tion of the rolls did not reach its center. Thus a different quality of metal in the circumference was produced. At any rate, want of homogeneousness is shown, and it is evident that it is not a hammer-forged bar. The appearance of homogeneous iron when fractured is shown in Fig. 17. This purported to be hammer-forged, and from the test there is every reason to believe that it was. Thus a simple and effective method of testing metals is at the service of the mechanical engineer.

GEORGE FREDERIC BARKER.

The proudest boast of an American citizen is that he is a self-made man. To overcome difficulties and acquire a high reputation by persistent effort is indeed well worthy of the highest ambition. Those who have made science a profession have, for the most part, been thoroughly educated and carefully trained in the leading universities and schools of the world. A notable exception is the subject of this sketch, whom we may fairly claim is a self-made scientist.

George Frederic Barker was born in Charlestown, Mass., under the shadow of Bunker Hill, on July 14, 1835. He was the son of a sea captain, who commanded one of the packet ships then sailing between Boston and Liverpool. His early education was received in the public schools of his native town, but in 1849 his parents moved to South Berwick, Me., where he continued his studies in the classical academy of that town, and later at similar institutions in Groton, Mass., and Yarmouth, Me. While a student he showed great fondness for the physical sciences, and even at that time was given charge of the chemical and physical apparatus.

The knowledge thus acquired he applied practically, for he celebrated the Fourth of Julys with fireworks of his own manufacture, and accompanied the performance with electrical displays from Leyden jars, galvanic batteries, and friction machines, which he himself had constructed.

In 1851 his father took him to Europe, and he visited the great world's fair held at the Crystal Palace in London—the first of the international exhibitions, on the juries of which, in later years, he has served.

On his return, the boy, then sixteen years of age, with a fair education, was apprenticed to J. M. Wightman, of Boston, a well known maker of philosophical apparatus. For five years he was employed in this manner, acquiring not only a knowledge of the principles of mechanical construction with the use of tools, but also learning the scientific principles which the apparatus embodied and illustrated.

The system of fire alarm telegraph which William F. Channing and Moses G. Farmer were at that time introducing in Boston attracted his attention, and he formed a warm personal friendship with Mr. Farmer, that has since continued.

His apprenticeship ceased when he became of age, and he determined to supplement his practical knowledge with two years' study. Accordingly, he entered the Yale, now Sheffield, Scientific School, and was graduated in 1858 with the degree of bachelor of philosophy.

His entire university career was limited to a two years' course at Yale, the last half of which was spent as private assistant to Benjamin Silliman, Jr. Compared with those who have supplemented the usual college course with years of study in foreign universities, Professor Barker stands out as a scientist whose early training was practical.

In 1858–59 and in 1860–61, he assisted Professor John Bacon in his lectures on chemistry at the Harvard Medical School, and in 1861 was called to the chair of physical sciences in Wheaton College, Ill.

He was invited, in the autumn of 1862, to fill, temporarily, the professorship of chemistry in the Albany Medical College, where he remained until 1864, having meanwhile pursued a course in medicine, and in 1863 he received the degree of M.D. from that institution.

After delivering his third course of lectures, he was, in 1864, chosen professor of natural sciences in the Western University of Pennsylvania, in Pittsburg, where he remained a year. It was at this institution that the apparatus placed at his disposal for demonstrations proved to be that which he had constructed years before when an apprentice in Boston.

In 1865 the younger Silliman urged his return to New Haven as demonstrator of chemistry in the Yale Medical School. This appointment he accepted, and in 1867 he became the professor of physiological chemistry and toxicology in that department, also having charge of the entire instruction in the academical department of Yale during the absence of Professor Silliman in California, during the college year 1866–67; and he likewise delivered the lectures on chemistry at Williams College in the years 1868 and 1869. In 1873, when the University of Pennsylvania remodeled its scientific department and erected new buildings at West Philadelphia, Professor Barker was invited to fill the chair of physics, an appointment which he accepted and has since filled.

The collection of physical apparatus selected by him, now in the possession of that university, is probably unsurpassed in the United States, and in some branches it is absolutely unique in the world.

Of his original work it is difficult to write, for his career has been so largely a public one that his investigations have either been of a special character, called forth by government or private request.

He was invited by the late Henry Draper to become a member of the expedition which observed the solar eclipse of July 19, 1878, from Rawlings, Wyoming. Professor Barker was specially assigned to the observation of the spectrum of the corona.

