that he thought he would let them retain that impression. They put him to bed when, he said, he remembered that he had left some valuable papers in his unlocked desk and attempted to get out of bed and go downstairs to get the papers.

Says Women Pounded Him

He said that the women held him in bed by the ankles and that when he persisted in his efforts to get up. They pounded him. He said he finally got away, but in the mix-up his clothing was torn. Before he could get downstairs, his wife threatened to call the police unless he got back into bed, and he said he went to bed.

He was charged with being under the influence of liquor at the time of the Joffre parade in Boston and last July 4 at Sandwich. He denied the allegation and said that he had obtained a window at the Thorndike for his family to see the parade and that he drove them there and back. On July 4, he said he drove the family to the fireworks and back.

Kinraide was questioned regarding his wife's health a few years ago, and he said that she appeared to be healthy and weighed 225 pounds. Later, she took a weight-loss course and is now considerably lighter.

His wife was extremely indifferent to him, said Kinraide, and did not care for his company or companionship during their married life. He said that she never sought his company and that during the entire 15 years of his marriage he never had an opportunity to sit down for a whole evening and chat alone with his wife. His mother-in-law was always around, and he said that she constantly interfered in any arguments he had with his wife.

Kinraide told the court that he was devoted to his children, and many times when they were teething, he sat up half the night with them. The children would cry in pain or from bad dreams, and his wife never responded. Kinraide said that at times he waited an hour to see if she would wake up and go to the children, but that she did not, and he visited them.

About 50-50 on Not Speaking

Regarding the charge that at times he did not speak with his wife, he said it was about "50-50," for there were many times when she did not speak to him. He said that once he ordered a nephew of his out of the house because Mrs. Kinraide became too hilarious over what the

nephew was saying and doing. Kinraide said he always had liquor in the house and that Mrs. Ford always ordered it.

Many character witnesses testified during the day. They said they never saw Kinraide under the influence of liquor. For the most part, that was the extent of opinion asked of them.

Mrs. Jennie R. Kingsbury, a character witness, injected a little novelty into her testimony by declaring that she would not listen to words said by Kinraide and his wife who were squabbling. She said she was walking to the Winraide room at Sandwich, August 5. She

said she was within hearing distance "if she listened." "Did you take any precautions not to Nhear?" asked Mr. Morse. Witness said she did, adding, "I buried my head in the pillow, for I was a friend of both." She would not deny that she begged Mrs. Kinraide the next day to leave the house for her safety.

William Davidson, an electrician, who lived at the Jamaica Plain house, said that he is a nephew of Kinraide and that he came to Massachusetts in 1894 with Kinraide and Mrs. Ford from his home in Moncton, NB. He said he had keys to both the Summer and Winter places and lived there much of the time, and for most of the time had been in Mr. Kinraide's employment.

He said that many times he was called to the house by the women, but often did not go; or, if he went, found Kinraide ill in bed.

Says Kinraide Struck Him

He said that at the time Kinraide ordered one of his nephews out of the house, he interfered and Kinraide struck him, the only time in all their association. He admitted that on several occasions he had helped the women put Kinraide to bed and said that once he, alone, put Kinraide to bed

Among those who testified to Kinraide's sobriety were Alberta M. Ripley of Moncton, NB, who in 1902 was brought to Boston by Mrs. Ford and Kinraide; Mrs. William Davidson of Jamaica Plain; Mrs. Bessie Fraser of Somerville; Miss Olivia Davidson of Somerville; Frederick K. M. Durkee of Brookline; Gustave E. Wicksell of Roslindale; John Edward Callahan of Jamaica Plain; Delia King of Jamaica Plain, at one time a maid in the Kinraide home; Katherine Tracy of Roxbury, who was also a maid; Anita Stanley of Newark, NJ; Rev. Harold L. Pickett of Woburn; and John A. Holway, register of deeds of Parnstable.

Court adjourned to tomorrow morning at 9:30, but it is understood that the Kinraide case will not proceed until Wednesday, when all evidence should be in by noon and arguments completed by late afternoon.

KINRAIDE'S SISTER TELLS OF SQUABBLES

Mrs. Carpenter Warned Wife Her Mother Would Suffer - Inventor Called "Only a Figurehead"

By JOHN J. DONOVAN

BARNSTABLE, Dec 15 - "He is only a figurehead and is only here to pay the bills," is what Mrs. Kinraide said about her husband, according to Mrs. Annette Carpenter, president of the Women's Alliance in Sandwich, who was the principal witness this morning in the Kinraide separate support action before Judge Raymond Hopkins in the Probate Court today.

Mrs. Carpenter makes her home at the Hermitage. The Summer Place Thomas Kinraide, the Jamaica Plain inventor, is also her sister, and her testimony this morning was interesting

Mrs. Carpenter also said: "When I inquired why it was Mr. Kinraide married Ethel Ford, Mrs. Ford had told me that she, Mrs. Ford, would not allow anyone else to marry her daughter." Mrs. Carpenter said that she had been a resident of Sandwich since July 1913. She said she had first met Mrs. Ford in 1894 and that the meeting took place at Mrs. Ford's home, 550 Columbus Avenue, Boston. In 1899, when Mrs. Ford moved, it was feared Kinraide had weakened his brain and needed Mrs. Ford, but she could not be in both places at once.

Changed Care of Homes

Witness said that she went to Boston and took charge of Mrs. Ford's house on Columbus Avenue, and Mrs. Ford went to Kinraide's home in Jamaica Plain. She said that at the time Mrs. Ford went to Ravens Croft, there were in the Columbus Avenue house Mr. Ames, Kendall, Richardson, Dearborn, Davidson, Mrs. Ford's sister, and the latter's young daughter. Some of the men, she said, were chemists assisting Mr. Kinraide in his laboratory work. According to the witness, Mrs. Ford was installed at the Jamaica Plain home and "became manager at the home in every shape and manner." Asked regarding the personal appearance of the children at the Kinraide home, witness said that they often came to the table with dirty hands and faces and were very ill-mannered. She aided that on several occasions her brother-in-law sent the children away from the table to be washed.

She referred to the time in 1913 when, it was alleged, Mr. Kinraide threatened to throw one child out of the dining room door. She said her brother took the child and started to the door, but Mrs. Ford and Mrs. Kinraide headed him off and took the child away from him. Kinraide left the room.

She said at the time there was a cook in the house, a second girl, a general girl for upstairs and a man to do the odd jobs around the house.

"If Mrs. Ford Had Stayed Away"

Witness also said that Mrs. Kinraide had told her that if Mrs. Ford had stayed away, Mrs. Kinraide and her husband could make up their differences much easier. Mrs. Carpenter said Kinraide is a very good man and for weeks at a time was working at the shop and so busy that he came to the table in a flannel shirt, not having time to change his clothes. So he would simply throw on a linen coat.

Asked if Mrs. Ford had told her about Kinraide, seeing Mrs. Ford, she said Mrs. Ford had told her several times that Kinraide feared her.

She was then questioned regarding July 21, the day upon which Mrs. Ford left her home in Sandwich with her daughter and proceeded to bring action against Mr. Kinraide. She said that that morning Kinraide asked her to do work in his room which needed attention, and, she said, she started upstairs to the room, but that Mrs. Ford met her and told her not to do the work. Witness said that she replied that her brother had asked her to do the work and she was going to do it. Witness said she took the pillows off the bed and then Mrs. Kinraide came into the room and threw the pillows on the floor.

Final Scene Before Separation

She turned to Mrs. Kinraide and remarked: "Ethel, you are making a big mistake. If this goes to court, someone is going to suffer." "Who will suffer?" Mrs. Kinraide had asked.

"Mrs. Ford will suffer."

Mrs. Ford then came into the room and added: "Yes. Ethel, I have been Burton's mistress." Mr. Kinraide heard the argument and came in. It was at that point that Mrs. Kinraide, enraged, asked her husband, "Why didn't you marry my mother?" Mrs. Carpenter testified that Kinraide replied it was impossible because she had such a temper, that she was quarrelsome, and that there were other things. Mrs. Carpenter also said that she had understood that Mrs. Ford had met Kinraide at a theosophical meeting and at that time she mentioned it to Mrs. Ford, and Mrs. Ford replied: "I never was in one in my life."

Mrs. Carpenter continued, that Mrs. Ford turned to her daughter and said: "Ethel, put on your clothes and we will go."

Mr. Kinraide interfered and Mrs. Ford said: "I did all I could to keep her from leaving years ago," and turning to her daughter she asked: "Haven't I told you often how noble he is?"

Kinraide Asked Wife to Stay

Mrs. Ford told her daughter to go to Boston, that the court was in session and she could get a divorce.

Kinraide had replied: "I don't want you to go. I want you to stay and take care of the children."

Then Mrs. Kinraide told her mother: "No, I can't go, look at the disgrace." Mrs. Carpenter also told of an incident two months after the Kinraides were married, when there was trouble in the Jamaica Plain home and Mrs. Ford and her daughter had packed their things and lived at a hotel for two or three days.

Mrs. Carpenter said that on several occasions Mrs. Ford had said that if she ever left Kinraide, her daughter would go with her. Mrs. Carpenter declared she never heard Kinraide call his wife any names and that his treatment of his wife was always extremely kind and courteous

Asked about Mrs. Kinraide's manners and treatment, Mrs. Carpenter asserted that she never saw any sign of affection for him and there was none of the little attentions that ordinarily are maritalized by married couples. She also declared she never saw her brother under the influence of liquor.

Another witness today was Mrs. Ruby Ripley of Munson, NB, also a sister of Kinraide. She testified to the incident, told many times, regarding Kinraide taking his wife for a drive 13 days after the ceremony was performed. When Kinraide had first driven up in the handsome car, Mrs. Ford had turned to her daughter and called: "Isn't he a prince?"

Argument of Kinraide's Counsel: William A. Morse, counsel for Kinraide, began his argument shortly after 11 this morning.

Referring to Mrs. Ford, he said that she saw an opportunity to enter into Kinraide's life. She had plenty of money and did not need to come to Boston, according to Mrs. Morse, but she saw in Kinraide a chance for a life of ease and plenty, and a young boy was no entanglement.

"When the Jamaica Plain house was built, she wrote that she had a softening of the brain. It was part of a plan and purpose to install herself in the house, in which she had already installed a sister and daughter," said the attorney. Mr. Morse then referred to the X-Ray accident to Mrs. Kinraide and his offer to either marry the girl or settle money upon her. He then asked Mrs. Ford's opinion of Kinraide when she put her daughter in his arms. "She had known him for 13 years and she had urged that Ethel become his wife, and she said she would let no other man marry her daughter," said Mr. Morse. "Mrs. Kinraide had her husband brought into court on charges of cruel and abusive treatment. Did she lack the necessities of life and suffer in silence? Did your honor ever know of a home where there were such liberal rations?" continued Mr. Morse.

Blank Checks Given to Wife He called attention to blank checks drawn on Boston stores, where Mrs. Kinraide would fill in any amount she desired and wanted.

"Mr. Kinraide said: 'Go buy all that you like and want.' He was ready to grant any one of his wife's wishes and he made a mistake. He left her with no responsibilities and her mother could buy and do as she liked, and there came what normally comes: a degree of selfishness, a lack

of warmth and appreciation." Attorney Morse called attention to the two incidents in that bill that charged Kinraide with hitting his wife. "One was with a magazine and the other by throwing water on her. In 15 years only these two things happened to Mrs. Kinraide, while during the 28 years that Mrs. Ford was with Kinraide he threw a powder puff box at her once and she was scattered with powder," said the attorney.

He then referred to Mrs. Kinraide's temperament and he said: "She has sufficient temper, stress and uncharitableness not to enter her husband's room when he was ill, and it seems to me that if anyone should bring a complaint of cruel and abusive treatment, it was Mr. Kinraide." Mr. Morse blamed the trouble on Mrs. Kinraide as she had a desire to get control of Kinraide's property, to obtain a substantial income so that she could be independent of him and have a home of her own. He ridiculed the charge of drunkenness and said he had called many reputable persons Kinraide before the court for years and had never seen anyone from the town of Sandwich who saw Mr. Kinraide under the influence of liquor. Mr. Morse said, "The only witnesses that stated they saw Kinraide drunk were his wife, his mother-in-law, Mrs. McDonald, a nurse and companion of Mrs. Kinraide, and Mrs. Brown, a cousin of the women. Referring to the testimony of Mrs. McDonald that Kinraide attempted to enter her room when she was at his home and his offer to take her in an automobile. Attorney Morse said it was part of a plan to bolster up Mrs. Kinraide's story. He called attention to the fact that Mrs. McDonald never told the story until after Mrs. Kinraide had separated from her husband.

"Man Abused in His Own Home" He characterized Kinraide as one of the unfortunate men who are abused in their own home and then asked to apologize himself to the persons who abused him. "Mr. Kinraide always lived in fear that Mrs. Ford, who was of such an uncontrollable temper, would give out the story of their relationship, and when she did, he tried to calm down this fanatic old woman." But she left the house and tried to force a settlement where she would receive a large sum of money, so that she could live luxuriously without him," continued Mr. Morse.

"There sometimes comes into a man's life a time when he says, 'Do your worst.' Kinraide was told of what story they were going to tell and given notice to come across, and told that he didn't dare refute the allegations. But he is here." Further, he said. "Mrs. Kinraide's place is back home, where she was never hurt, where she would never be. I don't believe that Mrs. Kinraide believed the story told by her mother as to the relations with Kinraide. Though she said she believed it all, I don't think that she did, and if she did believe that it was so, she continued to live with the woman who debauched her husband, one who was not fit for her children." Atty Morse concluded his argument just before the recess. This afternoon, William C. Adams, attorney for Mrs. Kinraide, will make his argument.

MRS. KINRAIDE WINS SEPARATE SUPPORT

Given Custody of the Children - Judge to Fix Payment - Will Appeal, Asserts Husband

By JOHN J. DONOVAN

BARNSTABLE, Dec 15 - Mrs. Ethel S. Kinraide of Jamaica Plain is justifiably living apart from her husband, Thomas Burton Kinraide, by a decision given late this afternoon by Judge Raymond Hopkins in the Probate Court. Mrs. Kinraide was given custody of their four children. Judge Hopkins did not set the allowance to be paid by Mr. Kinraide from his admitted income of \$25,000 a year. The amount will be determined later by the court. It was announced by Mr. Kinraide and his counsel that Judge Hopkins' finding would probably be taken to the Supreme Court.

The arguments in the case were in just before 3 o'clock. Judge Hopkins then caused surprise by asking counsel for both parties to join him in his lobby for a few minutes. Immediately, the impression became general that Judge Hopkins was prepared for some definite decision and would not take the case under advisement.

Attorneys William A. Morse and Eugene Upton for Mr. Kinraide and William C. Adams for Mrs. Kinraide followed Judge Hopkins to his private lobby. Mrs. Kinraide remained in the courtroom, while her husband nervously paced the corridors. He was visibly distressed and very nervous. After more than an hour, court reconvened, and Judge Hopkins then made public his decision.

Finding of Judge Hopkins

His finding was as follows: "This case has been on trial since a week ago, Monday, and it has been a remarkably well-tried case. I have decided first that Mrs. Kinraide has done nothing improper at any time. There are four children, and I can't bring myself to think that a woman of her age, proper in conduct all her life, should not have custody of her children. "I find she is living apart from her husband for justifiable cause. I cannot say 'Go back and live with your husband' unless at some time she feels she should. It is for her to decide. She shall have custody of the four children.

As to the amount of the allowance, I am unable to state at this time what Mr. Kinraide shall pay his wife. It depends much on who will pay the children's tuition, and there are so many complications I will let that stand until I find out. And also there are other expenses. ("Mr. Kinraide will pay tuition for his children," said Mr. Morse at this point. I can't state an exact sum he shall pay his wife. "I find the plaintiff has maintained the allegations of cruel and abusive treatment. I find her husband used too much liquor. I won't say any more."

Kinraide "To Spend Last Cent" on case

The court then adjourned. The decision was a distinct disappointment to Kinraide and his counsel. Kinraide was heard to declare that he would spend his last cent to carry the case to the highest courts.

Mrs. Kinraide received the judgment quietly and unemotionally. Several staunch admirers of Mrs. Kinraide during the long trial congratulated her on her victory in the suit. The case was one of the most sensational in the history of separate support actions in Massachusetts. The children are in the custody of Mrs. Kinraide and have been during the trial.

All evidence in the case was in shortly after 11 o'clock this morning, and William A. Morse, chief counsel for Kinraide, argued for the defense. Referring to Mrs. Ford, he said she saw in Kinraide a chance for a life of ease and plenty. He quoted Mrs. Ford's opinion of Kinraide when she placed her daughter in his arms. "She had known him for 13 years and she had urged that Ethel become his wife, and she said she would let no other man marry her daughter," said Mr. Morse.

The attorney then asked if Mrs. Kinraide lacked the necessities of life and called attention to the blank checks drawn on Boston stores where Mrs. Kinraide could fill in any amount she desired. He said Mrs. Kinraide has sufficient temper, surliness, and uncharitableness not to enter her husband's room when he was ill, and it seems to me that if anyone should bring a complaint of cruel and abusive treatment, it should be Mr. Kinraide.

Mr. Morse blamed the trouble on Mrs. Kinraide, saying she wanted to get control of Kinraide's property. He ridiculed the charge of drunkenness and characterized Kinraide as one of the unfortunate men who are abused in their own home and then asked them to excuse themselves to the persons who abused them. "Mrs. Kinraide always lived in fear that Mrs. Ford, who was of such an ungovernable temper, would give out the story of their relationship, and when she did, he tried to calm down this fanatical old woman," said Mr. Morse. "But she left the house and tried to force a settlement where she would receive a large sum of money." Mr. Morse continued. "Mrs. Kinraide's place is back home where she was never hurt, where she would never be." Mr. Morse added. He said he did not think Mrs. Kinraide believed the story told by her mother as to the relationship with Kinraide.

Argument of Wife's Attorney

Attorney Adams said Mr. Morse had pictured Kinraide as an impressionable youth of 22 meeting a mature woman of 35 in 1892. Mr. Adams declared Kinraide was not an impressionable youth, but rather a man of remarkable mental equipment with an inquiring mind from boyhood. He denied any mercenary motive on the part of Mrs. Ford, who had money when she came to Boston, though Kinraide told her when she arrived that he did not have any. "If she was mercenary," said Mr. Adams, "why didn't she drop him? She took a lodging house and supported herself, and he ingratiated himself so that the child called him 'Uncle Burton.'

"This respondent never earned a dollar in his life, and his researches were never practical to the extent of bringing in a dollar. He took Mrs. Ford and her daughter into his home, and she conducted practically all his affairs so that he had his entire time to devote to his shop."

