

# JOURNAL

OF THE

# FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,

FOR THE PROMOTION OF THE MECHANIC ARTS.

---

VOL. CLV, No. 6.

78TH YEAR.

JUNE, 1903

---

THE Franklin Institute is not responsible for the statements and opinions advanced by contributors to the *Journal*.

---

## THE FRANKLIN INSTITUTE.

### On the Present Status of the X-Rays.\*

---

BY M. I. WILBERT.

---

A short seven years ago the newspapers of the country were publishing lengthy accounts of physical experiments, that were being carried on by scientific investigators all over the civilized world. These experiments were being made with a view of proving, or disproving, if possible, the assertion of a German professor of physics, that he had made a wonderful discovery, and that he was able, by means of certain well-known physical apparatus, to take photographs of objects that were invisible to the human eye.

How slow the civilized world was to grasp or appreciate the possibilities contained in the original contribution, is evidenced by the fact that it was nearly a calendar month after Professor Roentgen announced his discovery before

---

\* A lecture delivered before the Franklin Institute and the Central Branch Young Men's Christian Association, in Association Hall, Philadelphia, Friday, February 13, 1903.

the Physico-Medical Association of Würzburg, before any news of the same reached this country, and it was fully three weeks more before sufficient of the details were available to permit American physicists making experiments along the same lines.

Many of you will remember how, after the publication of additional reports of success, excitement and expectation ran high, the wildest and most wonderful assertions were made as to what this new form of energy really was or what it might be expected to do. A collection of newspaper clippings of the early months of 1896 would be interesting reading at the present time.

It must not be supposed for a moment that this discovery was entirely an accidental one, or made by a man whose mind had not been trained to make observations along particular lines of scientific research.

Wilhelm Conrad Roentgen was, at the time he discovered the X-rays, 50 years of age, and by far the greater number of these years had been devoted to the study of physical phenomena. In consideration of his abilities and scientific worth he had been made professor of physics at Giessen, in 1879. It will be remembered that this is the university at which the celebrated Liebig did his world-renowned work in chemistry. From Giessen, Roentgen was transferred to Würzburg in 1888, having acted as assistant here to Professor Kundt, in the early seventies. It was in the Physical Institute of the University of Würzburg, while at work on a subject that had been more or less actively discussed for upwards of eighty years, that Professor Roentgen noted that a piece of paper, coated with platinum barium cyanide, fluoresced, when a vacuum tube, which he had wrapped in black or opaque paper, was excited by means of a suitable electric current. The direct cause of this particular experiment dates back to 1816, when the English philosopher and scientist, Michael Faraday, in one of his lectures, suggested that matter probably existed in a fourth state, in which it had properties as different from a gas as this is from a liquid, or a liquid from a solid. Matter in this supposed fourth state was designated by Faraday as radiant matter.

A discussion of the subsequent investigations and the controversies that arose from them would take us too far from the subject immediately before us. Suffice it to say that, following along lines of thought suggested by Faraday, a number of noted scientists have made experiments and propounded theories. In Germany, Professor Plücker, of Bonn, was able to induce the ingenious mechanic, Heinrich Geissler, to devote a considerable amount of time to the construction of those ingenious pieces of the glass-blower's art so well known to all of you as Geissler tubes.

Professor Hittorf and, somewhat later, Professor Goldstein, worked along the same lines, and it was the latter who propounded the theory that the phenomena observed when a current of electricity was passing through a vacuum tube was due to vibratory motion in the ether.

The English physicist, Mr., now Sir William Crookes, was able to construct and use tubes of very high vacuum, with which he appeared at least to be able to demonstrate that the visible phenomena was due to the movement of material particles, thus actually demonstrating Faraday's supposed fourth state of matter.

The lecture or demonstration embodying Crookes' investigations was given in connection with the annual meeting of the British Association for the Advancement of Science, at Sheffield, in 1879. In the course of this lecture Crookes failed to mention the work done along the same lines by German scientists, particularly Hittorf and Goldstein, and it was this omission, probably more than the difference in theory advanced, that caused a revival of interest in the subject in Germany.