For this purpose he used a Merz spectroscope of high dispersion, and during the totality he saw distinctly several of the dark lines characteristic of the spectrum of the sun's disk, thus confirming the observation made by Janssen in 1869. In 1886 the latter again obtained like results, in his observations made at the Caroline Islands.

It was at this time that Mr. Edison, who was one of the party, established the fact of the existence of heat in the solar corona. Indeed, all of the results obtained on the Draper expedition tended to prove that a part of the light of the corona is reflected from the sun.

NATIONAL ACADEMY OF SCIENCES.

During the years since Professor Henry Draper's death, many of his unfinished researches, that were placed by Mrs. Draper in Professor Barker's charge, have been gradually approaching completion, and already some of them have been published.

As an expert in court, Professor Barker has very ably distinguished himself. In the line of chemistry and physics, his reputation is unequaled in the United States, and his great knowledge of these subjects is universally conceded. The power of explaining complicated forms of apparatus in simple language, and of demonstrating to conviction a scientific problem, is the secret of his power.

During his connection with the Yale Medical School, important toxicological cases were submitted to him for examination. Of these the Lydia Sherman case in 1872 is the most celebrated, owing to the interest which it created at the time.

On account of the inefficient testimony offered in the Wharton trial, a doubt had been raised in the public mind as to the possibility of detecting by means of chemical analysis the presence of poison in a dead body.

Mrs. Sherman was accused of having poisoned three husbands and four children within the space of three years, and the bodies of four persons were given to Professor Barker for examination. He established the presence of arsenic in each, and nearly two hundred specimens of this poison in various forms, obtained by him from his analyses, were placed on exhibition in court during the trial.

This overwhelming evidence resulted in a full confession by Mrs. Sherman, thus substantiating the analytical results obtained by Professor Barker, and the confidence of the community was largely restored to a belief in the value of such testimony. The chemical evidence was subsequently inserted as a typical case in the later editions of Wharton and Stillé's "Medical Jurisprudence."

He has also served as expert in many chemical patent cases, of which the phosphate baking powder suit is perhaps the best known, and he was one of the scientific witnesses on behalf of the people in the suit in New York City where the use of the lactometer by the health authorities was opposed.

His attention since his residence in Philadelphia has naturally been more in the direction of physics. With the advent of the electric light, and in its subsequent development, Professor Barker has taken a leading part. His relations with Thomas A. Edison have been exceedingly confidential, and he is the retained adviser on scientific matters to the great inventor.

His intimate knowledge of this subject led to his being requested by the department of justice to act as one of the government experts in the suit against the American Bell Telephone Company. He has appeared in other important telephone suits, and testified in behalf of the American Union Telegraph Company in their suit against the Western Union Telegraph Company on the Page patents.

In 1881 he was appointed one of the U. S. Commissioners to the International Electrical Exhibition, held during that year in Paris, and also was a delegate to the International Congress of Electricians convening at the same time. He was made one of the vice-presidents of the jury of award, and was decorated by the French government with the cross of commander of the Legion of Honor, of which organization he is the ranking officer in the United States.

He was appointed, in 1884, by President Arthur, a member of the United States Electrical Commission, which was formed for the purpose of determining the standard of the electric light.

Among the municipal appointments which Professor Barker has held in Philadelphia, several are noteworthy. These include studies of the local water supply, the quality of illuminating gas, and means for protecting the public buildings from lightning.

As a lecturer, Professor Barker is fluent and forcible, with a perfect command of his subject. For the elucidation of his topic, he finds no experiment too troublesome, and prosaic formulas acquire under his influence new and vivid significance.

During the winter of 1859–60, he gave a series of lectures on scientific subjects in Pittsburg, under the auspices of the Western University of Pennsylvania, and in 1864 he was invited to address the Chemical Society of Union College, on which occasion he spoke on the "Forces of Nature."

In 1871 he delivered a lecture before the American Institute in New York City, on the "Correlation of Vital and Physical Forces," in which he advanced the idea that the word "mind" possessed a certain physiological significance, and could represent the energy phenomena of brain tissue in the same way as mechanical work represents that of muscular tissue. From experiments performed in his own laboratory, he had proved that mental action did not increase the destructive assimilation of brain tissue any more than muscular work increased that of muscular tissue.