Mr. Adams then made a statement not heard in open court during the trial, and as it was not objected to, it is presumed it was given in private testimony. He declared that when Ethel Ford was 14 years of age, Kinraide had her dismissed from school and took her into town for lunch. According to Kinraide, when he married her, as he says, at 17 years of age, she was a large woman weighing 185 pounds. Regarding the X-Ray burn that Kinraide claimed was his reason for marrying her, attorney Adams said the burn healed in one year, and that before the marriage, there had been three years in which to learn if she had been incapacitated. Regarding Mrs. Kinraide's trip to Philadelphia, he said that it was made with the intention of protecting the interests of her children and not from mercenary motives of her own. "This is a most significant case," said counsel. "The petitioner admits all the creature comforts and luxuries, yet comes in here for separate support. She is not asking for a divorce to get loose. She knows that a large division of property cannot be secured by these proceedings. She saw it meant having a home of luxury, and would she have submitted herself to the humiliation of this case unless driven to it?" He said his client should not be ordered to return to Mr. Kinraide, that she was justifiably living apart, and asked the court for custody of the Kinraide children.

MRS. KINRAIDE WINS in her Case for Separate Support.

Mrs. Ethel S. Kinraide of Jamaica Plain is justifiably living apart from her husband, Thomas Burton Kinraide, since late yesterday, by a decision given by Judge Raymond Hopkins in Probate Court at Farnstable late yesterday. Mrs. Kinraide was given custody of their four children.

Judge Hopkins did not set the allowable amount to be paid by Mr. Kinraide from his admitted income of \$25,000 a year. The amount will be determined later by the court. It was announced by Mr. Kinraide and his counsel that Judge Hopkins' decision would probably be taken to the Supreme Court

Judge Hopkins said: "This case has been on trial since a week ago, Monday, and it has been remarkably well-tried. I have decided first that Mrs. Kinraide has done nothing improper at any time. There are four children, and I cannot bring myself to think that a woman of her age, proper in conduct all her life, should not have custody of her children.

"I find she is living apart from her husband for justifiable cause. I cannot say 'Go back and live with your husband' unless at some time she feels she should. It is for her to decide. She shall have custody of the four children. "As to the amount of the allowance, I am unable to state at this time what Mr. Kinraide shall pay his wife. It depends much on who will pay the children's tuition, and there are so many complications I will let that stand until I find out, and also there are other expenses. "I find the plaintiff has maintained the allegations of cruel and abusive treatment. I find her husband used too much liquor. I won't say any more."

CHILDREN GIVEN MRS. KINRAIDE

Wins Separate Support; Too-Husband Will Appeal

BY ROY ATKINSON, Post Staff Correspondent

BARNSTABLE, Dec. 15. Mrs. Ethel S. Kinraide of Boston and Sandwich, through the decision of Probate Judge Raymond A. Hopkins of this place, won the case late today which she brought against her husband, Thomas B. Kinraide, noted scientist and X-Ray expert, in which she asked for separate maintenance and the custody of her four children, charging that Kinraide was cruel and abusive as well as habitually intoxicated.

WILL APPEAL DECISION

Judge Hopkins had barely voiced his findings in this trial, which has been in progress for 10 days and which has attracted attention far and wide due to the sensational nature of the testimony, before Kinraide announced, through his attorney, William A. Morse, that he would appeal to the Supreme Judicial Court. To a newspaperman, he said, "I will fight this matter to the end, even if it takes every cent I have in the world."

There were few people in the courtroom of the ancient building where the trial has been in progress when Judge Hopkins gave his decision. Mrs. Kinraide was seated in the bar enclosure, while her mother, Mrs. Rachel Ford, self-admitted mistress at one time of the widely known inventor and defendant, was in the front row of spectators.

Had Done Nothing Improper

As several of the people in the room gathered about the two women, a court officer stepped forward and announced that there must be no demonstration

whereupon everybody filed out of the place

Briefly and speaking slowly, Judge Hopkins said that he had found that Mrs. Kinraide had done nothing improper at any time.

"There are four children," he went on, "and I cannot bring myself to think that at her age she should not have her own children.

"I find that she is separated from Mr. Kinraide for a justifiable cause. I can't say that she should go back and live with her husband unless at some time she feels so disposed."

Judge Hopkins then said that Mrs. Kinraide should have custody of the four children, but that he was unable to state at the time the amount of the allowance because it is to be so dependent with regard to who pays the tuition of the children at school.

Attorney Morse interrupted the judge to say that Mr. Kinraide would pay the tuition, but the court continued that he could not state the exact sum that the defendant husband should pay his wife

"I find that she has maintained her allegation of cruel and abusive treatment." Judge Hopkins went on, "and I find that her husband used too much liquor."

Timeline of events relating to Thomas Burton Kinraide's life									
Date			Grant Date			Number	Title	Inventor/Name	
Day	Month	Year	Day	Month	Year				
13	5	1817					GIDEON FRENCH THAYER REED BORN	GIDEON F. T. REED	
13	11	1819					REBECCA JACKSON BORN	REBECCA JACKSON	
24	10	1839					GIDEON FRENCH THAYER REED MARRIES REBECCA JACKSON IN BOSTON	GIDEON F. T. REED	
12	12	1841					CHARLES ALEXANDER REED BORN	CHARLES ALEXANDER REED	
	2	1842					CHARLES ALEXANDER REED DIED	CHARLES ALEXANDER REED	
25	5	1856					RACHEL ANN FORD BORN	RACHEL ANN FORD	
10	7	1856					NIKOLA TESLA BORN	NIKOLA TESLA	
1	7	1864					THOMAS BURTON KINREAD BORN IN MONCTON, NEW BRUNSWICK	THOMAS BURTON KINREAD	
6	6	1872					FREDERICK FINCH STRONG BORN	FREDERICK FINCH STRONG	
20	12	1879					EARLE LEWIS OVINGTON BORN	EARLE L. OVINGTON	
		1882					EMIGRATED TO MASSACHUSETTES	THOMAS BURTON KINREAD	
13	4	1888					ETHEL SUGG FORD BORN TO RACHEL ANN FORD AND ROBERT SUGG	ETHEL SUGG FORD	
23	2	1892					GIDEON FRENCH THAYER REED DIES	GIDEON F. T. REED	
15	5	1892					ROBERT H. FORD COMMITS SUICIDE	ROBERT H. FORD	
18	11	1893					NATURALISED IN THE UNITED STATES, CHANGED SPELLING OF NAME	THOMAS BURTON KINRAIDE	
23	5	1896					KENNETH STRICKFADEN BORN	KENNETH STRICKFADEN	
16	8	1896					DELETERIOUS EFFECTS OF X-RAYS ON THE HUMAN BODY - GUSTAV A. FREI	ELECTRICAL REVIEW	
9	9	1896					PRACTICABILITY OF STATIC MACHINE FOR X-RAY WORK - GUSTAV A. FREI	ELECTRICAL ENGINEER	
16	9	1896					X-RAY PHYSIOLOGICAL EFFECTS - GUSTAV A. FREI	ELECTRICAL ENGINEER	

23	12	1896						X-RAYS HARMLESS WITH STATIC MACHINE	ELECTRICAL ENGINEER
6	1	1897						G. A. FREI BEGINS MANUFACTURE OF NEW STATIC MACHINE	ELECTRICAL WORLD
6	1	1897						PHYSIOLOGICAL EFFECTS OF X- RAYS PRODUCED WITH STATIC MACHINE	ELECTRICAL ENGINEER
9	1	1897						SWETT & LEWIS SUCCESSORS TO GUSTAV FREI AT 17 BROMWELL	ELECTRICAL WORLD
15	1	1897	21	12	1897	US	595,812	METHOD OF AND APPARATUS FOR CONVERTING X RAYS INTO LIGHT FOR PHOTOGRAPHIC PURPOSES	THOMAS BURTON KINRAIDE
20	1	1897						DISCOVERY OF A NEW NON- PHOSPHORESCENT, HIGHLY FLOURESCENT CRYSTAL	ELECTRICAL REVIEW
3	2	1897						A PROPOSED EXPERIMENT TO DEMONSTRATE X-RAYS ARE MATERIAL	ELECTRICAL REVIEW
3	2	1897						X-RAYS OR STATIC DISCHARGE - GUSTAV A. FREI	ELECTRICAL ENGINEER
20	2	1897						SWETT & LEWIS MOVES FROM 17 BROMWELL TO 11 BROMWELL TO EXPAND	ELECTRICAL WORLD
24	2	1897						SAMPLE NON- PHOSPHORESCENT SCREENS SENT TO NIKOLA TESLA	THOMAS BURTON KINRAIDE
25	2	1897						LETTER FROM NIKOLA TESLA TO KINRAIDE REGARDING SAMPLES	NIKOLA TESLA
26	2	1897	12	7	1898	US	607,176	ELECTRIC BREAK FOR INDUCTION-COILS	THOMAS BURTON KINRAIDE
15	3	1897						LETTER TO NIKOLA TESLA ABOUT NON- PHOSPHORESCENT SCREENS AND FLUOROSCOPES	THOMAS BURTON KINRAIDE
21	3	1897						LETTER FROM NIKOLA TESLA TO KINRAIDE REGARDING QUALITY OF FLUORESCENT SCREENS	NIKOLA TESLA
3	4	1897						SPRING PARK LABORATORY HAS BEEN KEPT BUSY SUPPLYING ROENTGEN RAY DOCTORS WITH FLUORESCENT SCREENS AND SALTS	ELECTRICAL WORLD

7	4	1897						LETTER TO NIKOLA TESLA ABOUT FLUOROSCOPES	THOMAS BURTON KINRAIDE
13	5	1897	6	12	1898	US	615,652	HIGH FREQUENCY APPARATUS	THOMAS BURTON KINRAIDE
6	6	1897						LETTER FROM NIKOLA TESLA REGARDING PAYMENT OF FLUOROSCOPE	NIKOLA TESLA
18	6	1897						LETTER TO NIKOLA TESLA REGARDING NEW SCREENS SOON AVAILABLE	THOMAS BURTON KINRAIDE
26	7	1897	12	7	1898	US	607,177	ELECTRIC BREAK AND INDUCTION APPARATUS	HOWARD JACKSON
7	8	1897						SWETT & LEWIS SELLS STANLEY STATIC, GEISSLER TUBES, CROOKES TUBES, RUMKORFF COILS	ELECTRICAL WORLD
18	9	1897						SWETT & LEWIS EXPANDS ITS X-RAY APPARATUS SELECTION	ELECTRICAL WORLD
4	3	1898	6	12	1898	US	615,653	HIGH-FREQUENCY INDUCTION APPARATUS	THOMAS BURTON KINRAIDE
18	3	1898	5	6	1898	US	623,316	INDUCTION APPARATUS	THOMAS BURTON KINRAIDE
21	3	1898	2	3	1900	DE	108,924	VORRICHTUNG ZUR ERZEUGUNG ELEKTRISCHER ENTLADUNGEN	THOMAS BURTON KINRAIDE
2	4	1898						SWETT & LEWIS PURCHASES STANLEY DRY PLATE COMPANY & STATIC MACHINE PARTS	ELECTRICAL WORLD
5	5	1898	21	2	1898	US	619,760	ELECTRICAL APPARATUS	THOMAS BURTON KINRAIDE
11	6	1898						SWETT & LEWIS STARTS DISTRIBUTING FARADIC BATTERIES	ELECTRICAL WORLD
12	7	1898	10	3	1900	DE	108,855	SELBSTUNTERBRECHER	THOMAS BURTON KINRAIDE
12	7	1898	10	9	1898	UK	15,246	IMPROVEMENTS IN AUTOMATIC BREAK OR INTERRUPTER APPARATUS FOR ELECTRIC CURRENTS	THOMAS BURTON KINRAIDE
27	9	1898						LETTER FROM FREDERICK FINCH STRONG TO NIKOLA TESLA REGARDING KINRAIDE X-RAY APPARATUS	FREDERICK FINCH STRONG

4	10	1898						LETTER FROM NIKOLA TESLA TO FREDERICK FINCH STRONG ABOUT PATENTABILITY OF KINRAIDE COIL	NIKOLA TESLA
10	10	1898						SPRING PARK LABORATORY OF 38 SPRING PARK AVE SHOWING FOR THE FIRST TIME KINRAIDE INDUCTION COILS, TRANSFORMERS, AND HIGH POTENTIAL OZONE GENERATORS	20TH TRIENNIAL EXHIBITION OF THE MASSACHUSETTS CHARITABLE MECHANIC ASSOCIATION
24	10	1898	18	4	1898	US	623,317	ELECTRICAL BREAK	HOWARD JACKSON
24	10	1898	18	4	1898	US	623,618	ELECTRICAL SPARK GAP	THOMAS BURTON KINRAIDE
29	10	1898	21	2	1899	US	619,761	DYNAMO ELECTRIC MACHINE	THOMAS BURTON KINRAIDE
			6	12	1898	UK	25,670	IMPROVEMENTS IN INDUCTION COILS	THOMAS BURTON KINRAIDE
22	12	1898						WAS IN KEELY'S CONFIDENCE - T. BURTON KINRAIDE WILL TAKE UP AND CONTINUE EXPERIMENTS WITH THE MOTOR	BOSTON DAILY GLOBE
2	1	1899						TO TAKE UP KEELY'S WORK - LABORATORY OF THE GREAT INVENTOR SENT TO THIS CITY	BOSTON DAILY GLOBE
4	1	1899						WILL CONTINUE KEELY'S WORK. T. B. KINRAIDE OF JAMAICA PLAIN HAS MOST OF THE LATE INVENTOR'S APPARATUS AT HIS HOME	BOSTON DAILY GLOBE
4	1	1899						THE FAMOUS KEELY MOTOR - SECRET OF PERPETUAL MOTION NOT FULLY EXPLAINED TO INVENTOR KINRAIDE	PHILADELPHIA PRESS
11	1	1899						MOTOR KEELY'S BACKER - MRS. BLOOMFIELD MOORE'S GREAT FAITH IN THE INVENTOR'S MOTOR	MANSFIELD NEWS
17	1	1899						KEELY MOTOR MYSTERY - STARTLING DISCOVERY MADE IN LATE INVENTOR'S LABORATORY	NEWARK DAILY ADVOCATE
25	1	1899						KEELY MOTOR MYSTERY - WHAT SCIENTISTS FOUND IN THE INVENTOR'S WORKSHOP - SECRET HIDDEN IN BOSTON	NORTH ADAMS EVENING TRANSCRIPT

30	1	1899						EXPOSE OF KEELY'S MOTOR. PHENOMENA SAID TO HAVE BEEN PRODUCED BY DECEPTION AND TRICKERY.	CHAMPAIGN DAILY GAZETTE
30	1	1899						DUPED BY MR. KEELY - THE FAMOUS MOTOR DECLARED TO HAVE BEEN A HUGE FRAUD	THE STEVENS POINT JOURNAL
5	2	1899						KEELY AND HIS SECRET - INVENTOR ADMITTED USE OF DELICATE SECRET TUBES - THEY CAME FROM CONNECTICUT	MANSFIELD NEWS
26	2	1899						THE "YELLOW" IN SCIENCE - KEELY'S MOTOR A TYPE OF MANY FRAUDULENT INVENTIONS USED TO CHEAT THE PUBLIC	SUNDAY HERALD SYRACUSE
4	3	1899	8	7	1898	UK	5,518	IMPROVEMENTS IN ELECTRIC SPARK GAP APPARATUS	THOMAS BURTON KINRAIDE
14	3	1899	15	4	1898	UK	5,519	IMPROVEMENTS IN ELECTRIC BREAK APPARATUS	THOMAS BURTON KINRAIDE
21	3	1899				DE	17,884	ELEKTRISCHER SELBSTUNTERBRECHER	THOMAS BURTON KINRAIDE
27	4	1899						"A NEW FORM OF INDUCTION COIL" - PRESENTATION TO THE SOCIETY OF ARTS	MIT
7	5	1899						KINRAIDE GIVES IT UP - ADANDONS ALL CONNECTION WITH KEELY MOTOR - HE DISLIKES THE NOTORIETY IT HAS BROUGHT HIM - ALL MACHINERY AND PAPERS WILL BE SENT BACK TO PHILADELPHIA	BOSTON DAILY GLOBE
8	5	1899						DROPS THE KEELY MOTOR - T. BURTON KINRAIDE ABANDONS WORK ON THE MACHINE	POST-STANDARD SYRACUSE
27	5	1899						SWETT & LEWIS EXPANDS MOVING FROM 11 BROMWELL TO 79 FRANKLIN AVE	ELECTRICAL WORLD
18	3	1900				US		WORLD=ASTOUNDING ELECTRICAL DISCOVERIES MADE BY THOMAS B. KINRAIDE OF JAMAICA PLAIN	BOSTON SUNDAY POST

28	3	1900				CA		FORMER MONCTON BOY IN DANGER OF BECOMING FAMOUS	THE DAILY TIMES MONCTON
31	3	1900						REMARKABLE PHOTOGRAPHS - EXHIBITION OF PICTURES OF ELECTRICAL DISCHARGES - THEIR AESTHETIC AND SCIENTIFIC INTEREST	BOSTON EVENING TRANSCRIPT
9	6	1900				CA		A FORMER MONCTON BOY MAKES SOME REMARKABLE DISCOVERIES IN X-RAYS AND WIRE-LESS TELEGRAPHY	THE DAILY TIMES MONCTON
13	8	1900	18	3	1901	US	676,583	ELECTRICAL APPARATUS	THOMAS BURTON KINRAIDE
22	12	1900						SWETT & LEWIS EXHIBITS KINRAIDE COILS AND VACUUM TUBES AT ROENTGEN SOCIETY MEETING	ELECTRICAL WORLD
5	3	1901	10	9	1901	US	682,203	STATIC MACHINE	THOMAS BURTON KINRAIDE
2	5	1901	17	12	1901	US	689,199	ELECTRODE	THOMAS BURTON KINRAIDE
18	6	1901	20	7	1901	UK	12,408	IMPROVEMENTS IN AND RELATING TO STATIC RECTIFIERS AND OTHER ELECTRICAL APPARATUS FOR PRODUCING OR MAINTAINING CONTINUOUS OR UNIDIRECTIONAL DISCHARGES	THOMAS BURTON KINRAIDE
21	7	1901						LETTER FROM ANABEL PARKER TO ROBERT UNDERWOOD JOHNSON ABOUT KINRAIDE'S ELECTRICAL PHOTOGRAPHS	ANABEL PARKER
24	7	1901						LETTER FROM ROBERT UNDERWOOD JOHNSON TO ANABEL PARKER ABOUT WORK OF TESLA AND KINRAIDE	ROBERT UNDERWOOD JOHNSON
25	7	1901						LETTER FROM ANABEL PARKER TO ROBERT UNDERWOOD JOHNSON ABOUT DIFFERENCES IN TESLA'S AND KINRAIDE'S WORK	ANABEL PARKER
3	9	1901						LETTER FROM ANABEL PARKER TO ROBERT UNDERWOOD JOHNSON ABOUT KINRAIDE'S ELECTRICAL PHOTOGRAPHS	ANABEL PARKER
5	9	1901						LETTER TO ROBERT UNDERWOOD JOHNSON ABOUT BEING SICK AND UNABLE TO TRAVEL	THOMAS BURTON KINRAIDE