Among others, Prof. Heinrich Herz, of Bonn, devoted considerable time to the study of the phenomena accompanying the discharge of high potential electric currents through vacuum tubes. After his death the subject was continued by his assistant and pupil, Paul Lenard; the work done by the latter investigator practically leading up to where it was taken up by Roentgen, who, while repeating and elaborating on Lenard's experiments, discovered the very interesting physical phenomena, the practical application of which we are to review this evening.

As noted before, Roentgen's attention was attracted by the fluorescence of a piece of paper coated with barium platinum cyanide. His trained mind was not slow in grasping the possibilities of this phenomena, and these he demonstrated by subsequent experiments.

It may be interesting to add here that so complete were Roentgen's researches and experiments, that comparatively little of practical importance has been added since Roentgen read his first paper. The practical application of the X-rays has been largely restricted to medicine and surgery; but in this field their usefulness has fully come up to, if not exceeded, the expectations of the early experimenters. It is true that the crudeness of the early apparatus and the careless way in which many of the early experiments were conducted brought failure, and with failure discredit and suspicion of a method so little understood, and apparently so fraught with possible dangers.

To get some idea of the improvements that have been made in apparatus and methods of technique, let us first look at these two pictures of a purse. The first was made by Professor Goodspeed, of the University of Pennsylvania, in February, 1896, and was one of the first X-ray pictures made in this city. It required an exposure of thirty minutes at a distance of 10 centimeters (about 4 inches) from the tube. The second picture, made recently, required an exposure of but three seconds, with the tube 50 centimeters, or about 20 inches, from the object.

In addition to the very decided decrease in the time of exposure, we have in the latter picture a very marked increase in detail and penetration. The two coins in the purse are sharply outlined, the seams of the leather are clearly indicated, and, in addition to this, there is sufficient penetration of the metallic objects to show the contour of the silver through the brass coin. The reasons for this improvement will be more appreciated when we come to consider the source of the X-rays.

So far as known, X-rays are produced only by the discharge of a high potential electric current in a vacuum-tube. To get the most efficient rays, however, it is necessary that the tube be of special construction.



The most satisfactory tubes available at the present time are those in which the cathode rays are focussed to impinge on a comparatively small portion of a platinum plate forming the anode. This plate then becomes the source of the X-rays.

In the early tubes the cathode rays impinged on the glass wall of the tube directly opposite to the cathode. The whole area on which the cathode rays impinged became the source of X-rays, thus distributing their origin over a large surface, thereby causing a more or less blurred image on the photographic plate or fluorescent screen.

The source of the electric energy is of considerable importance. Broadly speaking, we have two possible sources of supply—the older and perhaps less efficient generator, and the more modern and now widely used transformer.

The generator type is best represented in the well-known static machine, the forerunner of which was invented by an early German scientist, Otto Von Guericke, more than 250 years ago; it was later improved upon by Sir Isaac Newton, who substituted a glass globe for the sphere of sulphur used by Von Guericke.

The present type of influence machine was invented almost simultaneously by Holtz and Toepler, in 1864, while a modification of it was introduced by Wimshurst, and is usually referred to by that name. Static machines, as used at the present time, may be said to consist of two or more glass plates so arranged that we have alternately a stationary plate carrying the so-called armature, and a revolving plate in front of which are the combs or brushes to collect the electricity when the machine is set in motion.

This, however, while it is no doubt the simplest form of generator for an electric current of high potential, is not so uniformly reliable as is the transformer.

With the transformer we must of course have some other source of electric energy; this may be the simplest form of primary battery, or we can use the current direct, or modified in several ways, from the ordinary street-lighting plants, the latter of course being much the more economical where any appreciable quantity of current is to be used.

The type of transformer that has been used with most satisfactory results is represented by the well-known Ruhmkorff or Ritchie coils. Here, again, we cannot stop to go into details as to the construction or the comparative efficiency of different modifications of this well-known piece of physical apparatus; suffice it to say that while even the best available coil cannot be considered the acme of perfection, these coils must, at the present time at least, be considered to be the most reliable and altogether the most satisfactory source of high potential electric energy available. In addition to the Ruhmkorff type of coil, what is variously known as a Tesla, Thompson or high-frequency coil, has been used to some extent in connection with X-ray work. This type of coil, while it is perhaps more efficient as a transformer, does not give as satisfactory results in connection with the high-vacuum tube.