His lectures on "Spectrum Analysis" and "Electricity and its Applications" have been given before crowded audiences in the Academies of Music in New York and Philadelphia. In 1876 he was elected to membership in the National Academy of Sciences, and has served on many of its important committees that have furnished reports to the government, notably those "On the Measurement of the Velocity of Light," in 1878; "On the Co-operation with the National Board of Health," in 1879–80; "On the Separation of Methyl from Alcohol," in 1883; and he was chairman of those "On Glucose," in 1883, and "On Opium," in 1886. Professor Barker is also chairman of the standing committee on the Henry Draper medal, which honor was in 1885 conferred on Samuel P. Langley, and in 1887 on Edward C. Pickering.

In 1859 he joined the American Association for the Advancement of Science, and in 1876 presided over the section of chemistry, delivering an address on "The Molecule and the Atom" which is a valuable contribution to theoretical chemistry. At the St. Louis meeting, in 1878, he was elected president of the Association, and after presiding over the Saratoga meeting, delivered his retiring address at Boston, in 1880, on "Some Aspects of the Life Question," a masterly discussion of the oft-repeated, query "What is life?" that attracted very general interest, not only from the scientific world, but also from the cultured public.

Professor Barker is one of the secretaries of the American Philosophical Society, life member of the Chemical Society of Berlin and of the Society of Telegraphic Engineers and Electricians in London, and also a member of other scientific bodies, both in the United States and in Europe.

He has published "A Text Book of Elementary Chemistry" (New Haven, 1870), which has passed through eight editions and has been translated into the French and Japanese languages. It has met with great favor, over 10,000 copies were sold within five years of its publication, and it has been adopted officially by many colleges in the United States and also at the University of Tokio, in Japan.

Those who teach science know how hard it is to find a suitable text book on physics, and those who have used his "Chemistry" will be glad to learn that Professor Barker has in preparation a work on physics especially adapted to the wants of teachers.

Japanese Carpentry.

W. K. Burton, in the *Br. Journal of Photography*, gives the following interesting account of how Japanese carpenters work:

The workshop is a room perhaps twenty feet square, the floor all covered with straw mats. We are accommodated with chairs. This is an unexpected and certainly a pleasant advantage. We had looked to sitting on the floor, and accommodating our lower limbs as best we could.

And now to give some idea of the manner of working, if possible. There are four carpenters in the shop. Each squats on the floor with his bench—or what takes the place of the bench—and his smoking gear beside him.

The bench is nothing more than a flat board of hard wood, the dimensions some three or four feet long, about eighteen inches wide, and an inch thick. It lies directly on the straw mats. The smoking gear consists of a stoneware bowl, which is filled with wood ash, in the center of which a few embers of charcoal are kept always alight. The bowl stands in a square box, in one corner of which also stands a short piece of bamboo, into which is knocked the tobacco ash after smoking. The pipe has a wooden stem and a metal mouthpiece and bowl, the latter very diminutive. A pinch of tobacco is put into the bowl, the bowl is thrust among the live embers, a single puff, or at most two, are taken, the ash is knocked out of the pipe into the bamboo pot, and the smoke is over. The tobacco is the very mildest and is cut exceedingly fine. I think no Japanese workman is ever without this smoking gear. In his work he pauses every few minutes, takes his smoke, as I have described, very deliberately, then returns to his occupation. The smoke is by no means unpleasant, but would certainly be too mild to satisfy certain photographers at home that I could mention.

The bench has no arrangement whatever for fixing the work. It is merely the board of wood that I have described, without any addition whatever. That work should be turned out, on such a bench, of a quality to rival all but the finest camera work at home, is a thing I certainly should not have believed unless I had seen it. One thing which enables a Japanese carpenter to get on without any arrangement for fixing his work is that he uses his feet as well as his hands.

It is doubtless mostly due to practice, but also in great measure to the foot gear used by the Japanese, that they can use their toes to grip in a manner which Europeans could not imitate at all. The foot gear consists either of straw sandals or wooden clogs—the latter generally mere thick slabs of hard wood—which are held on the feet each by a thick cord which passes up between the big toe and the one next to it, bifurcates just over the toes, and joins the sandal or clog again at each side of the heel. The foot is thus never cramped or distorted as with us, and the toes can be freely used. A Japanese tailor holds his cloth with his toes, and a carpenter holds and turns about his wood with his feet. I was about to say that he manipulated it, but this, I presume, would not be allowable.