16	9	1901						LETTER TO ROBERT UNDERWOOD JOHNSON ABOUT MEETING NIKOLA TESLA	THOMAS BURTON KINRAIDE
22	10	1901	5	3	1901	US	684,828	SPARK GAP REGULATOR	THOMAS BURTON KINRAIDE
17	2	1902						LETTER FROM ELIHU THOMSON ABOUT SPARK PHOTOS AND HIGH FREQUENCY X-RAY TUBE	ELIHU THOMSON
1	7	1902						CURIOUS ELECTRICAL FORMS BY ANABEL PARKER	CENTURY MAGAZINE
21	3	1902						LETTER FROM ANABEL PARKER TO ROBERT UNDERWOOD JOHNSON ABOUT PROOF OF CENTURY MAGAZINE ARTICLE	ANABEL PARKER
25	3	1902						LETTER FROM ANABEL PARKER TO ROBERT UNDERWOOD JOHNSON CONCERNING SOUND WAVES OF KINRAIDE'S RESEARCH	ANABEL PARKER
26	9	1902						ELEVENTH ANNUAL MEETING OF ELECTROTHERAPEUTIC ASSOCIATION - REPORT ON COMMITTEE OF THE ROENTGEN RAY - KINRAIDE COIL	MEDICAL RECORD
22	1	1903	31	3	1903	US	724,186	ELECTRICAL APPARATUS FOR THERAPEUTICAL WORK	THOMAS BURTON KINRAIDE
6	4	1904	20	9	1904	US	770,431	INTERRUPTER	THOMAS BURTON KINRAIDE
25	5	1904	20	9	1904	US	770,433	THERMAL INDUCTOR	THOMAS BURTON KINRAIDE
25	5	1904	15	11	1904	US	774,758	ELECTRIC SPARK-GAP	THOMAS BURTON KINRAIDE
27	6	1904	15	11	1904	US	774,759	PORTABLE HIGH FREQUENCY DEVICE AND VACUUM TUBE STAND	THOMAS BURTON KINRAIDE
5	7	1904	15	11	1904	US	774,760	SELF CONTAINED HAND ELECTRODE	THOMAS BURTON KINRAIDE
27	7	1904	21	3	1905	US	785,671	DETONATOR OR AUXILIARY PROTECTIVE ALARM SPARK GAP FOR HIGH FREQUENCY APPARATUS	THOMAS BURTON KINRAIDE
15	2	1905						MARRIED ETHEL SUGG FORD AT ST. STEPHENS EPISCOPAL CHURCH IN SAVANNAH, GEORGE	ETHEL SUGG FORD
20	2	1906						REBECCA THAYER REED DIES	REBECCA JACKSON

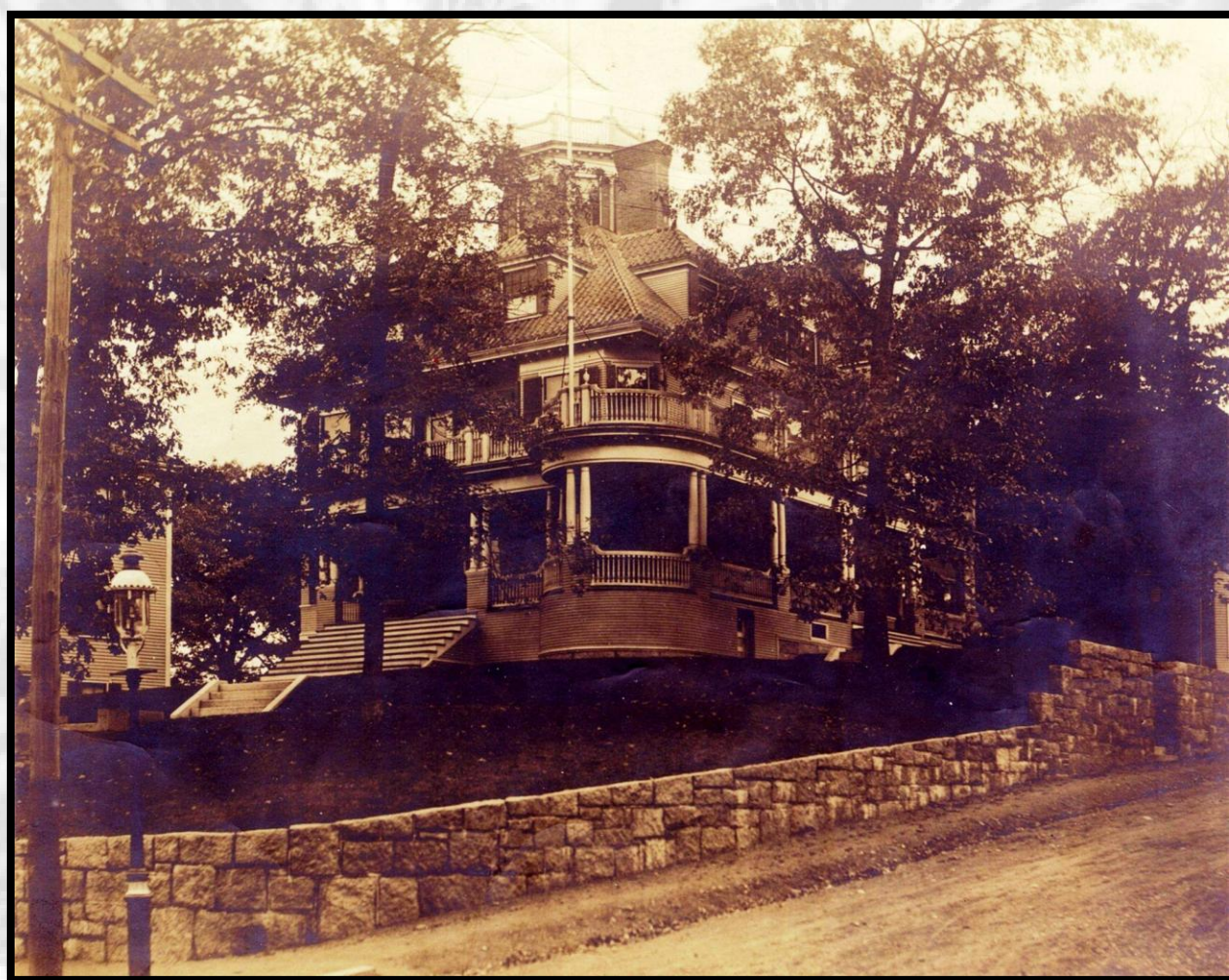
24	4	1906	14	4	1908	US	884,499	ELECTRIC SPARK-GAP FOR INTERRUPTERS	THOMAS BURTON KINRAIDE
5	1	1906						CECIL RACHEL LOUISE KINRAIDE WAS BORN IN JAMAICA PLAIN MA	CECIL RACHEL LOUISE KINRAIDE
12	5	1906						ULTRA-VIOLET LAMP WITH HEAT-RADIATING QUALITIES	THE WESTERN ELECTRICIAN
26	7	1908						ROBERT BURTON CHARLES AUGUSTUS KINRAIDE BORN IN SANDWICH MA	ROBERT BURTON CHARLES AUGUSTUS KINRAIDE
27	11	1908						KINRAIDE SHOOTS FOX; RETURNS TO RAVENCROFT FOR WINTER	SANDWICH INDEPENDENT
2	7	1909						KINRAIDE LEAVES TO BOSTON BY CAR	SANDWICH INDEPENDENT
7	5	1909						SANDWICH WINTER CLUB	SANDWICH INDEPENDENT
4	6	1909						HERMITAGE OPENED FOR THE SUMMER	SANDWICH INDEPENDENT
25	6	1909						WILLIAMS CLUB ANNIVERSARY 12-13 JUNE AT THE HERMITAGE	SANDWICH INDEPENDENT
1	10	1909						WILLIAMS CLUB PRESENTED CUP TO THOMAS BURTON KINRAIDE	SANDWICH INDEPENDENT
18	2	1910						SANDWICH WINTER CLUB	SANDWICH INDEPENDENT
25	3	1910						CARD FOR HELPING PUT OUT FIRE AT HERMITAGE	SANDWICH INDEPENDENT
20	5	1910						SANDWICH WINTER CLUB MEETING	SANDWICH INDEPENDENT
24	6	1910						WILLIAMS CLUB MEET AT WILLIAMS GRAVE 12 JUNE 1910	SANDWICH INDEPENDENT
24	6	1910						OUTING AT THE HERMITAGE	SANDWICH INDEPENDENT
23	3	1911						WINTER OUTLINE OF THE WINTER CLUB AT RAVENCROFT	SANDWICH INDEPENDENT
21	6	1912						FORTY MEMBERS OF THE WILLIAMS CLUB ENTERTAINED AT HERMITAGE	SANDWICH INDEPENDENT
8	2	1912						MR. CROCKER PRESENTED KINRAIDES A SKETCH OF THE CLIPPER HE SAILED	SANDWICH INDEPENDENT
17	1	1913						SANDWICH WINTER CLUB WITH MRS. KINRAIDE	SANDWICH INDEPENDENT

16	5	1913						SANDWICH WINTER CLUB MEETING	SANDWICH INDEPENDENT
21	11	1913						OWL SHOT BY KINRAIDE ON DISPLAY IN MCCANN'S WINDOW	SANDWICH INDEPENDENT
10	7	1914						SANDWICH WINTER CLUB	SANDWICH INDEPENDENT
11	2	1914						WILLIAM THOMAS REED KINRAIDE BORN IN JAMAICA PLAIN MA	WILLIAM THOMAS REED KINRAIDE
8	7	1915						CARD FROM MR KINRAIDE THANKING LOCALS FOR FIGHTING FIRE NEAR HERMITAGE	SANDWICH INDEPENDENT
15	4	1916						ETHEL LEONA KINRAIDE BORN IN JAMAICA PLAIN MA	ETHEL LEONA KINRAIDE
6	7	1916						PATRIOTIC PARADE IN SANDWICH - KINRAIDE CHIEF MARSHALL	SANDWICH INDEPENDENT
7	9	1916						KINRAIDE DONATES BASES TO ATHLETIC TEAM IN SANDWICH	SANDWICH INDEPENDENT
10	5	1917						THOMAS BURTON KINRAIDE CONTEMPLATES LEAVING SANDWICH AFTER CAR ACCIDENT FROM BAD ROADS	SANDWICH INDEPENDENT
15	5	1917						ARTICLE 28 CALLED FOR IMPROVEMENT OF ROADS	SANDWICH INDEPENDENT
1	11	1918						T. BURTON KINRAIDE DONATES 35 BOUND VOLUMES OF SCIENTIFIC AMERICAN AND ELECTRICAL REVIEW TO THE STATE PRISON IN CHARLESTON MASSACHUSETTES	THE MENTOR
7	3	1918						KINRAIDE REIMBURSED FOR TOWN SPRAYER	SANDWICH INDEPENDENT
13	5	1918	6	4	1920	US	1,336,239	APPARATUS FOR FORMING A SMOOTH SURFACE ON METAL WHILE BEING MILLED	THOMAS BURTON KINRAIDE
21	4	1920						WILLIAMS CLUB MEETING - KINRAIDE REELECTED PRESIDENT	SANDWICH INDEPENDENT
12	5	1920						KINRAIDE IN MEETING REGARDING ROADS AND SCHOOL TRANSPORTATION	SANDWICH INDEPENDENT

6	12	1920					MRS KINRAIDE ASKS SEPARATE SUPPORT	BOSTON GLOBE SPECIAL EDITION
7	12	1920					MRS KINRAIDE ASKS SEPARATE SUPPORT	BOSTON GLOBE
7	12	1920					DIDN'T LOVE HUSBAND WHEN SHE MARRIED HIM	BOSTON EVENING GLOBE
8	12	1920					SENSATIONAL STORY BY MRS. KINRAIDE - ADMISSION INVOLVES HER HUSBAND AND MOTHER	BOSTON DAILY GLOBE
8	12	1920					MRS KINRAIDE FOUND DICTAGRAPH IN HOME - TRACED WIRES TO KINRAIDE'S SHOP, TORE THEM DOWN - MRS. KINRAIDE SAYS KINRAIDE THREW POWDER AT HER	BOSTON EVENING GLOBE
9	12	1920					WOMAN, MARRIED WHEN 16, NOW APPLIES FOR SEPARATION - SAYS HUSBAND IS EXCESSIVE DRINKER AND CLAIMS TO HAVE FOUND STILL IN SUMMER HOME	THE BUFFALO ENQUIRER
9	12	1920					KINRAIDE PRINCE, MRS FORD SAID - MOTHER-IN-LAW CONTINUES TESTIMONY OF RELATIONS - DICTAPHONE IN JAMAICA PLAIN HOME DISCOVERED BY WIFE	BOSTON DAILY GLOBE
11	12	1920					KINRAIDE CASE IS CONTINUED - DEFENDANT EXPECTED TO TESTIFY TODAY	BOSTON POST
11	12	1920					KINRAIDE SAYS HE MARRIED WIFE BECAUSE OF X-RAY BURNS - JAMAICA PLAIN MAN TESTIFIES IN SEPARATION SUIT THAT HE TOLD HER MOTHER HE FELT IT HIS DUTY	BOSTON EVENING GLOBE
12	12	1920					KINRAIDE TELLS HIS LIFE STORY	BOSTON SUNDAY POST
12	12	1920					MARRIED GIRL OF 16 FROM SENSE OF DUTY - SEVERELY BURNED IN LABORATORY KINRAIDE TESTIFIES - WANTED TO MAKE LIFE EASY - TELLS OF RELATIONS WITH MOTHER AND WIFE	BOSTON SUNDAY GLOBE

13	12	1920					WIFE INDIFFERENT TO HIM, SAYS KINRAIDE "I NEVER HAD ONE EVENING'S CONVERSATION WITH HER IN ALL MY MARRIED LIFE"	BOSTON EVENING GLOBE
14	12	1920					READY TO HAVE WIFE GO HOME - MOTHER-IN-LAW BARRED, SAYS KINRAIDE - INVENTOR'S TESTIMONY AT BARNSTABLE ENDS - DENIES STORY TOLD BY MRS. RACHEL FORD	BOSTON DAILY GLOBE
14	12	1920					KINRAIDE WOULD TAKE WIFE BACK - MAKES OFFER IN COURT BUT BARS MOTHER-IN-LAW - BREAKS DOWN WHILE GIVING TESTIMONY	BOSTON POST
15	12	1920					KINRAIDE'S SISTER TELLS OF SQUABBLES - MRS. CARPENTER WARNED WIFE HER MOTHER WOULD SUFFER - INVENTOR CALLED "ONLY A FIGUREHEAD"	BOSTON EVENING GLOBE
16	12	1920					MRS. KINRAIDES WINS SEPARATE SUPPORT - GIVEN CUSTODY OF THE CHILDREN - JUDGE TO FIX PAYMENT - WILL APPEAL, ASSERTS HUSBAND	BOSTON DAILY GLOBE
16	12	1920					CHILDREN GIVEN TO MRS. KINRAIDE - WINS SEPARATE SUPPORT TOO - HUSBAND WILL APPEAL	BOSTON POST
23	12	1920					MONCTON FOLKS IN DIVORCE COURT - THOS. B. KINRAIDE SUED BY HIS WIFE; SISTERS TESTIFY	MONCTON TRANSCRIPT
17	8	1921					TAX COLLECTORS SALE OF LAND - TB KINRAIDE	SANDWICH INDEPENDENT
20	2	1922					RACHEL ANN FORD DIES	RACHEL ANN FORD
22	10	1924					SALE OF KINRAIDE'S LAND IN SANDWICH	SANDWICH INDEPENDENT
24	11	1926					KINRAIDE WAS IN TOWN AND VISITED THE HERMITAGE	SANDWICH INDEPENDENT
15	12	1926					LAFOREST J. CARPENTER DIED	SANDWICH INDEPENDENT
2	7	1927					DEATHS - KINRAIDE, SUDDENLY IN CALIFORNIA JUNE 29	BOSTON GLOBE

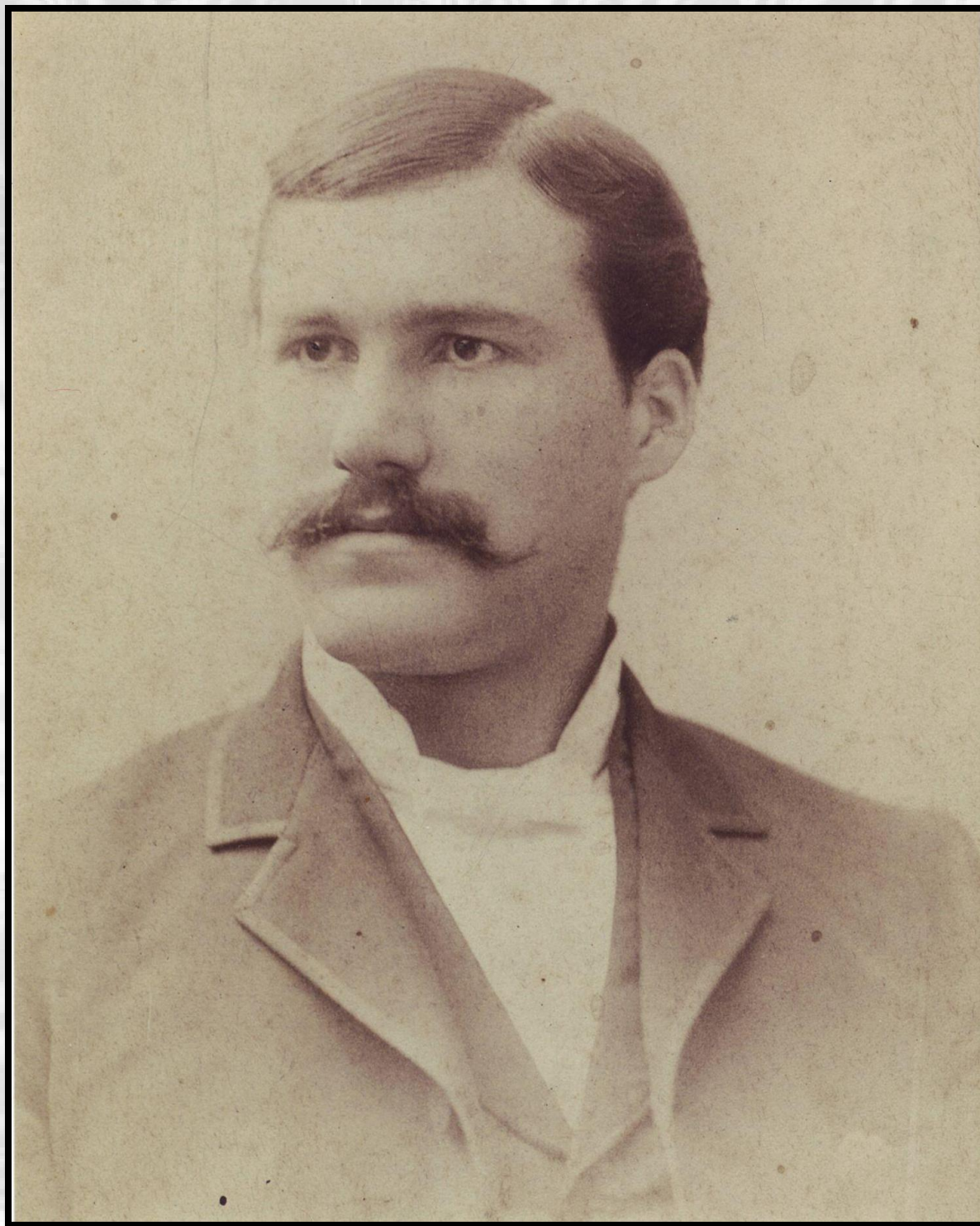
6	7	1927					DEATHS - KINRAIDE, SUDDENLY IN CALIFORNIA JUNE 30	SANDWICH INDEPENDENT
11	1	1928					1550 MILLIGRAMS OF RADIUM IN 3 TUBES FOUND AMONG THE EFFECTS OF THOMAS B. KINRAIDE WORTH \$80,000	SANDWICH INDEPENDENT
30	5	1928					ARTHUR W. DOLAN GUARDIAN OF ETHEL LEONA, THOMAS REED, AND ROBERT BURTON KINRAIDE (MINORS)	SANDWICH INDEPENDENT



Ravenscroft, photo donated by Donald Harris.