Among other forms or modifications of older transformers we may mention the Kinraide coil; this is practically a double induction coil; Thompson's static transformer, this being essentially a combination of Leyden jars, and Professor Trowbridge's ingenious combination of storage batteries, with which he has been able to duplicate any and all of the results obtainable with an induction coil.

We said a few moments ago that the only available source of the X-rays was by means of a discharge of a high potential electric current through a vacuum tube; this statement should be qualified by saying that this is the only practicable source of the X-rays. Early in 1896, when all sorts and kinds of experiments were being conducted with a view of finding other sources of the X-rays, Monsieur Henri Becquerel discovered that several chemical substances had the property of affecting photographic plates through opaque wrappers. A number of scientists have taken up this particular line of investigations, and the results obtained so far appear to indicate that this field offers some most interesting possibilities. Madame and Monsieur Curie have devoted considerable time to the study of what is usually referred to as radio-active matter, and they have been able to isolate several supposedly new

elements, one of which, at least, appears to have been established as a distinct and separate element. This is radium, which has just been added to the list of elements by the International Commission on atomic weights. It has been given the symbol Ra, and is supposed to have an atomic weight of approximately 225. In addition to radium, there are two other radio-active elements—polonium and actinium; while, in addition, both thorium and uranium appear to have radio-active properties.

We have this evening several pictures that were made by means of the Becquerel rays. (All of the rays produced by these various radio-active bodies are usually referred to as Becquerel rays.) These pictures were made by placing a quantity of urananite in a paper envelope, wrapping a photographic plate in several layers of opaque paper, and then placing several metallic objects between the envelope containing the urananite and the package containing the photographic plate, and allowing them to remain in contact in a dark-room for from one to ten or twelve hours. On developing the photographic plate it will be found that an image of the denser objects interposed is quite sharply defined.

So far, these Becquerel rays have attracted little attention outside the realm of pure science; and while the possibilities of their application are numerous, the scarcity and comparative high price of strongly radio-active materials has prevented any extensive experiments being made in their practical application.

A possible use for the X-rays that suggested itself at an early date was their application in time of war to locate bullets and other missiles, and in this way dispense with the oft-times dangerous practice of probing.

These rays have been used, with very satisfactory results, in no less than four campaigns: the British Soudan campaign, the Græco-Turkish war, the American war with Spain, and also in the British-Boer war in South Africa.

In the war with Spain the X-rays were used quite extensively and with very satisfactory results. In this connection it may be mentioned that military surgeons usually ascribe a marked proportion of the decided decrease in the mortality of the injured to the judicious use of the X-rays.

The medical department of the United States Army has recently issued a very complete and exhaustive report on "The Use of the Roentgen-Ray by the Medical Department of the United States Army in the War with Spain, 1898."

The data for this report was compiled by Captain, now Major, W. C. Borden, who has charge of the X-ray work in the army hospitals.

The contained half-tone plates and pictures are particularly interesting, as illustrating the variety or kind of an injury made by the modern small-arm projectile.

Wars, while becoming more dangerous, are fortunately becoming more and more expensive and less plentiful. There are, however, quite a number and variety of accidents that are of daily occurrence and to which the X-rays are important as an additional means for determining the nature as well as the extent of the resulting injury. We cannot expect to go over the list of possible fractures, so must content ourselves with indicating just a few of those occurring most frequently, and incidentally pointing out to you several points in which injuries of this kind differ from the accounts or descriptions of them found in the older textbooks on surgery.

There is a widespread popular belief that a sprain is worse than a fracture or break. The fundamental reason for this belief is illustrated by a number of pictures that we have here, which show that what is usually called a sprain is oftentimes a fracture involving one or more of the bones at or near a joint. These joint fractures usually do not involve any appreciable amount of the articulating surface of a bone, and are therefore not readily recognized as fractures by the ordinary methods, consequently are not treated as they should be. It does not require much medical knowledge to appreciate that an injury to a bone at or near a joint, not properly treated, may lead up to very considerable interference with the normal function or use of that joint. Among the portions of the body that are particularly susceptible to injuries of this kind are the wrist, elbow, shoulder and ankle; in each of these the X-rays have demonstrated fractures that formerly were not even suspected.