The tools are much more simple than ours. The hammer is merely a cylindrical mass of iron with a transverse round hole through which the handle passes. The saw is merely a strip of steel with serrated edge, and with a "tang" whereby it is fixed into a round handle like a chisel handle, much as we fix a file at home. The work is done by the upward or drawing stroke.

The plane is, in general form, somewhat like ours, but the wooden portion is much thinner—shallower from top to bottom—and the knife is inserted much nearer one end than with us. It is unlike our planes in that there is no second adjustable iron and that there is no wedge for fixing the iron. The iron is just in the form of a chisel, and is held in position by friction against the sides. With the plane, as with the saw, the work is done by pulling or drawing, not by pushing. The knife is fixed near the end, which goes in advance as the plane is drawn along. One would suppose that with such a primitive tool only rough work could be done, but the very reverse is the case. I have seen a Japanese carpenter do what any one who has ever practiced carpentry will know is by no means an easy thing. I have seen him take out of the middle of a board of hard wood a th n, delicate shaving several feet long and the whole width of the plane iron. One reason, perhaps, why such good work is done with the Japanese plane is that unless the edge of the knife is kept in very good condition the tool will not work at all. It is, therefore, kept as sharp as a razor, a deal of time being consumed in the very frequent setting of it.

One result of the simple construction of the Japanese plane is that a carpenter thinks nothing of making a special plane for any piece of moulding or such like work that he may have to do. These are sometimes very minute. I have seen them only about an inch and a half long and three-eighths of an inch wide. It thus comes that much of the work done by us with gauges, chisels, etc., is done by the Japanese with the plane.

None of the other tools that I noticed differed greatly from those used at home, except in being rougher and less finished in appearance.

The work that was being done was merely the exact copying of an English camera and dark slides. At work of this kind the Japanese are very clever, but they appear to have but little capacity for original mechanical contrivance. They, moreover, have very little idea of saving labor by machinery, or of division of labor. The consequences are that, although they turn out work of the kind that I have been describing cheaply—the camera was to cost about one half what it would cost at home—they would turn it out no more cheaply if goods were manufactured on a large scale. If a thousand dark slides were to be made, each one would be made precisely as the first, one workman doing the whole of the work.

It is probably due to this very fact—to the fact that the Japanese use little or no machinery, and that, as a rule, an article is made from beginning to end by one individual—that we owe the indefinable artistic charm which there is in the commonest product of Japanese labor. It is because each article has something of the individuality of the worker in it.

The camera maker thought it his duty to keep us entertained as we watched the progress of the work, and brought up to us, one at a time, what he considered the greatest treasures of his store. He brought first a fine and very large musical box. It was of French make, but set to play Japanese airs—or music rather, for I have failed as yet to find any approach to air or melody in the Japanese singing or playing. He next produced a Hall type writer, afterward various other mechanical toys for our amusement.

The bellows of the camera was being pressed in the selling shop by the simple expedient of piling lithographic stones on the top of it to a height of some four or five feet.

It Pays to Think.

A striking instance of the extent to which labor saving machinery is carried nowadays, says the *Industrial Journal*, is shown in the tin can industry. Everybody knows that tin cans are manufactured by machinery. One of the machines used in the process solders the longitudinal seams of the cans at the rate of fifty a minute, the cans rushing along in a continuous stream. Now, of course, a drop or two of solder is left on the can. The drop on the outside can be easily cleaned away, but it is not so easy to secure the drop left on the inside. It wouldn't do, of course, to retard the speed of the work—better waste the drop, it is only a trifle, anyhow, and to 99 men in 100 it would not seem worth a minute's attention. The hundredth man worked for a firm using one of these machines, and he set about devising an ingenious arrangement for wiping the inside of the can, thereby saving that drop of solder and leaving none to come in contact with the contents of the can. He was encouraged by his employers to patent his invention, did so, and has already received several thousand dollars in royalties for its use. As the machine solders 20,000 cans a day, the solder saved by his invention amounted to $15 a day. It pays to think as you work.

The Sense of Smell in Dogs.