The Hermitage, photo donated by Donald Harris.



Thomas Burton Kinraide, photo donated by Donald Harris.



The Williams Club with Rachel, Robert, and Ethel in the automobile. Burton seen with a bandaged finger in the front. Photo donated by Donald Harris.



**Rebecca Reed of Tiffany & Reed, who financed Thomas Burton Kinraide.
Photo donated by Donald Harris.**

Sandwich Independent

24 June 1910

Outing at the Hermitage

On Saturday and Sunday June 11th and 12th our fellow townsman Thos. Burton Kinraide, entertained at his country residence, The Hermitage, on the shores of SPECTACLE pond, the Williams club of Boston, of which he is the president. The party of thirty came from the city in the driving rain storm by automobile by way of Plymouth, making the run in good time and with no serious mishap.

The party found good cheer, warmth and refreshment awaiting them and soon forgot the storm. The day was spent in indoor sports though some of the more ardent sportsmen dressed in oilskins braved the rain and tried their luck at fishing. Landlord Cooney of the Central House, Sandwich, with a corps of attendants provided beautiful meals and lunches of seasonable and tempting eatables and provided for the inner man. In the evening an initiation ceremony was performed for the benefit of two new members and the party joined in song and story.

On Sunday, in the morning the weather was more propitious and the party spent the time in walks about the estate, boating on the pond and entertaining visiting friends. At three o'clock a special meeting of the club convened and a suitable framed picture of the late William H. Willimas, for whom the club is named, was presented to Mr. Kinraide in the name of the club. It was announced in the course of the presentation that at the same hour a wreath was being laid on the grave of Brother Williams at Forest Hills. It may be interesting to note that the club is a voluntary self-supporting association of the members of Joseph Webb lodge, F. & A.M., Boston, who meet at stated times during the year for sociability, the purpose of the organization being primarily to exemplify certain social principles entertained by Brother Williams and to promote sociability among its members, affording an opportunity to make and perpetuate friendships.

At all the meetings, which are held on the 12th of the month, Brother Willimas birthday having been June 12th, a toast is given to the memory of Brother Williams and appropriate remarks and reminiscences given by some member of the club, which includes many of his personal friends. It may be remembered that in his will he gave the residue of his large property to the Grand lodge of Masons in Massachusetts for the establishment of a Masonic home for the needy members of the fraternity, which will no doubt later be incorporated into and be made a part of the Masonic home established by the Grand lodge at Charlton, Mass. Mr. Kinraide was one of the founders and has been the president of the club since its formation.

After the presentation the meeting adjourned to partake of a banquet prepared by Landlord Coomey, and served in a spacious tent erected for the purpose. Suitable resolutions were offered tendering thanks to Mr. Kinraide, and to the members of his household, who contributed to the success of the outing. Mr. Kinraide in his response gave an entertaining description of the historic region in and about Sandwich touching upon the King Philip war and relating anecdotes of former residents, Webster, Cleveland and Jefferson.

After dinner adjournment was made to the camp, where a social evening was passed. A few of the guests returned to Boston by the afternoon train, but a majority remained over night making a leisurly journey home by way of Plymouth and the south shore, taking leave of their host at his home in Jamaica Plain, where they personally expressed to Mr. Kinraide and his family their appreciation for the courtesies extended to them.

SANDWICH INDEPENDENT

21 November 1913

A handsome brown owl, shot a few days ago by T. B. Kinraide, is on exhibition in McCann's window.

8 February 1912

Selectman Laban P. Crocker has been the guest of Mr. and Mrs. T. B. Kinraide at their home in Jamaica Plain. Mr. Crocker has recently presented Mr. and Mrs. Kinraide an original sketch of the clipper ship in which he sailed when a young man.

SANDWICH INDEPENDENT

January 11, 1928

SANDWICH - Leaves three tubes of Radium

In the estate of the late Thomas B. Kinraide of this town, who died recently in California, an unusual and interesting discovery was made.

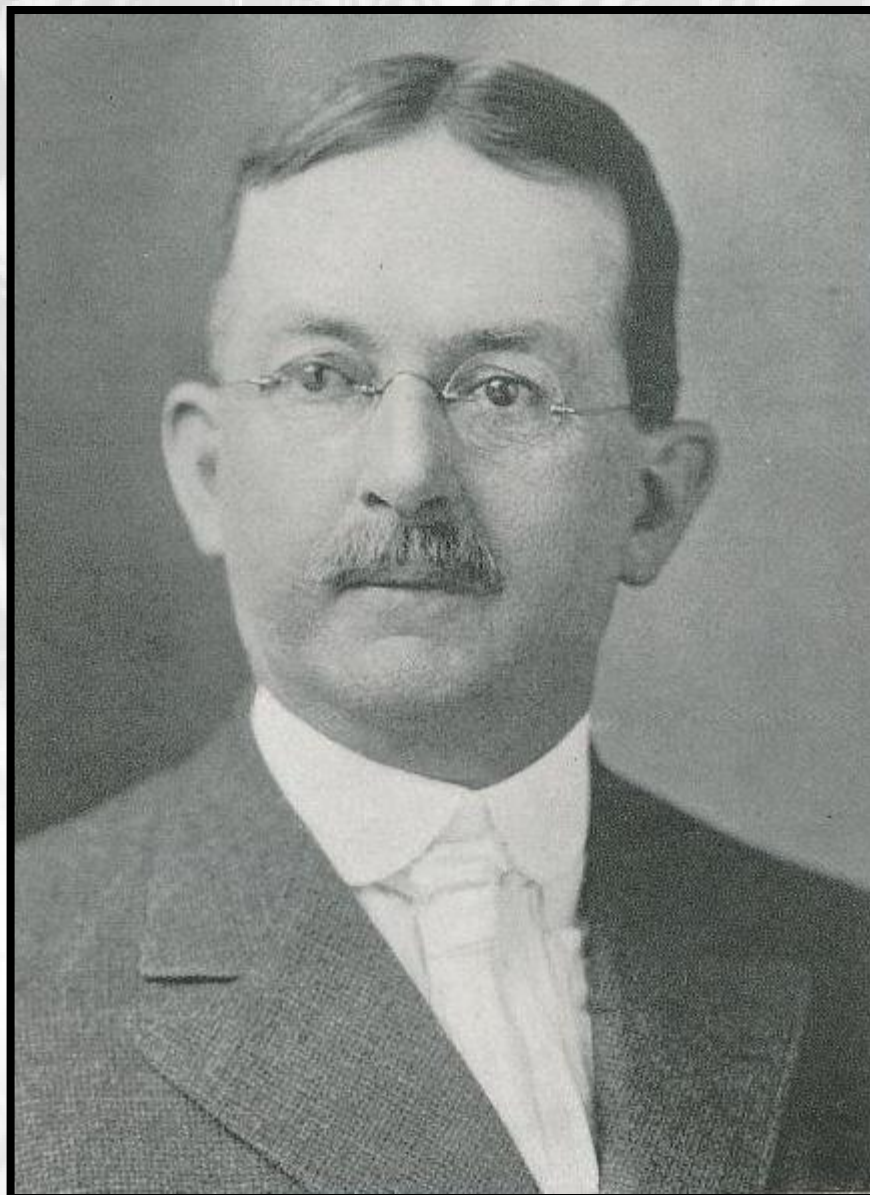
The San Francisco Chronicle furnishes the following information: Three tubes found among the effects of the late Thomas B. Kinraide were labeled as containing altogether 1550 milligrams of radium.

The public administrator, Amos O. Williams, sent the tubes to the United States Bureau of Standards at Washington for analysis.

The tubes are supposed to contain \$80,000 worth of radium.

Several from Sandwich attended the funeral services for Thomas Burton Kinraide, which were held from his late home in Jamaica Plain. Mr. Kinraide's death came as a great shock to his host of friends in Sandwich. When he resided here, his many acts of kindness and his generosity to those in trouble and sickness will long be remembered. He loved the old town and its people.

The author believes Burton acquired the radium to try and save his friend's life, Frank H. Swett of the former Swett & Lewis Company who sold Kinraide's inventions.

**FRANK HOWARD SWETT****1868-1929**

Frank Swett was well known to the early radiologists of New England. A merchant of the commodities and apparatus of the radiological laboratory, he was a familiar figure often seen here and there in the x-ray departments of hospitals or in private offices. A genial and cheerful soul, his arrival with supplies was often most welcome at the scene of one of the minor accidents or emergencies so well remembered by the pioneer.

Swett was of old Yankee stock. Born in Amesbury, Massachusetts in 1868, he was the son of John Howard and Annie (Williams) Swett. He was educated in the local graded schools and finally at Phillips Exeter Academy. His early life was largely devoted to various mercantile pursuits. Before the year of Röntgen's discovery, he was engaged in the distribution of electric motors as an agent for the General Electric Company, but sharing the initial general interest in that event and visualizing the possibilities in its medical development, in the spring of 1897 he formed a partnership with his brother-in-law, Mr. Clarence H. Lewis, for the distribution of x-ray apparatus to hospitals and physicians. Their establishment in Boston constituted one of the first American ventures for this purpose. As a distributor of Crookes tubes and fluorescent screens especially, it became Mr. Swett's duty to demonstrate and test this apparatus for the information of prospective purchasers, and at first much of this work was done by means of a small influence-(static-) machine.

Swett's first dermatitis appeared on the back of his left hand. This slowly healed with the deposition of pigmentation, to be followed, for some years subsequent to 1897, by similar attacks which in turn subsided, but later left keratosis-formation. It was not until 1905 that an ulcerative process formed on the back of the left hand, which failed completely to heal although showing a tendency to do so.

Many keratoses also formed on the left hand and the front of the chest, as well as a small persistent wart on the tip of the nose. These lesions were all successfully removed and, where necessary, were also successfully skin-grafted.

With this excellent restorative result, Mr. Swett returned to the activity of his mercantile life. Being a merchant well-liked and highly respected, his field of usefulness widened, and he was the means of supplying much of the earliest x-ray apparatus to hospitals, physical laboratories, and practitioners in urban New England. When his association with his brother-in-law was terminated, he joined forces with a group of Boston tube-makers, and all were later combined as a branch of a large mercantile corporation engaged in the production of all forms of roentgen apparatus.

Swett's affable manner and his generosity of his time and energy seriously hampered his physical well-being. During the six or seven years following 1908, he continued to work diligently, demonstrating—although now not so frequently—by fluoroscope and exhibiting apparatus that was rapidly developing in practicality and efficiency. A naturalist, he gave little thought to his own condition, which seems not to have manifested itself acutely again until 1913, when a process of ulceration appeared on a thickened area of keratosis on his left forefinger. This was surgically removed and closed with a skin graft.

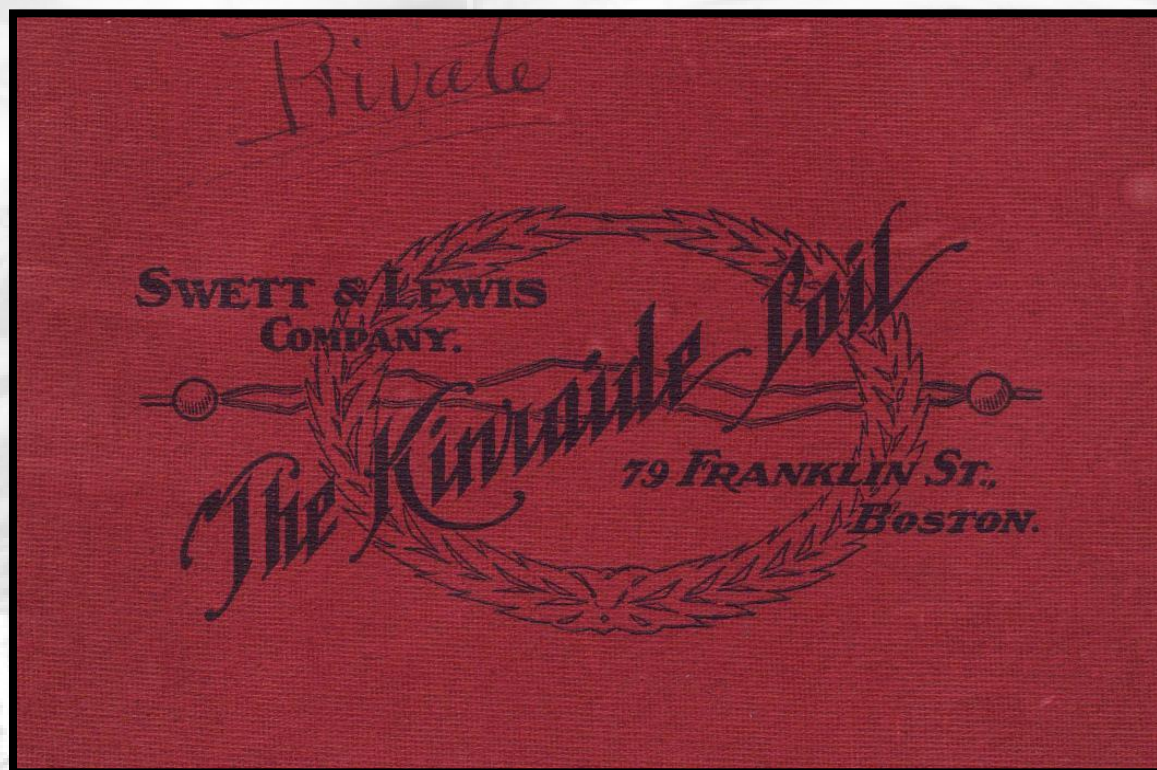
In the early summer of that year, by an unfortunate accident—the scratch of a cat, apparently trivial at the moment—the edge of this graft was wounded and an ulceration promptly appeared. This was removed and found by microscopic examination to be carcinomatous. Although the finger was immediately amputated, with healing in two weeks, it did not forestall the upward extension of the disease by metastasis. Toward the end of 1914, the glands in the axilla and in

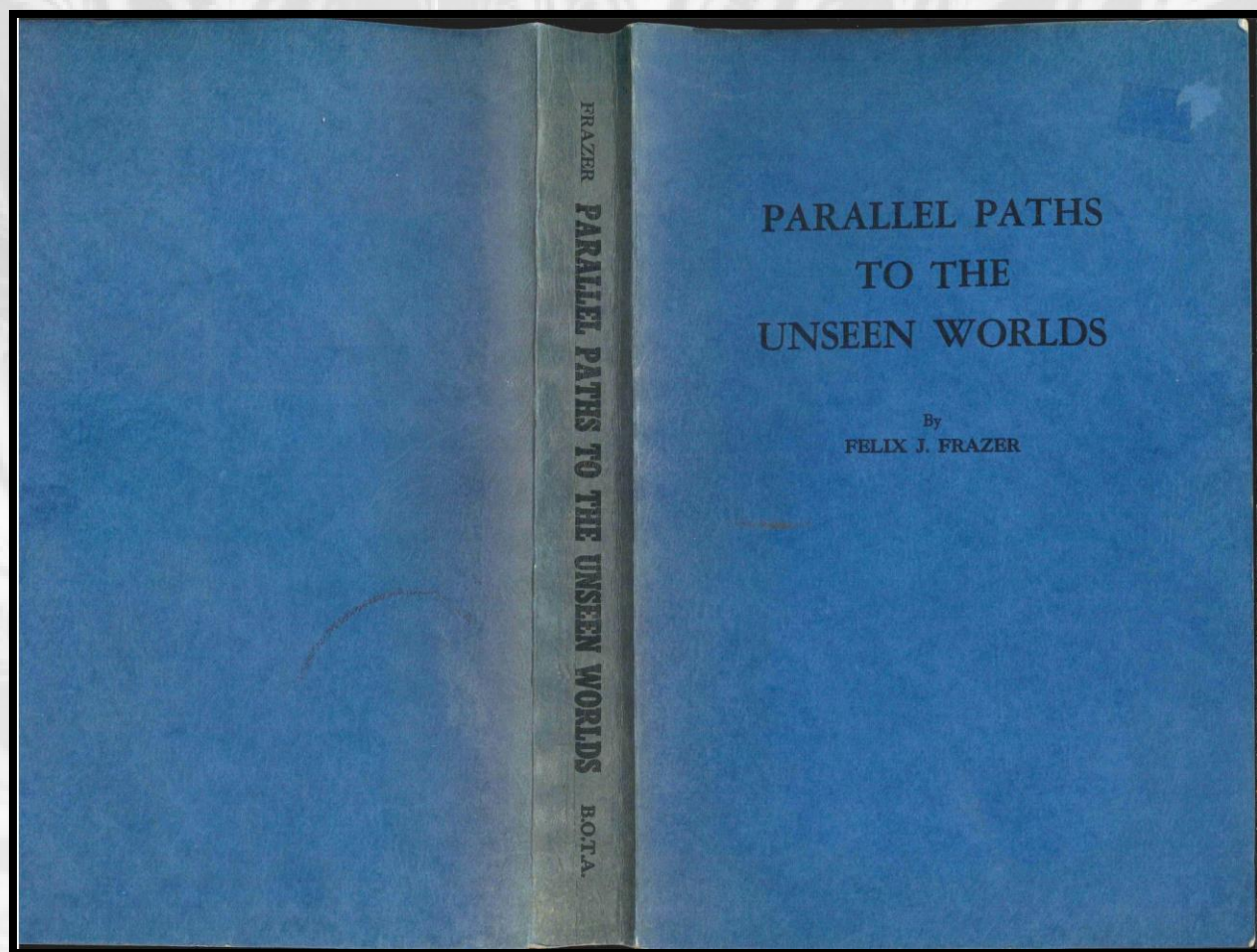
the anterior wall of the chest were found to be involved. As soon as possible, these glands were removed, as well as suspicious areas involving other fingers of the left hand.

In common with all who were engaged in the production and demonstration of Crookes tubes vide histories of Henry Green, Rome Wagner, Burton Baker, and others—Frank Swett sustained much x-ray damage to the tissues of the face, lips and chest. Such lesions were the result of mechanical necessity, furthered by enthusiasm for the work and its future, and glorified by a spirit of complete selflessness. From 1915 until the moment of his death, almost, he submitted with the utmost cheerfulness to the unrelenting efforts of his surgeons to stay abreast of the disease in these areas. The length of time his life was preserved speaks strongly to their loyal persistence and his own unflinching fortitude. More radium was used in his case than in any other of chronic radiation dermatitis recorded among the pioneers similarly affected, partly perhaps because of his own predilection for this form of treatment rather than orthodox surgery, but as time elapsed, it seemed impossible to thwart the tendency to metastatic spread.