The proper treatment of injuries of this kind is, of course, made practically simple and easy by the accuracy and the completeness of the diagnosis. In addition to being useful as an additional means for diagnosis, the X-rays are also useful to control or to observe the progress of the subsequent treatment. After a fracture has been reduced, or set, as it is sometimes called, and the proper dressings applied, the X-rays may be used to see the exact position of the bones, whether or not they are in apposition, and whether or not the dressings have been properly applied.

The only kind of surgical dressing that interferes materially with an examination of this kind is one in which a metallic splint is used. The ordinary wooden splint, or even a plaster-of-paris cast, does not interfere materially with the penetrating properties of the X-rays.

That there is even with the X-rays a possibility of making an error cannot be denied; this possible error is however entirely due to the personal factor that necessarily enters into the making of an examination of this kind. With increased experience on the part of the X-ray operator, or possibly with the introduction of improved apparatus that will do away with the necessity of close personal attention, this possible source of error will be largely if not entirely eliminated. The X-rays themselves being a purely mechanical problem, with fixed and definite factors, the results obtained must necessarily represent the sum total of these various factors. We must pass on, however, to the consideration of other possible uses for the X-rays.

Dislocations or luxations are not always so readily recognized as one would be led to suppose. There are quite a number, partial luxations particularly, that are not easily recognized in the ordinary way, or that are sometimes mistaken for an injury or lesion of quite a different character.

We have here a number of pictures that illustrate the difficulty of making a diagnosis of a luxation, or especially of a partial luxation. If any further evidence were needed, it might be found in the newspaper reports of the clinics given by the celebrated Austrian orthopedic surgeon, Dr. Lorenz, who, when on his visit to this country, operated on

quite a number of luxations, particularly congenital luxations of the hip joint.

These congenital luxations are so persistent and difficult of treatment, simply because they are not recognized early enough. The injury, usually occurring at the time of birth, is not recognized until the child begins to try to walk. By this time the muscles and tendons have adapted themselves to the new position of the thigh bone, the normal articulation has been partially obliterated and a new or false articulation has been formed. To overcome this combination at this late day requires an operation of considerable extent, and operative skill of a very high degree; whereas, if the lesion had been recognized in time a comparatively simple procedure would have accomplished the same purpose.

Foreign bodies, particularly when they are of a substance denser than the portion of the human body in which they are imbedded, are readily recognized.

In the extremities they are easily located by taking X-ray pictures in two different directions. In the flat portions of the body this is not done so readily, and for locating foreign bodies in the third dimension, several very ingenious and more or less successful methods have been adopted. In England pictures of this kind are quite frequently taken stereoscopically; by mounting the resulting negatives so that they may be looked at in a reflecting stereoscope, a very fair idea of the depth at which the body is imbedded may be had. Another method that depends on pretty much the same principle is that followed by Mr. Mackenzie Davidson. This consists of taking two pictures of the same part from two different angles, and then, by a very simple method of triangulation, locating exactly the depth at which the foreign body is located.

Dr. William M. Sweet, of this city, has devised a very ingenious little apparatus that was designed to locate foreign bodies in the eye, but is also applicable to other portions of the body, particularly the hands and feet.

The location of foreign bodies in the gastrointestinal tract is of very great importance. Quite a number of deaths have been reported, due to injury caused by unrec-

ognized or unsuspected metallic bodies in different portions of the body.

Accidents of this kind are not at all infrequent, particularly with children, who appear to have a morbid fancy for swallowing all sorts and kinds of metallic substances, such as coins, pins and small toys. How readily these ingested foreign bodies may be located is illustrated in a series of pictures that we have here showing foreign bodies in the esophagus, the stomach and also in different portions of the intestinal canal.