It is, I think, of some interest to supplement the very striking and exact experiments of Mr. Romanes on the scent of dogs by an account of some experiments of a like kind made with a very different kind of dog, viz., a pug bitch. She was taught to hunt for small pieces of dry biscuit in a good sized dining room. The dog was put out of the room and a small piece, not much bigger that a shilling, of dry Osborne biscuit was hidden; and as long as the hiding place was accessible to the dog, she never failed to find it. Sometimes the biscuit would be placed under a heap of a dozen or more newspapers, on a dinner wagon, sometimes under a footstool, or soft cushion, or fire shovel, and on two or three occasions in the foot of a boot which had been just taken off, the hiding body being always carefully replaced before the dog was admitted into the room, and without exception the biscuit in a very short time was discovered. It was over and over again proved that the dog did not follow the trail of the person who had hidden the biscuit; often the dog went by a different route, and in some cases one person hid the biscuit and another opened the door.

The experiment which has now special interest is the following one. A small piece of biscuit was placed on the floor under the center of a footstool which was one foot square and six inches high, and standing on feet which raised it one inch from the ground. The dog, from the way in which she would set about moving the stool—not a very easy thing to do, as it stood in an angle of the wall—was evidently certain that the biscuit was beneath, and as scent seemed the only means by which she could have come at this conclusion, I thought to entirely mask this scent and prevent her finding the biscuit by pouring eau de cologne on the stool. I found, however, it had no such effect. The biscuit was as readily and surely found when the eau de cologne was there as when absent. It seems, then, that not only well-worn boots leave behind a recognizable odor, as Mr. Romanes proved, but also that to us at least so odorless a substance as dry plain biscuit emits so much and so characteristic a smell that it immediately spreads, even through considerable obstacles, to a distance of several inches in a few seconds, for in most cases the biscuit was found in thirty to sixty seconds after it had been hidden; thus time was not allowed, one would think, for all the surroundings of the hiding place to become saturated with the scent.—*W. J. Russell, Nature.*

The Government Suit to Annul the Bell Telephone Patent.

For the second time the government has met with a reverse in its suit brought to cancel the Bell telephone patent. The last action was brought in Boston, and was demurred to by the counsel for the telephone company, in great part on the grounds of lack of jurisdiction.

This view the court accepted, sustained the demurrer, and dismissed the bill. The grounds on which the decision was rendered are of much interest as defining the views held by the court of the limitations of its own power in dealing with a regularly issued patent. The argument on the demurrer was given before Judge Colt.

In his opinion, which was handed down Sept. 26, the judge recited the principal allegations, as to want of novelty, fraud, etc., that were brought against the patent by the complainant. He then examined the question of jurisdiction, whether, in the absence of any specific statute, the United States, by direction of the attorney-general, could bring any action in equity to cancel a patent for an invention. This question the court decided negatively, to the effect that the United States had no statutory rights in the matter, as by statute the questions involved in issuing patents were confided to the commissioner of patents. Neither could he find a basis for a general equitable right. Hence the decision was adverse to the complainant. The government, however, propose to appeal the case to the U. S. Supreme Court. In the natural course the case would not be reached for four years. Long before this the decision in the appealed infringement suits will be rendered. So the great government suit now is rather a matter of minor interest.

Wheat in America.

Concerning the introduction of wheat into America, reliable information is obtainable. It may be difficult in the present day to realize the fact that wheat was at one time unknown in America; yet prior to the discovery of this continent by Columbus. there was no cereal in America approaching in nature to the wheat plant. It was not until 1530 that wheat found its way into Mexico, and then only by chance. A slave of Cortez found a few grains of wheat in a parcel of rice and showed them to his master, who ordered them to be planted. The result showed, that wheat would thrive well on Mexican soil, and to-day one of the finest wheat valleys in the world is near the Mexican capital. From Mexico the cereal found its way to Peru. Marie D'Escobar, wife of Don Diego de Chauves, carried a few grains to Lima, which were planted, the entire product being used for seed for several successive crops. At Quito, Ecuador, a monk of the order of St. Francis, named Fra Jodosi Bixi, introduced a new cereal; and it is said that the jar which contained the seed is still preserved by the monks of Quito. Wheat was introduced into the present limits of the United States contemporaneously with the settlement of the country by the English and other European settlers.—*Milling World.*

BE careful in handling naked lights around bolting chests. Not long ago a correspondent of the *Milling World* entered a mill and found the miller searching for his hair, eyebrows, and beard. He was inspecting a bolting chest, using an unprotected light to illuminate the interior. No sooner was the light thrust into the chest than the miller was startled by a flash and a shock. When he picked himself up, his head was as bald as a celluloid billiard ball and his flowing beard was floating around the mill in gaseous form, sensible only to the nose. Fortunately, the fire did not spread and the accident was not reported.