In spite of radical surgical procedures to this end, Frank Swett died, a paragon of cheerful courage and stoic fortitude, his self-sacrifice crowning a life of continued usefulness

"A quiet and unassuming man, who bore his burdens and did his work faithfully, effectively, patiently and without complaint.... He suffered that the realm of knowledge might be widened and humanity blessed with a new agency with which to combat disease."





PARALLEL PATHS TO THE UNSEEN WORLDS by FELIX J. FRAZER

A book such as this requires the cooperation of many minds. Thus, source material and permission to quote has come from many individuals and publishers. Critical reading, editing, and the like have been freely given and are herewith gratefully acknowledged. Special credits are often included in the text.

Harper & Brothers, Publishers, New York. William Sloane Associates, Publishers, New York. Dr. Ian Stevenson, School of Medicine, University of Virginia. Harcourt, Brace & World, Inc., Publishers, New York. The late Dr. Nandor Fodor, New York and Los Angeles. Mr. Colin Evans, medium, London, England. Psychic Science Publication, London, England. Psychic Observer Publication, Southern Pines, North Carolina. The Herald-Express and reporter Moffitt, Los Angeles. Mr. Attila Von Salay, photographer, Los Angeles. Mrs. Mary C. Pato, Publisher, Surrey, England. The Society for Psychical Research, London, England. The American Society for Psychical Research, New York. Dr. Gina Cerminara, constructive criticism. Mrs. Edith Dow, editing and typing. Mrs. Edna M. Allen, typing. Rev. Alastair O. Wallace, New Zealand. Mr. William Bell, New Zealand. Rev. Harriet B. Case, and many others who have so kindly contributed their share.

THREE-SPACE PERSPECTIVES APPLIED TO FOUR-DIMENSIONAL OBJECTS

Relating this to the fourth dimension, what can we infer about the actual existence of this dimension from the dimensions with which we are familiar? In Figs. 5 and 6, we see a two-dimensional representation of three-dimensional figures. Thus, you may rightly ask if it is possible to construct a solid three-dimensional representation of a four-dimensional object, such as the imagined four-dimensional cube or tesseract.

Some 45 years ago, the late Dr. Burton Kinraid and I did exactly that. The object we made took several weeks to fashion on precision lathes and other equipment, and this was preceded by many months of mathematical calculation. The rules of perspective drawings were mathematically "stepped up" to give us, by analogy, what they would be if applied to the fourth dimension.

The idea is simple, but the execution is difficult. Since we know that perspective, or two-dimensional representation, has its rules, we also know that these rules, which are algebraic-geometrical, can be expressed mathematically by means of analytical geometry. Thus, Dr. Kinraid and I assumed that we could do a "perspective drawing" of a four-dimensional object in the medium of three dimensions, much the same as you can take a picture, or make a drawing, of a three-dimensional landscape or object and show it on a two-dimensional sheet of paper.

A SUPERCONSCIOUS GLIMPSE

We did it and came out with a geometric solid of three dimensions made of hardwood and painted white. It was disappointing at first, for we certainly saw nothing of the fourth dimension in it. But my brilliant and wise colleague did not stop there, as I might have done. He suggested that we place it thoughtfully on a shelf in our dining room and look at it from time to time during meals. Also, that we meditate upon it and go over in our minds everything that we had done to construct it. We might, as he said, "grow the necessary brains" to actually see and perceive what it represented

This we did. Several weeks later, as I was sipping my morning coffee, I happened to look up at this object and found myself staring in bewilderment at a four-dimensional object. Yes, the four dimensions were all there and as plain as daylight. Dr. Kinraid noticed my astonishment and burst out laughing, so I asked him if he had seen it too. He told me that he had seen it the day after it was placed on the shelf and was waiting for me to see it.

Shortly after that, Dr. Kinraid passed on. Before I was able to take photographs and write a monograph, the object and our laboratory notes were lost in the careless handling of that part of his estate. Nor could I hope to duplicate what was done without such a one as he stood at my elbow. Thus passed into oblivion, temporarily I'm sure, a significant advance in this subject. In the cosmic sense, it was doubtless premature... just a foretaste of things to come.

THE FOURTH DIMENSION IN PHILOSOPHIC THOUGHT

Others, too, have had a foretaste of these things. Kant recognized the possibility of extensions in this new direction. He inferred their probability in these words:

"If it is possible that there are developments of other dimensions of space, it is also very probable that God has somewhere produced them. His works have all the grandeur and variety that can possibly be comprised."

The concepts of hyperspace can never be dismissed as impossible or illogical. The rules of mathematical analogy sustain their logical nature at every point. These concepts have solved several of the problems and many of the contradictions that have plagued our scientists. Helmholtz was fully aware of the possible existence of hyperspaces, as was Kelvin, who expressed himself as ready to accept hyperspace explanations of physical phenomena when such could be more consistently explained by such concepts

On the philosophical side, the idea of hyperspace has been found in the teachings of ancient India, as well as in the philosophical systems of, to name but two, Parmenides and Pythagoras. While not explicitly referred to, the teachings of B.O.T.A., which comprise a modernized and Westernized version of the Ageless Wisdom as taught by Masters of all climes and times, can be better understood if related to higher-space concepts

Even as it is convenient and useful to have a location (locus) in which to place and systematically arrange the objects of everyday observation, and even though this locus, which we call empty space, can never be perceived of or by itself by any exoteric means whatsoever, it is also convenient, proper, and useful to have a locus, such as the hyperspaces, in which to place and systematically arrange, insofar as may now be possible, certain SPR phenomena and certain occult concepts. To do the one is just as valid and reasonable as to do the other. In this connection, C. Howard Hinton tells us:

"Either of two things must be true that four-dimensional conceptions give a wonderful power of representation to the thought of the East, or that the thinkers of the East must have been looking at and regarding four-dimensional existence."

On the mathematical and scientific side, Claude Bragdon tells us:

"The notion of geometries of many-dimensional geometry, that is, of higher-space, began to suggest itself to mathematicians in the early half of the 19th century, and has assumed an increasing importance ever since. Attempts to utilize the higher-space hypothesis in the explanation of chemical and physical phenomena has served to bring the subject prominently before workers in these branches of science."

Switching back to the philosophical and mystical side, Mr. Bragdon goes on to say:

"This hypothesis (the fourth dimension), because it accounts for many so-called psychic phenomena, has been seized upon by the psychic researcher, hard pressed for some quasi-scientific explanation of things whose reality cannot be doubted."

"Research always leads into the profound. The light of things known serves only to reveal the greater abyss of mystery beyond the threshold of consciousness. The higher-space hypothesis makes Man in his present state appear but as an earthworm in power and knowledge. Nevertheless, it holds out the promise of eternal progress.

In the following chapter, we will look at other aspects of hyperspace concepts by the method of strict analogy.

* * *

Suggested reading:

A PRIMER OF HIGHER SPACE, and FOUR-DIMENSIONAL VISTAS, by Claude Bragdon.
Alfred A. Knopf, New York, Publisher

Fourth Dimension

In the evolution of the line into the square and the square into the cube a new form results whose parts are those of the previous units.

Thus we form a square with four lines.

These lines are the units of the structure of the square. Six Squares are added to each other to form a cube.

The units of the structure of the cube are 6 squares. It is evident therefore that if we add cubes together we obtain another form whose units are cubes.

In the Square the 4 lines and 4 points are visible. In the cube the lines and points of all the squares are visible. In the 4th dimensional figure the points, lines, squares and cubes are all visible.

Human beings and all beings living in three dimensional bodies cannot have access to any other dimensional existence or be in any way conscious of anything outside of the particular three dimension they occupy or beyond their boundaries.

If such limitation did not exist our powers would be very marvellous such as would be possible to us as we are to which add freedom from our boundaries that limit us physically.

The universe seems vast beyond all comprehension space is to us all but incomprehensible. This would not be so if we could pass our boundaries. The distance from star to star would be but a little flight and thus would disappear all concepts formed by our inhibition such as bind us now.

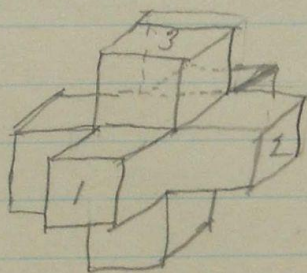
Inasmuch as we have lines
and a form constructed of lines
of 2 dimensions called a square.
and a figure constructed of planes
or squares called a cube ^{having 3 dimensions} then we should
have a form composed of cubes that
that would have to be known as
4th dimension

are there not atoms having poles
that unite to form units of length
these uniting to form areas and
these uniting to form three dimension-
al forms. Having obtained forms
that are solid their next evolution
would be expansion of that form.
This expansion of the three dimension-
al form must then be the fourth
dimension of evolving form. The
next would be the fifth and so
on until the ego at work has come
to that dimension that is a measure
of its cohering power as a form.

No Matter how vast we may make
three space - even if it be extended to the
boundaries of the universe if that were
possible - fourth dimension would still
bear the same relation to three space that
three space bears to two space

The ratio of magnitude of three space is
determined by two space . . . the ratio of
four space is determined by three space

The figure produced by placing
the cube where the square was placed
in the mirror is the figure of 3dimen-
sions whilst the cube is the cube and
not to be confounded with this new
figure



The subdividing of a square and the movement of its subdivided parts in the direction of third dimension makes of the square a condition of three dimension as related to its smaller squares

In a like manner a line may be subdivided and its subdivisions moved to positions that exist in two dimensions $\text{---} \overset{\text{line}}{\text{---}} \text{---}$ If $\text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---}$ moved line

this broken line is viewed from A it will appear to be the same as before it was moved

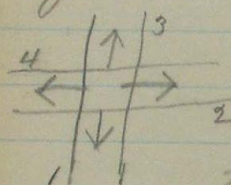
It follows therefore that if we subdivide a cube and move its subdivided parts in the direction of fourth dimension it will appear as a cube still when viewed from fourth dimension

The Fourth dimension
formed by the movement
outward of the contents of a
cube in the direction of its
faces one half of the cube
appearing on each face

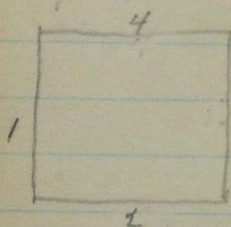
a line has length only

a Square has two dimensions
measured along the lines that
form its boundaries

The square is produced
by moving the lines 1. 2. 3. 4



in the direction of the
arrows outwardly from
the central square until
the square is produced



The square thus produced
has no surface and is merely
space inclosed by the lines
1. 2. 3. 4

One dimension converges from all directions upon a point

Two dimensions converge from all directions at right angles to one dimension

Three dimensions converge from all directions at right angles to two dimensions

Four dimension converges from all directions at right angles to three dimensions

A great number of lines can converge upon a point converging from all directions. To illustrate this use a ball of shellack and stick heated needles into it.

A large number of squares can converge upon a line from all directions at right angles to its length or one dimension.

Two cubes can converge upon the two faces of a square from two directions at right angles to its surface.

all angles Squares Tetrads
cubes and all regular or
symmetrical forms can be subdivided
into units of their form exactly like
themselves but smaller
The sphere?

The True Mirror that will
reflect a correct image

This produced by placing two Mirrors
at an angle of 90° This gives
the image correctly so that the
Right hand of the image is the same
as the original /

Mirrors producing 4 space

Two plane mirrors are mounted so as to form the two sides of a box  in their interior angles that are 90° we may produce the image of the lines forming the boundaries of a square by placing a wire rod having its ends slightly beveled the ends of the rod resting upon the faces of the mirror marked by the two points A B

This will produce an image of the wire repeated three times and will form with rod itself a perfect square

The mirrors it will be seen are entirely in three space relative to the squares they may generate

We can now construct a set of mirrors that will make a cube of our square the mirrors extending wholly in the fourth dimension relative to the cube generated by the square in the same meaning of the term as we found in the generation of a square from a line

Law of transposition of Matter

all solid forms may be symmetrically subdivided. The reversing or turning outward of these subdivisions changes the original form to the next higher type. Planes occupy the places of the previous lines generally.

The new form will inclose twice the volume. This can only be true of three space.

Golden Spiral $\rightarrow$ 4th dimensionized
lands

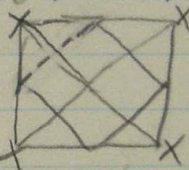
Transposition of Octahedron

The solid substance of the Octahedron may be subdivided into eight parts these sections may be turned inside out producing a cube whose inside shape is that of the Octahedron

a line has two ends - points
 a square " four edges - lines
 a cube " six sides - squares
 a cuboid " eight faces - cubics

a line has two points
 a square " four lines
 a cube " six squares
 tetrahedron " 8 cubes
 10 tetrahedra
 12
 20

two points bound lines three lines bound
triangles four triangles bound tetrahedrons
Tetrahedrons combine to construct
figures in two ways the apex turned
in or out 20 tetrahedrons (apex in)
form a sphere having 20 faces

The crossing and intertwining of three
 three dimensional figures at right
 angles to each other is produced
 by six pyramids that form a cube when
 put together. a section is removed
 from the corners of each of the pyramids
 so that instead of the square forming
 the base of the pyramid a new
 square is produced.  The
 x mark the sections to be removed
 These when put together
 so as to form a cube will produce
 three three dimensional solids crossing
 each other at right angles

Intersecting or Crossing Planes

Three planes cross each other at right angles in a cube of eight cubes

Four planes cross each other in the subdivision of a cube into six pyramids the faces of the cube being the bases of the pyramids. Four planes cross each other in the four square segment of the double pyramid formed by removing a double pyramid from its two apices to their meeting place at the centre

all pyramids are inclosed by eight planes. The tetrahedron is inclosed by four planes. In pairs they can cross at right angles

In three intertwined pyramids eight planes cross at its centre

Two intertwined Tetrahedrons inclose a space bounded by eight planes

The Dodecahedron is formed of six double pyramids and has six planes crossing in the directions of from line to line crossing the cube

Three Dimensional planes

These are found in the construction of a cube with cubes. The line of cubes extending from the corners to the centre and those extending from the edges inward represent a three Dimensional plane that takes the place of the planes of the cube when the two dimensional pyramids are used.

These planes can be traced in all forms constructed of cubes. The cube face extends inside this line or form.

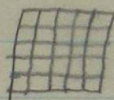
Boundaries are the limits of
all dimensions beyond which they
do not extend.

What is a three dimensional boundary
how many boundaries has fourth dimension
in points lines planes and?

Transposition of cubes
 Occupying four positions Hidden or obscure
 Inferior Mediocre Superior

The determination of a higher dimension from a lower is based upon the higher conditions of expression found in the lower

A square is divided into smaller squares thus

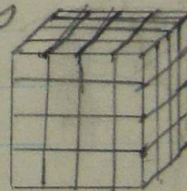


It will be seen at once

That the squares at the corners have an advantage over all the other squares since two of their sides are exposed whilst the others have only one

A cube is subdivided into smaller cubes

It is evident that the corner cubes occupy a superior position over the edge cubes and these in turn have an advantage



over the face cubes. The corner cubes having three sides exposed, the edge cubes have two, and the face cubes one. From the preceding it is evident that



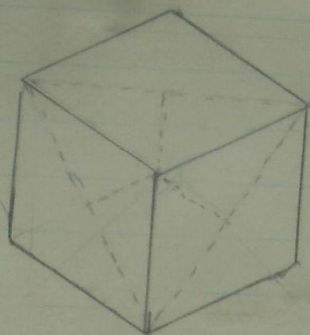
The next higher form will have the following conditions
 Its face cubes will have two sides exposed its edge cubes will have three and its corner cubes four sides exposed. This is realized in the Rhombahedron

having faces formed by the edges of cubes. The next higher form will have three sides of the cubes forming the faces exposed the edges will have four sides exposed and the corners five. This is a description of the cubic Octahedron.

The next higher form will have four sides of its face cubes exposed, the edges will have five sides exposed and the corners six. This form is the Rhombic Dodecahedron having edges of cubes alternating with each other across its face.

The next higher form will have five sides of the cubes forming its faces exposed. Its edges will have six

and its corners six sides exposed  The next higher dimension The cubes forming its sides will have six sides exposed The edges will have six sides exposed The corners will have six sides exposed All the hidden cubes that have been hidden within the cube have in the seventh dimension become equal with those on the outside



section of cube producing when
turned outward three twinning
cubes

If a small netting needle is
 fixed in a support so that it stands
 perpendicular to the surface of a table.
 a wire is bent to form the three sides
 of a square and fixed in a light
 support so that the netting needle
 forms the other side of the square
 thus  if we look down in
 the direction of the length of the needle we
 see that the bent wire square occupies but
 a small portion of the region about the
 netting needle, and that we could
 place a number of such squares around
 the netting needle each of which would
 have the needle as their fourth side. 

It is possible for the figures
bounded by corners of planes
to be the third dimension
three dimensions should have
3 planes crossing each other at
right angles

The Cube has on subdivision six pyramidal sections having their apex at the centre. The Rhombic Dodecahedron has twelve pyramidal sections having same angle as cube but having the corners of the pyramid at the centre.

The Rhombic Dodecahedron has the same faces as the Octahedron except that they are cubic. By placing the right sections of the Dodecahedron on the faces of the Octahedron the latter is changed to the former.

⊕

Points Bound lines, lines bound
planes, Planes bound cubes,
Cubes bound fourth Dimension

The adding of lines to any
two dimensional form does not
cause it to become a three dimens-
ional one if added in the same
plane we may thus make a four
out of a three sided figure or a five
sided but this does not cause it
to become three dimensional

The addition of faces to a three
dimensional figure cannot therefore
cause it to become fourth Dimension
no matter how many may be added
we must assume therefore that the
statement that is made that the
fourth Dimensional cube has eight
faces is not correct since the
boundaries of two dimension stop
at the third dimension and the fourth
must be bounded by cubes and
also that it must have eight cubic

⊕

Boundaries In other words it will have eight faces formed of cubes. This figure is realized in the cubic Octahedron

A square has four one dimensional sides, a cube has six two dimensional faces. The cubic octahedron has eight cubic faces

Progression of boundaries Φ

A line is bounded by two points
a square is bounded by four
lines a cube is bounded by
six squares. The addition
of more lines to a square will
not make it three dimensional
if the added lines are in the same
plane neither will the addition
of more squares to a cube make
it fourth dimensional if in the
same three space

an infinite plane may be divided by two lines crossing it at right angles so that plane beings living in such a universe would be unconscious of those living on the other side of the lines dividing one portion of two space from the other (this is an assumption)

The cleaving of space by three infinit planes at right angles to each other divides space into eight three dimensional regions separated from each other by three boundaries that limit each of the three dimensions completely separating them from each other; since a three dimensional being could occupy and perceive that dimension only in which he was, the other seven three dimensional spaces would be invisible and would lie beyond the boundaries of his world.

2 Points determine a line 3 points determine
a plane 4 points determine a three dimension
5 points determine four dimension.

The movement of one point in one dimensional space produces a line

The movement of two lines in two dimensional space in directions that cross each other produces a square

The movement of three squares in three dimensional space in directions that cross each other produces a cube

The movement of four cubes in four dimensional space in directions that cross each other produces a cube of cubes

Fourth Dimension

In the evolution of the line to the square and the square into the cube a new form results whose parts are those of the previous units. Thus we form a square with four lines. These lines are the units of the structure of the square. Six squares are added to each other to form a cube. The units of the structure of the cube are squares. It is evident therefore that if we add cubes together we obtain another form whose units are cubes. In the square the 4 lines are 4 points are visible in the cube and the lines and points of all the squares are visible in the 4th dimensional figure the points lines squares and cubes are all visible.

Human beings and all beings living in three-dimensional bodies cannot have access to any other dimensional existence or be in any way conscious of anything outside of the particular three dimension they occupy or beyond their boundaries if such limits did not exist our powers would be very marvelous such as would be possible to us as we are to which add freedom from our boundaries that limit us physically

The universe seems vast beyond all comprehension spaces to us but incomprehensible this would not be so if we could pass our boundaries the distance from star to star would be but a little flight and thus would disappear all concepts formed by our inhibitions such as hand us now and as much as we have lines and a form constructed lines of two dimensions called a square and a figure constructed of planes or squares called a cube having three dimensions then we should have a form composed of cubes that would have to be known as fourth dimension

Are there not atoms having poles that unite to form units of light these uniting to form areas in these uniting to form three-dimensional forms having obtained forms that are solid their neat evolution would be expansion of that form this expansion of the three-dimensional form must then be the fourth dimension of evolving form the next would be the fifth and so on until the ego at work has come to that dimension that is a measure of its cohering power as a form

No matter how vast we may make three space even if it be extended to the boundaries of the universe if that were possible fourth dimension would still bear the same relation to three space that three space to two space the ratio of magnitude of three space is determined by two space the ratio of four space is determined by three space

The figure produced by placing the cube where the square was placed in the mirror is the figure of three dimensions whilst the cube is the cube and not to be confounded with this new figure

The subdividing of a square in movement of its subdivided parts in the direction of this dimension makes of the square a condition of three dimension as related to its smaller squares

In a like manner a line may be subdivided and its subdivisions moved to positions that exists in two dimensions if this broken line is viewed from A it will appear to be the same as before it was moved

It follows therefore that if we subdivide a cube and move its subdivided parts in the direction of fourth dimension it will appear as a cube still when viewed from fourth dimension

The fourth dimension formed by the movement outward of the contents of a cube in the direction of its faces one half of the cube appearing on each face a line has length only a square has two dimensions measured along the lines that form its boundaries the square is produced by moving the lines 1, 2, 3, 4 in the direction of the arrows outwardly from the central square until the square is produced the square thus produced has no surface and is merely space enclosed by the lines

One dimension emerges from all directions upon a point two dimensions converge from all directions at right angles to one dimension three dimensions converge from all directions at right angles to two dimensions four dimension converges from all directions at right angles to three dimensions a great number of lines can converge upon a point converging from all directions

To illustrate this use a ball of shellac and stick heated needles into it a large number of squares can converge upon a line from all directions at right angles to its length or one dimension two cubes can converge upon the two faces of a square from two directions at right angles to its surface

All angles squares tetrads cubes and all regular or symmetrical forms can be subdivided into units of their form exactly like themselves but smaller the sphere?

The true mirror that will reflect a correct image

This produced by placing two mirrors at an angle of 90° this gives the image correctly so that the right hand of the image is the same as the original

Mirrors producing four space two plane mirrors are mounted so as to form the two sides of a box in their interior angles that are 90° , we may produce the image of the lines forming the boundaries of a square by placing a wire rod having its end slightly beveled

The ends of the rod resting upon the faces of the mirror marked by the two points A B

This will produce an image of the wire repeated three times and will form with rod itself a perfect square the mirrors it will be seen are entirely in three space relative to the square they may generate we can now construct a set of mirrors that will make a cube of our square

The mirrors extending wholly in the fourth dimension relative to the cube generated by the square in the same meaning of the term as we found in the generation of a square from a line

Law of transposition of matter all solid forms may be symmetrically subdivided the reversing or turning outward of these subdivisions changes the original form to the next higher type

Planes occupy the places of the previous lines generally the new form will enclose twice the volume this can only be true of three space

Transformation of octahedron

The solid substance of the octahedron may be subdivided into eight parts these sections may be turned inside out producing a cube whose inside shape is that of the octahedron a line has two ends points

A square has four edges lines - a cube has six sides squares - a cuboid has eight faces - cubic
A line has two points a square has four lines a cube has six squares tesseract has eight cubes
two points bound lines three lines bound triangles four triangles bounds tetrahedrons

Tetrahedrons combine to construct figures in two ways, the apex turned in or out
Twenty tetrahedrons apex in for a sphere having 20 faces

The crossing and intertwining of three three-dimensional figures at right angles to each other is produced by six pyramids that form a cube

When put together a section is removed from the corners of each of the pyramids so that instead of the square forming the base of the pyramid a new square is produced the X mark on the sections to be removed these when put together so as to form a cube will produce three three-dimensional solids crossing each other at right angles intersecting or crossing planes

Three planes cross each other at right angles in a cube of eight cubes four planes cross each other in the subdivision of a cube into six pyramids the faces of the cube being the basis of the pyramids

Four planes cross each other in the 4-square segment of the double pyramid formed by removing a double pyramid from its two apexes to their meeting place at the center

All pyramids are enclosed by eight planes

The tetrahedron is enclosed by four planes in pairs they can cross at right angles in three intertwined pyramids eight planes cross at its center two intertwined tetrahedrons and close the space bounded by eight planes

The dodecahedron is formed of six double pyramids and has six planes crossing in the directions of from line to line crossing the cube

Three-dimensional planes

These are formed in the construction of a cube with cubes

The line of cubes extending from the corners to the center and those extending from the edges inward represent a three-dimensional plane that takes the place of the planes of the cube

When the two-dimensional pyramids are used these planes can be traced in all forms constructed of cubes

The cube face extends inside this line or form

Boundaries are the limits of all dimensions beyond what they did not extend

What is a true dimensional boundary

How many boundaries has fourth dimensions in points lines planes and ?

Transformation of Cubes

Occupying four positions hidden on obtuse inferior mediocre superior

The determination of a higher dimensional from a lower is based upon the higher conditions of expression found in the lower a square is subdivided into smaller squares thus it will be seen at once that the squares at the corner share an advantage over all the other squares since two of their sides are exposed whilst the others share only one

A cube is subdivided into smaller cubes

It is evident that the corner cubes occupy a superior position over the edge cubes and these in turn have an advantage over the face cubes the corner cubes having three sides exposed the edge cubes having two and the face cubes one

From the proceeding it is evident that the next higher form will have the following conditions

Its face cubes will have two sides exposed it's edge cubes will have three and it's corner cubes four sides exposed

This is realized in the rhombhedron having faces formed by the edges of cubes

The next higher form will have three sides of the cubes forming the faces exposed the edges will have four sides exposed and the corners five this is a description of the cubic octahedron

The next higher form will have four sides of its face cubes exposed the edges will have five sides exposed and the corners six

This form is the rhombic dodecahedron having edges of cubes after mating with each other across its face the next higher form will have five sides of the cubes forming its faces exposed its edges will have six and its corners six sides of each exposed

The next higher dimension the cubes forming its sides will have six sides exposed

The edges will have six sides exposed the corners will have six sides exposed all the hidden cubes that have been hidden within the cube have in the seventh dimension become equal with those on the outside section of a cube producing when turned outward three twining cubes

A small knitting needle is fixed in a support so that it stands perpendicular to the surface of a table a wire is bent to form the three sides of a square and fixed in a light support so that the knitting needle forms the other side of the square that's if we break down in the direction of the length of the needle we see that the bent wire square occupies but a small portion of the region about the knitting needle and that we could place a number of such squares around the knitting needle each of which would have the needle as their fourth side

It is possible for the figures bounded by corners of planes to be the third dimension three dimensions should have three planes crossing each other at right angles

The cube has on subdivision six pyramidal sections having their apexes at the center the rhombic dodecahedron has twelve pyramidal sections having same angle as cube but having the corners of the pyramid at the center

The rhombic dodecahedron has the same faces as the octahedron except that they are cubic by placing the right sections of the dodecahedron on the faces of the octahedron

The latter is changed to the former points bound lines, lines bound planes, planes bound cubes, cubes bound fourth dimension

The adding of lines to any two-dimensional form does not cause it to become a three-dimensional one if added in the same plane

We may thus make a form out of a three sided-figure or a five-sided but this does not cause it to become three-dimensional

The addition of faces to a three-dimensional figure cannot therefore cause it to become fourth dimensional no matter how many may be added

We must assume therefore that the statement that is made that the fourth dimensional cube has eight faces is not correct since the boundaries of two dimensions stop at the third dimension and the fourth must be bounded by cubes and also that it must have eight cubic boundaries

In other words it will have eight faces formed of cubes

This figure is realized in the cubic octahedron

A square has four one-dimensional sides

A cube has six two-dimensional faces

The cubic octahedron has 8 cubic faces

Progression of boundaries

A line is bounded by two points

A square is bounded by four lines

A cube is bounded by six squares

The addition of more lines to the square will not make it three-dimensional if the added lines are in the same plane neither will the addition of more squares to a cube make it fourth dimensional if in the same three space

An infinite plane may be divided by two lines crossing it at right angles so that the plane beings living in such a universe would be unconscious of those living on the other side of the line dividing one portion of two space from the other (this is an assumption)

The delving of space by three infinite planes at right angles to each other divide space into eight three-dimensional regions separated from each other by three boundaries that the limit of the three dimensions completely separating them from each other, since a three-dimensional being could occupy and perceive that dimension only in which he was the other

Seven three-dimensional spaces would be invisible and would be beyond the boundaries of his world

Two points determine a line

Three points determine a plane

Four points determine three dimensions

Five points determine four dimensions

The movement of one point in one dimension space produces a line

The movement of two lines in two-dimensional space in directions that cross each other produces a square

The movement of three squares in three-dimensional space in directions that cross each other produces a cube

The movement four cubes in four-dimensional space in directions that cross each other produces a cube of cubes

Controller for Aeroplane

An instrument that would control the movements of an aeroplane in a perfect manner is a compound Gyroscope having six heavy rotating disks mounted on separate shafts all shafts converging to one centre from the six fly wheels. Each pair of wheels will be on opposite ends of a shaft separated at its centre so as to rotate each pair in opposite directions.

Such a device under high speed of rotation could not be twisted from its position in any direction. The aeroplane proper would be hinged to this device so as to change it to different angles for soaring circling descending.

Wind blasts could not tilt or turn such a device.

W. Thomas Burton Kinraide
grandfather of

Controller for Aeroplane. Felix Frazer, who worked for Kinraide, was an aircraft engineer. He also famously destroyed Thomas Henry Moray's phony free energy device with an ax!

(from the family archive of Stephen Hadley and Pamela Sage)

Controller for Aeroplane

An instrument that would control the movements of an airplane in a perfect manner is a compound gyroscope having six heavy rotating discs mounted on separate shafts all shafts converging to one centre from the six flywheels

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Such a device under high speed of rotation could not be twisted from its position in any direction

The aeroplane proper would be hinged to this device so as to change it to different angles for scaling - circling - descending - wind blasts could not tilt or turn such a device

So we must part forever.

And, though I long have beat
my wings and tried to, free from
thy narrow limits and control, forth
into space the true home of the soul.

Yet now, yet now that mine hour
is drawing near, I pause reluctant,
finding you so dear.

All joy awaits me in the realms
of God

Must you my comrade moulder neath
the sod?

I was your prisoner yet you were my
shack!

Your captive, yet, obedient you gave,
to all my earliest wishes and
commands

Whilst now to the worms I give these
willing hands that loiled for me or
held the book I
read

These feet that trod wherever I bid them
tread

These arms that clasped my dear ones
close

and heart in which was found
a fond repose

These Eyes that were the windows
of my prison -
and lips thro which my prayers
to God have risen

From these, all these, death's
angel bids me sever.

Dear comrade body fare you
well forever

I go to mine heritage
and going go with all the
joy the freed soul can know

Yet in my spirit wanderings I
trust I may sometimes pass near
your sacred dust

Love letter, though to be dedicated to Rachel (who died 20 Feb. 2022).

(from the family archive of Stephen Hadley and Pamela Sage)

So we must part forever.
and though long have beat my wings
and try to free from thy narrow limits
and control forth into space
the true home of the soul
yet now that my hours drawing near
I pause reluctant finding you so dear
all joy awaits me in the realms of God
must you my comrade smolder neath the sod
I was your prisoner
yet you were my slave
your captive
yet obedient you gave
to all my earliest wishes and commands
while smile to the worms
I give the willing hands
that toiled for me
or held the book I read
these feet that tread
where I bid them tread
these arms that clasped my dear ones close
and heart in which was found a fond repose
these eyes that were the windows of my prison
and lips through which my prayers to God have risen
from these all these deaths
angel bids me savor
dear comrade body
bury your will forever
I go to mine heritage
and going go with all the joy
the freed soul can know
yet in my spirit wanderings I trust
I may sometimes pause near your sacred dust



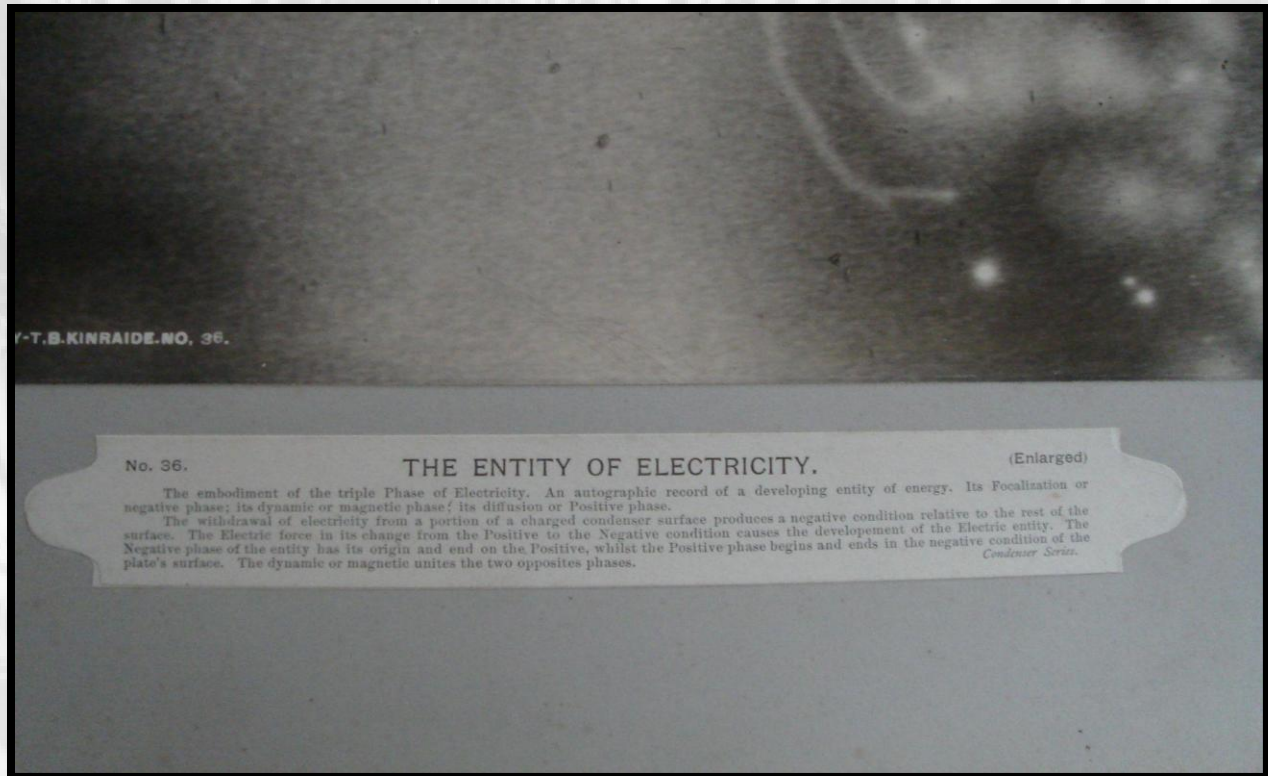
Photo of Thomas Burton Kinraide and son. From the family archive of Stephen Hadley and Pamela Sage.



Silver vase from the Tiffany & Reed Company. From the family archive of Stephen Hadley and Pamela Sage.



One of over fifty 18"x22" lecture photos Burton used to lecture with at MIT, Franklin Institute, etc. From the family archive.



No. 36

THE ENTITY OF ELECTRICITY. (Enlarged)

The embodiment of the triple Phase of Electricity. An autographic record of a developing entity of energy. Its Focalization or negative phase; its dynamic or magnetic phase; its diffusion or Positive phase.

The withdrawal of electricity from a portion of a charged condenser surface produces a negative condition relative to the rest of the surface. The Electrical force in its change from the Positive to the Negative condition causes the development of the Electrical Entity. The Negative phase of the entity has its origin and end on the Positive, whilst the Positive phase begins and ends in the negative condition of the plate's surface. The dynamic or magnetic unites the two opposite phases.

(It is interesting to note that in Kinraide's early articles the positive and negative figures were reversed...the filiciform is actually the positive, while the plumous discharge is the negative. This is likely from the electrical induction of the opposite charge upon the glass plates from his coil...)



Former entrance to Ravenscroft

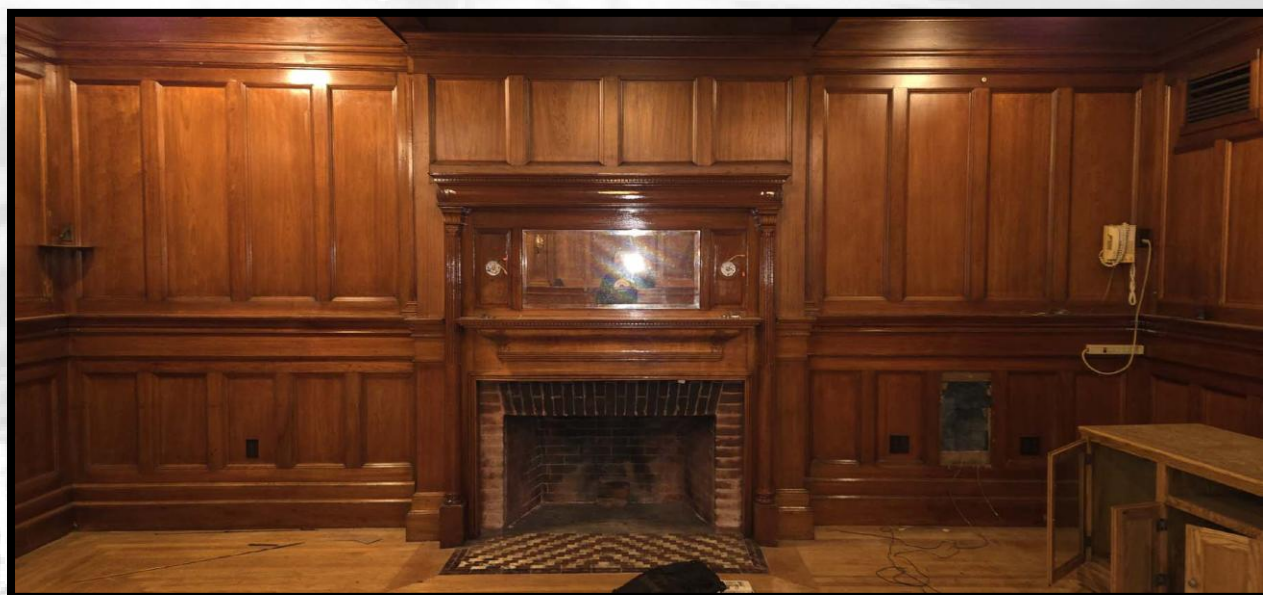


Steve Williams revealing Kinraide's hidden staircase to his lab. (2007)





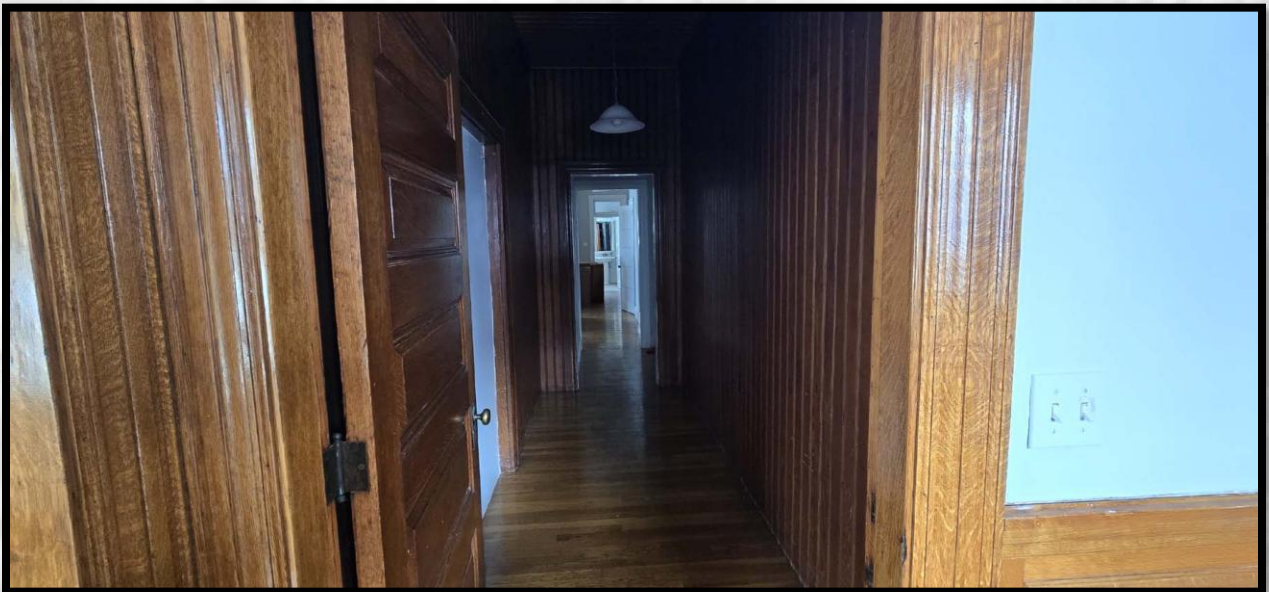
Fireplace in Kinraide's dark room.



Final view in 2026.



Ceiling of dark room.



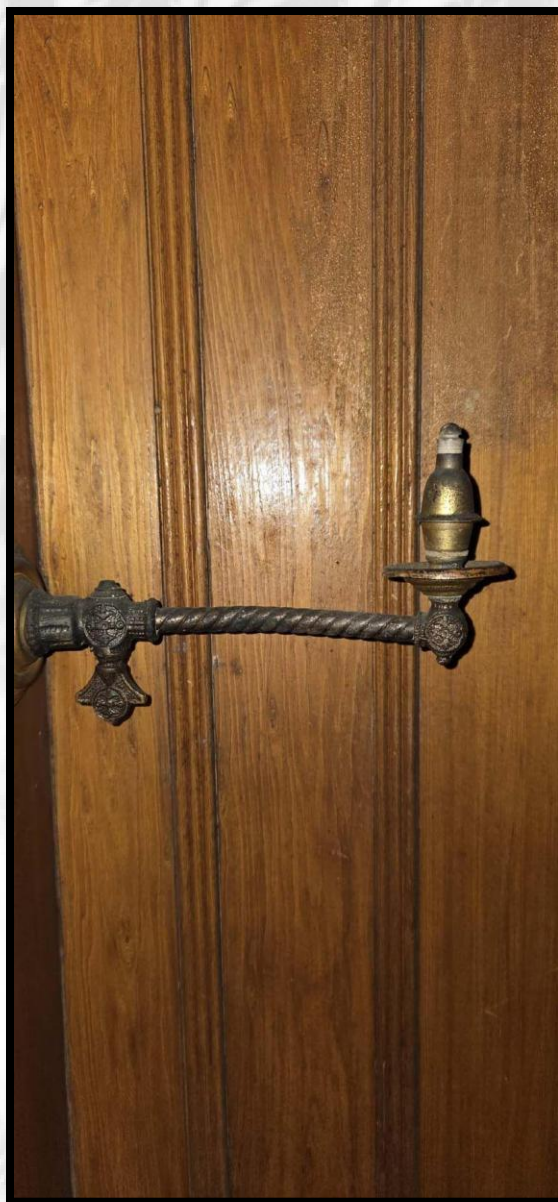
Last views of the house before it was destroyed internally to make modern apartments.



Bedroom and original cabinets.



Fireplace and lamps inside of Kinraide's Office.



Entranceway to Ravenscroft; Original gas light that Kellogg extinguished in Kinraide's lab



A last look at Ravenscroft, January 2026. View from the cupola overlooking Boston.









A journey through the hidden rooms found beneath Ravenscroft by the author in 2005.











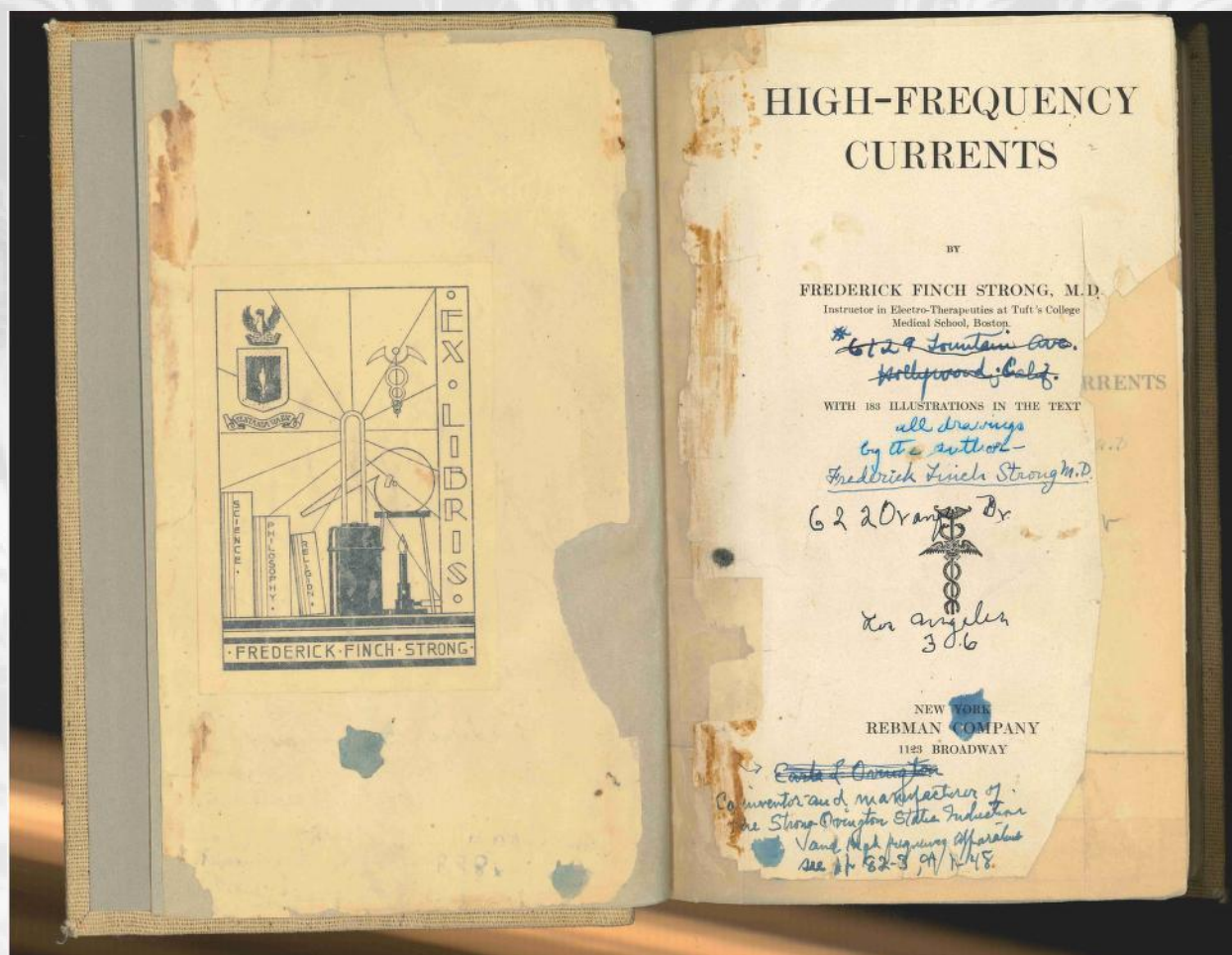
The Kinraide Coil used to make a majority of the electrical discharge photographs.



Remains of the copper-lined oak box that contained the oldest oil-filled high frequency coil of Kinraide's design. Found with Stephen Hadley in 2007. This coil was documented in Frederick Finch Strong's book High-Frequency Currents (1908).



Stephen Hadley at the entrance to Ravenscroft (2007).



Original copy of Frederick Finch Strong's book High-Frequency Currents.
 (from Author's collection)

The Realms Beyond the Senses

The Reality of the Unseen

A SERIES OF THREE LECTURES BY

Dr. Frederick Finch Strong

LECTURER ON ELECTRICITY
TUFTS MEDICAL COLLEGE, BOSTON

Monday, Wednesday and Friday
Evenings

October 15, 17 and 19, 1917, at 8:15 o'clock

Auditorium of Public Library
Franklin Avenue near Fulton Street, Brooklyn

Given under the auspices of the Theosophical Society
95 Lafayette Avenue, Brooklyn

The general purpose of Dr. Strong's "Occult" Science of today will be to indicate by brilliant demonstrations of the ways through which this change

Will Talk on Vibration.

Dr. Frederick Finch Strong, of Tufts College, will lecture on "The Reality of the Unseen Vibrations of Nature" on October 15, 16, and 17, at 8:15 in the evening, in the Brooklyn Public Library, Franklin Avenue and Fulton Streets. Dr. Strong will use a million-volt high-frequency coil, and the ultra-violet ray in demonstrations which he will give.

DR. STRONG TALK ON UNSEEN REALITIES

"The reality of the unseen" was the topic of Dr. Frederick Finch Strong's lecture, under auspices of First Spiritualist church, 55 Pearl Street, last night.

Our physical bodies, according to Dr. Strong, may be compared to overalls. We don them and come on earth to dig in the trenches. When the labor is over the overalls are cast aside and man stands in his spiritual underclothes, a reality but as yet invisible to the material eye.

Hundreds of scientific men, says Dr. Strong, who have passed years of study and investigation along the line of psychic phenomena are emphatic in their statements of the spiritual life of man on earth, even after he has passed thru what is called, or mis-called, death. The men who voice these opinions started their researches as rank materialists, scientists.

Men are both unequal, according to science, and the only logical way to account for the differences in the mental and spiritual caliber of the great financier and the day laborer is thru the theory of former existence and life on this earth. The brain of the financier is keener and more fully developed simply because he has lived longer, has had more lives than the day laborer.

Science has proved that there are vibrations so powerful around us at all times that it is beyond our physical senses to see or hear them, to be aware of their presence in any way, except thru a scientific vibrator transformer. These vibratory transformers are beyond the grasp of the lay mind. We cannot understand the technical side of the question because we have not been trained along scientific lines. Dr. Strong, by several spectacular experiments, left no doubt in the minds of the audience regarding the existence of the ultra-violet ray, a higher and more powerful vibration than the famous "violet ray."

Altho the public mind cannot often follow the scientific end of the story, still the public mind accepts the scientific proofs of the unseen reality of these powerful vibrations. Why does the public mind turn a deaf ear to science when speaking from deep study and investigation, it tells of a material life, on a higher and invisible plane. It is true, but nevertheless a real life after the physical overalls have been laid aside?

All around us, says Dr. Strong, are the astral bodies of friends and relatives who have done their bit in the trenches of life, and now stand in spiritual underclothes. We cannot see them because the matter which shapes their bodies is so fine for the physical eye, just as the ultra-violet ray was invisible to the senses.

There are some people who are sensitive to the unseen realities. These are the psychics or mediums. They are the vibratory transformers of the psychic world.

Dr. Strong concluded with wonderful experiments with the ultra violet ray, laboratory proof of the lecture's theory of the existence of forces and matter beyond the earthly senses.

Dr. Strong will lecture on the "Star of the East," at the First Spiritualist church, Dec. 2. The third and last of the series of "Realms beyond the senses," will be held the second Wednesday in January.



Excerpt from Dr. Frederick Finch Strong's personal scrapbook showing Kinraide UV lamp. (from Author's collection)



Endless thanks to the staff at UCLA for scanning this.



"LET'S ALL SING LIKE THE BIRDIES SING"

WHEN Charles Kellogg sings, almost anything can happen—and frequently has.

Insects and chickens go into ecstasy. Wild creatures fly out of the woods and gape in open-beaked amazement. Tall steady flames dance excitedly, then crawl back into their gas jets and expire. A dead automobile engine sputters to life. A glass tube shatters into a pile of perfect little rings. Walls of a room vibrate ominously. And women shriek in abashed dismay.

For Charles Kellogg unquestionably possesses the world's most remarkable vocal equipment. Nature, in one of her strange moods, endowed him with the throat of a bird. He has all the half rings of a songbird's syrinx—in addition to his own human larynx.

This rare gift enables him to pitch his voice far into the realm of inaudibility—altitudes detectable only by the Helmholtz tuning forks. Tetrizzini, credited with reaching the highest notes of them all, scaled a glorious three and a half octaves—a full octave above the ordinary individual's range. Kellogg soars to a lofty *twelve and a half* octaves.

To this generation of bobby soxers, musically nurtured on the nasal antics of the Sinatras, the name of Kellogg is instantly associated with a breakfast cereal. But their elders will recall Charles Kellogg with a certain nostalgia as the one and only Nature Singer of the Vaudeville Era—the heyday of the Orpheum Circuit and, beyond that, Bishop Vincent's Chau-tauqua and the Redpath Lyceum. His

name twinkled in Broadway lights with such stars as Nora Bayes, Sophie Tucker, and Claude Gillingwater. His woodsy skit—complete with warbles that doused flames—was a seasonal attraction in cities and towns across the nation. His records of wild bird calls were in every home that boasted a gramophone.

Kellogg's feats of voice, marvel of scientists and laymen alike, often put him in the headlines as well as up on the marquees. But for years now he has been absent from the national scene. Wearying of the smoke and turmoil of cities, he retired fifteen years ago to the foothills near Morgan Hill, California. There, in a red-tiled ranch-house overlooking the lower Santa Clara Valley, he lives quietly among his bird friends and bulky scrapbooks. His memories range a greater part of the world—treks across Newfoundland and Labrador, a 500-mile hike around Jamaica with John Burroughs, tramps in the High Sierras with John Muir, visits to the Paris home of August Rodin (he once sang to a Parisian multitude from an airplane), and a rare Fire Walking ceremony in his honor on the island of M'Benga in the Fijis.

THE YEARS—he's seventy-eight now—have snowed his great shock of brown hair but his voice has lost none of its magic. For visitors he will haul forth his old stage apparatus—a small gas pressure tank, a length of hose, and a gas jet. Lighting a tall flame he will extinguish it with a single note, properly pitched. And for good measure he will startle a passing magpie into amazed silence—simply by calling it everything in its own lexicon.

One November day in 1945 he spent

several hours conversing with the late Raffles, the famed talking mynah owned by Zetta and Carveth Wells.

"First I tried the inaudible on him," Kellogg recalls. "Raffles was so surprised he broke his good house behavior. He went around the room looking for that other bird. Then I talked to him naturally and he was quite excited to find that bird was I. We had a pleasant chat—not in English, understand, but in mynah."

And what would a man and a mynah talk about for two hours?

"Well, we talked of love for one thing. Certain notes will excite a bird in a romantic way, just as certain words spoken softly into the ear of a young woman will bring a response. But mostly Raffles and I just sang mynah melodies."

Many years prior to that chat, Kellogg's gift of bird gab astonished the great naturalist Burroughs, who wrote: "We had gone for days into the primitive jungle of the Cockpit country of Jamaica, when Kellogg set up a curious mixed chatter. Presently an answer came back from here and there as some denizen caught a familiar note. Gorgeously plumed birds, many of a species such as Kellogg never could have seen, appeared on branches close at hand and raised a chorus that was at once ludicrous and amazing."

Kellogg, who believes his bird throat is a "gift absolutely unique" to him, was even more lavishly endowed than a bird itself. The half rings of the finer songbird's vocal organ range from sixteen to thirty. Kellogg has at least thirty-nine!

David Wood, blind organist at a Broad Street church in Philadelphia some years ago, heard the Nature Singer in the early days of his career. Wood was startled to detect a multiple of tones and got word at once to Richard Zeckwer, head of a private music school. Zeckwer had a set of

Helmholtz tuning forks and arranged a Kellogg songfest in his home.

Zeckwer was amazed. The tuning forks clocked Kellogg's vocal vibrations from a lethargic fifty-four per second to an astounding peak of 49,560 per second. The average person can't vibrate above 4,000—if that much. A bird's vibrations begin at 14,000 and hum into the inaudible. Kellogg vibrates so rapidly men stone deaf have often "heard" him.

It was on Zeckwer's set of tuning forks that Kellogg first knew he could climb to a dizzy twelve and a half octaves.

IN ADDITION to the full-throated warbles and chirps, which he can produce through the nostrils with his mouth tightly shut, Kellogg has the unique ability to trill as a bird trills. A bird trills by vibrating only the upper part of its beak. Kellogg can do likewise—vibrate his upper lip at humming-bird speed while he keeps the lower lip rigid. (Easy, you say? Try it—right now!)

Another uncommon fact about Kellogg is the absence of a frenum, that restraining fold of flesh beneath the tongue. And speaking of this, Birdman Kellogg warns: "Never cut a bird's tongue to make him talk. Simply ruins a bird. Instead, cut his frenum."

"People often call me a whistler of bird tunes," he says. "I'm not. I've tried my darndest to whistle but, to save my soul, I can't. Listen—" He essayed a whistle but it sounded more like a poor imitation of a Bronx cheer.

"They say I imitate birds. I do not imitate; I reproduce. I can reproduce the song of any bird I've ever heard. I do not sing *like* a bird, but *as* a bird."

Medical men have peered beyond his tonsils—and come away shaking their heads. Late in the last century, before the miracle attending his birth had catapulted him to vaudeville fame, Kellogg went to London on a lecture engagement. His talk on American wild life was interspersed by bird songs. His peculiar talents aroused the curiosity of Sir Morell Mackenzie, the noted English throat specialist. Sir Morell ran a laryngoscope down the Kellogg gullet and began clucking in amazement. He counted not only thirty-six birdlike half rings in the trachea but three others in the bronchial tubes.

LEGENDS have already sprung up around his infancy. He was

born at Spanish Ranch, a gold town in the Feather River country of the High Sierras. When he was three weeks old—so one legend goes—burly miners tiptoed, hat in hand, into the cabin to hear the Kellogg baby's strange little cry. It was more of a whispering warble than a cry.

His mother died when he was still a toddler and little Charles, under the tutelage of the Digger Indians, became a sort of Child Tarzan. He spoke Digger Indian before he spoke English, and from these Redmen he learned the secrets of the wilds.

"My earliest recollection," Kellogg says, "is sitting with the Indians about their campfires and whispering bird songs, singing always through the nostrils as I had seen the birds do—watch your canary; he does the same. Much later I found that I could open the lips and chirp and sing full-throatedly. I felt perfectly free singing to the Indians, but the moment a white man appeared I would instantly stop. It was not until I was sixteen or seventeen that I could overcome my shyness and sing in public."

He then gave nature talks to school groups, sang to Chautauqua tent audiences and, along with Jack London, appeared on Redpath Lyceum platforms as the "famous California bird warbler."

ONE DAY he dived into a pond—and broke surface into Keith's big-time vaudeville. At the time, he was appearing before classes of Boston school children as a singing naturalist at five dollars a recital. One day, as he left the auditorium, a stranger who had regarded him with special interest on several previous occasions approached Kellogg.

"He was Berton Kinraide, a wealthy amateur physicist," Kellogg recalls. "He invited me to his home in Jamaica Plains and led me down to his laboratory three stories below ground. There he lit a carbon flame and asked

me to stand facing the wall, twenty-five feet away. Then he directed me to sing."

Kellogg sang—and Kinraide shouted. Kellogg pivoted. "Why did you turn the light out?" he asked.

"I didn't," Kinraide replied. "You did!"

Kinraide re-lit the flame and led Kellogg into the next room, closing the door. "Now," he said, "sing like hell."

Again Kellogg sang. They ran back into the lab—and found the flame extinguished.

"I knew it!" Kinraide exclaimed. "You sing like a bird."

Kinraide explained a theory of his that the high pitch of a bird's song—if sustained—could put out a sensitive flame, but he was never able to get a bird to sustain a given pitch. Kellogg had both the voice of a bird and the power of a man, so he was able to sustain the proper pitch.

For some reason Kinraide failed to explain at the time, he hurried Kellogg to his estate at Sandwich near Cape Cod, where there was a pond with a diving board. Kellogg got into a bathing suit, while Kinraide set up an apparatus on the springboard and lit a flame. Then, at Kinraide's suggestion, Kellogg dived into the pond and sang as a bird would if it ever had occasion to sing under water. The flame went out.

Just what Kinraide proved is not clear from this distance, but it did land Kellogg a more lucrative job. For just then—as if by pre-arrangement—out of the bushes came three men: Bob Larsen, reporter for a Boston paper; B. F. Keith, the vaudeville king; and Harry Houdini, who could also do things under water.

Kellogg repeated the stunt.

"Mr. Kellogg," said Mr. Houdini, "you can't keep this thing under a bushel."

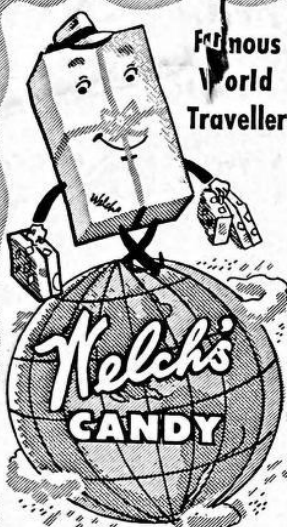
Kellogg didn't. He accepted a Keith contract—at \$900 a week.

IN TIME he built his famous act into four features: He filled the theater with the songs of a hundred birds. He doused gas flames with his powerful voice. By pitch he shattered a tall glass tube into small perfect rings which he tossed to the audience. And for a little camping flavor, he created fire by rubbing sticks together.

At first his flame quenching act met with official frowns. He was scheduled to appear at the Palace Theater in

(Continued on Page 50)





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Birdman Kellogg

(Continued from Page 15)

New York on December 12, 1924 (Sophie Tucker was on that bill), but they refused him a fire permit. Too dangerous, said Inspector of Combustibles John F. Dixon.

Too dangerous? Kellogg took his apparatus to Dixon's office and turned up a tall, steady flame. Then he walked out of the room, carefully closing the door. He sang—in a high, inaudible pitch. The flame on Dixon's desk danced excitedly, then crawled back into the jet and went out. Kellogg got his permit from an astonished inspector of combustibles.

This ability to extinguish flames by his voice—and to transform a yellow carbon flame into a blue Bunsen jet—attracted scientific interest. He demonstrated it in a radio broadcast for University of California scientists on the evening of September 6, 1926. Professor A. T. Jones introduced Kellogg before the microphone of Station KGO,

then located in Oakland, and briefly explained how the "sensitive flame" is affected by only the very highest vibrations. He added that what Kellogg hoped to do that night had never been done before.

In LeConte Hall on the Berkeley campus ten miles away, a group of physicists and other scientists, headed by Dr. Elmer Hall, gathered around a radio set, before which a sensitive flame burned without a flicker. Waiting with the scientists were wire service correspondents and reporters from the San Francisco Bay Area papers. The stunt had already been highly publicized by KGO.

A telephone line was kept open between the hall and the radio station and at various signals Kellogg was to make the two-foot yellow gas flame dance or become agitated, then turn it into a roaring blue Bunsen, then extinguish it entirely. He did all three, at call.

And not only that. Matches and candles were agitated, then extin-



"I had a grand evening, but I'm leaving before I've had too much!"

SCRIPT

guished in all parts of the western United States and Canada, on ships at sea, and in Hawaii and Alaska. A Chinese merchant of Hilo cabled that Kellogg had put out a candle and three matches as he tried to re-light it. In all, Kellogg received 11,000 letters, 7,000 of them explaining that match or candle flames had been doused in the novel experiment.

Kellogg has great faith in the power that lies hidden in the human voice. On a trip to the Fiji Islands he was invited by the superintendent of schools at Suva to witness a strange performance at the top of a cliff overhanging the ocean. There a group of Fijian girls sang—and out of the Pacific depths rose giant turtles. They hung on the surface and cocked their great heads as they listened. And when the song died out, they quietly submerged. In India, women singing in chorus have caused the surface of a still pond to wave like a blanket.

BUT THAT is nothing. Kellogg goes even farther with this startling theory: "Vocal vibration, intelligently harnessed, could keep the United States out of war for all time. For once aware of the frightful destructive power within the grip of our government, no one would dare make a menacing move." Kellogg will cite you "proof" of his theory in the Bible:

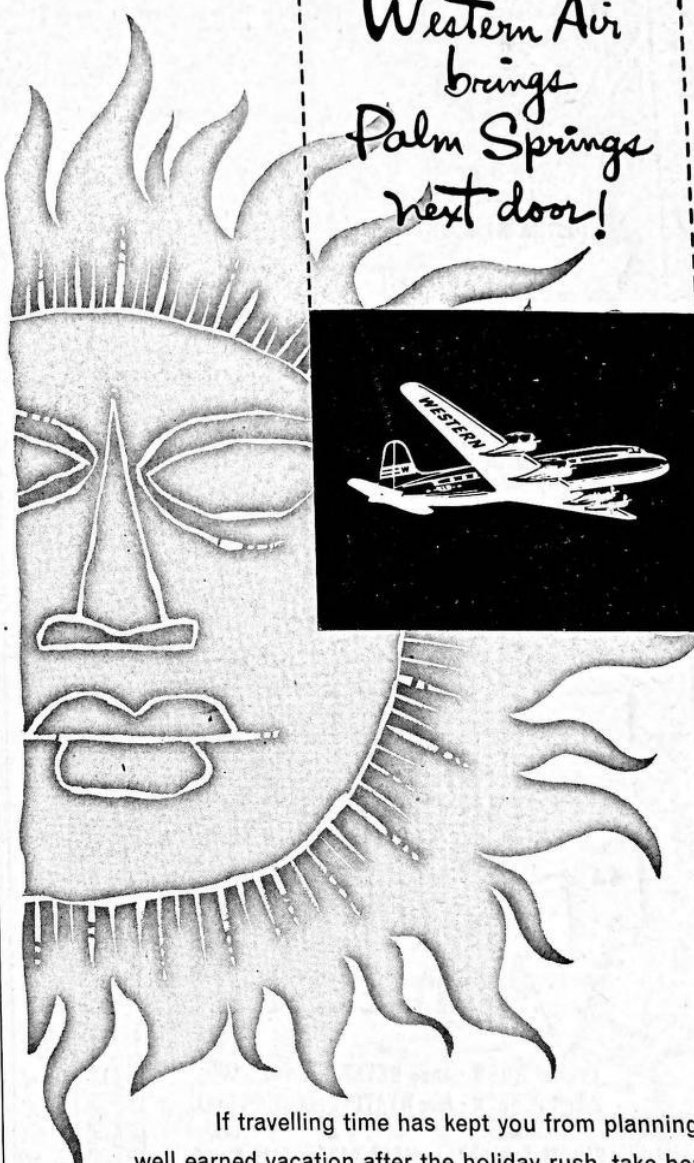
"You remember how the Lord instructed Joshua to proceed on the city but not to besiege it by force of arms. Joshua was told to order the priests to blow their trumpets and the people to shout in unison. Then, as the Bible relates, the walls of Jericho fell.

"But the tale does not give the explanation, which is that the trumpets of the priests and the shouts of the people *in unison* set up a wave of vibration attuned to the walls of the beleaguered city. As a natural consequence, the walls fell in.

"It was the potent force of pitch. Everything has pitch. I can, by low and intense humming, get the pitch of a room in a skyscraper—say, the Empire State Building. Once I get the pitch, the walls will hum back. Now, if I were capable of sustaining that note long enough, it would set up a sympathetic vibration throughout the skyscraper and cause it to collapse. In fact, the earth itself could be shattered to smithereens by anyone who could cause a corresponding number of vibrations to its own."

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ize on Kellogg's unusual vocal talents. Once a promoter in Denver sought to persuade him to found a religious cult wherein Kellogg would not only hear but produce voices.

"He told me I could make a million dollars," Kellogg says. "Women, he said, would flock to the cult. That may have been so because my voice at a certain pitch had a strange effect on women—just as it did on Raffles. But I've never found a need for that sort of money."

RUDDY faced, energetic, and full of youthful enthusiasms that belie his years, Kellogg likes to talk, laugh, and sing. He has never tasted alcohol nor tobacco. The smell of smoke, even second-hand, makes him woozy. Twice, at club luncheons in Toledo, Ohio, and Syracuse, New York, where he was guest speaker, the halls were so smoky he fainted dead away. "Let people smoke who want to," he says. "That's none of my affair. But if I can get away from the smell of it, let me."

And most of his life he has. He has roamed the air-pure wilds of the hemisphere without gun or compass, with only a camera in his hand. To him, even a snake is a "lovely, graceful, beautiful creature."

"Love—love rules the universe," is his creed. "Learn to love all creatures. Thus only may you hope to understand God."

Kellogg has never celebrated a birthday. He knows the year and the season—the fall of 1868—but not the day of his birth, because no such thing as vital statistics was kept by the pioneers. He is sorry on only one point—he has no candles on a cake to extinguish with one inaudible warble.

And—oddly enough for a man who has always liked to throw his voice around—Kellogg has never spoken into a telephone.

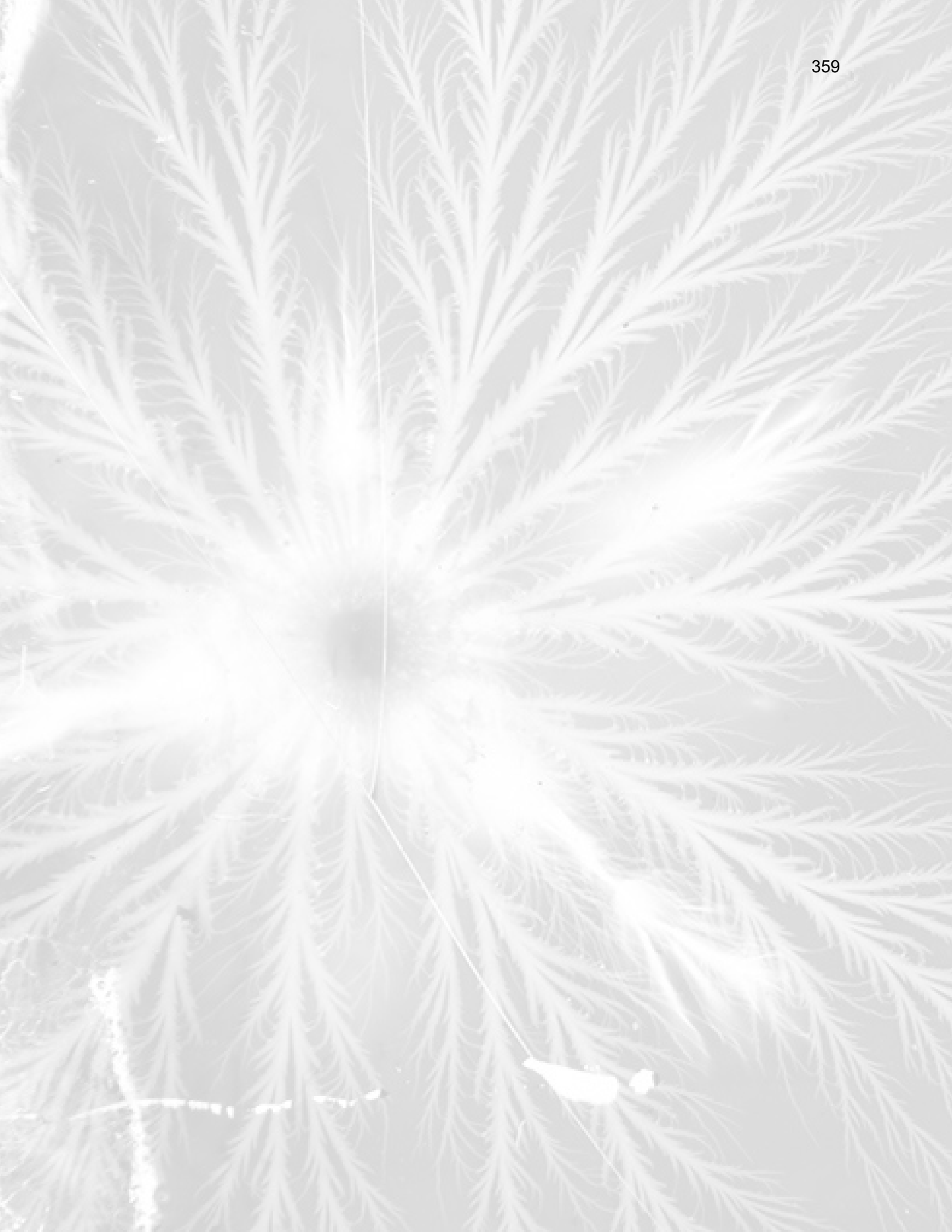
"Listened to one once," he said, shaking his leonine head. "That was enough. It does something queer to your voice."

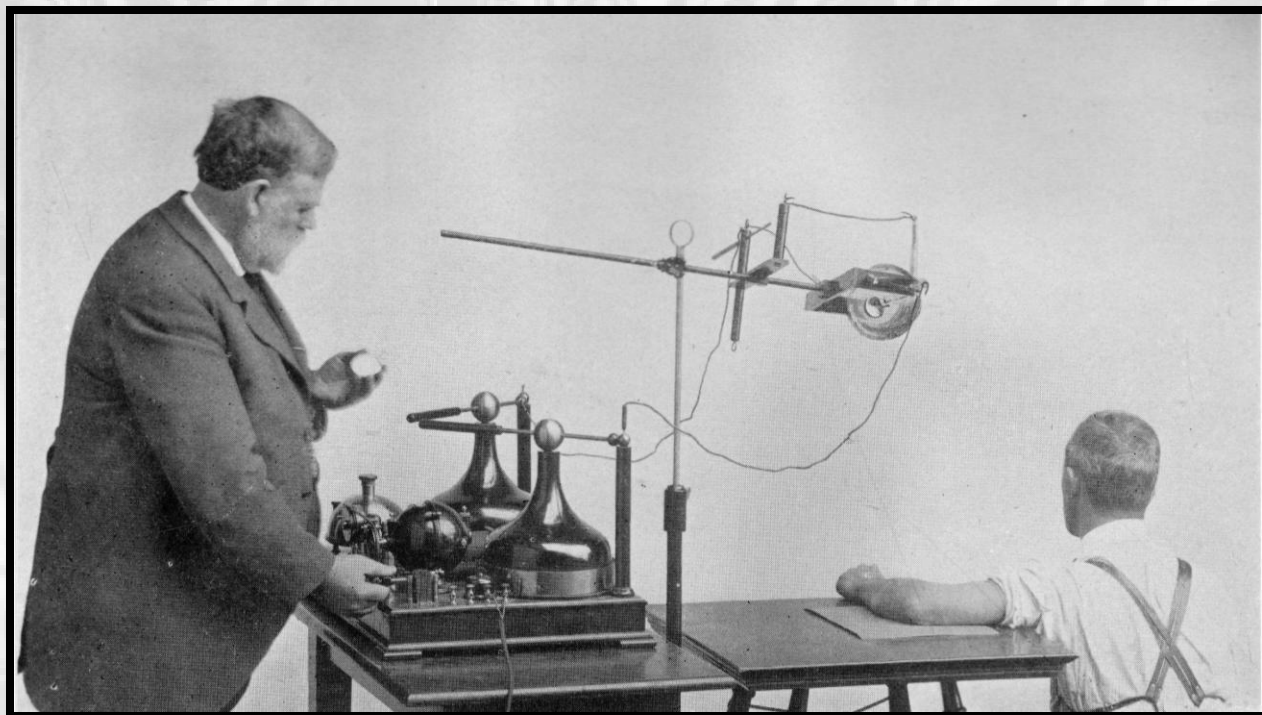
—J. CAMPBELL BRUCE





Thomas Burton Kinraide. Photograph donated by Donald Harris.





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