The treatment of these cases is simplified and may be closely followed and controlled by means of the X-rays. Usually a foreign body will pass through the intestinal tract without doing any material damage. There are, however, cases where prompt surgical interference is indicated, and for these the X-rays are of very great use and importance, in that we are able definitely to locate the foreign body, get a very fair idea of its comparative size, and from this data judge of its probable injurious action.

Ingested foreign bodies are not as painful or as dangerous as are the collections or accretions of materials that are sometimes formed in the different abdominal organs.

The gall-bladder, the kidneys and also the bladder are frequently affected in this way. Of the three, calculi or stones in the kidneys are most difficult to recognize by the ordinary methods. The X-rays make a diagnosis of stone in the kidney a matter of comparative simplicity, particularly in the hands of an experienced or careful operator. Dr. Charles Lester Leonard, of this city, has done much original work in this particular line, and has contributed materially to establish the X-ray method of diagnosing renal calculi.

From the kidneys these calculi occasionally find their way down through the little tubes, called ureters, to the bladder. While passing through the ureter they may be the cause of intense pain; at times they are so large that they completely occlude the ureter and become firmly lodged. In cases of this kind surgical interference becomes necessary, and here again the X-rays are of value in locating the site of the

occlusion, and in this way indicating the most desirable course for operation.

In the bladder, a kidney stone may become the nucleus for a larger stone or calculi; this may go on accumulating material for years before it interferes enough with the normal function of the organ to occasion pain or discomfort. It must be remembered, however, that a kidney stone is not necessary to occasion a stone in the bladder; a number of other causes may produce the same results.

In more purely medical cases the X-rays are quite extensively used to recognize or to demonstrate pathological conditions of several of the internal organs. For examinations of this kind, where the size, location and action of the different organs is to be studied, the fluoroscope is perhaps more valuable than is the photographic plate, as by means of the former the actions and movements of the different internal organs can be observed and a considerable amount of additional information gleaned in this way.

In case a pathological lesion has been observed by means of the fluoroscope, and a permanent record of the same appears desirable, a radiograph or X-ray negative may be made. This forms then a permanent record for future reference or comparison.

In the practice of dentistry the X-rays are of value. By means of them the process of dentition may be studied as it has never been observed before, as any irregularities or abnormal features are readily recognized. In addition to this, however, even the structure of the individual teeth may be demonstrated, and in case of abscess-cavities these may be recognized and positively located.

The nature and kind of work that has been done by the dentist can also be demonstrated or shown; and in case of an accident, such as the breaking of a drill in the root of a tooth, the foreign body is readily shown and located. In extraction cases the presence or absence of a fracture of the alveolar process may be determined if thought desirable.

In chemistry, particularly in detecting adulterations of inorganic materials in drugs or chemicals of organic origin, the X-rays have been used to considerable extent and have



quite a wide field of application. Drugs like the gums, gum resins, and resins, that are rather difficult to examine in the ordinary way, are readily examined for inorganic or earthy adulterations by means of these rays. In coal, asphalt and other materials of a like character, the amount as well as the distribution of the ash or inorganic material may be determined very readily.

For the study of human, or for comparative anatomy, the X-rays offer advantages not found in any other direction.

The osseous structure of any of the vertebrates may be pictured so as to show the size, structure and relative positions of any and all of the bones composing it. In addition to this, the development of the bones may be studied at different stages in the same animal or individual, and in this way a very complete study of the formation and gradual development of the osseous structure may be made and accurately recorded. The complete anatomical structure, of the smaller animals particularly, is at times rather difficult to get at. By means of the X-rays not alone one, but a number of small animals, may be examined, so that the normal structure of the animal may be decided on with a considerable degree of accuracy.

Even the conchologist can make use of the X-rays for the study of the shape, structure and composition of shells, particularly of such as are rare or difficult to get, and which he does not care to submit to dissection.

All of these recounted uses, however important as they may appear, become comparatively insignificant when compared to the possible uses of the X-rays as a therapeutic agent.

Not long after the discovery of the X-rays by Roentgen, it was noted that after a prolonged, or even after repeated short exposures of any portion of the body to the energy emanating from a vacuum tube, peculiar secondary effects sometimes manifested themselves; these secondary effects varied from a slight tanning or reddening of the skin, simulating sunburn, to the production of a deep burn or ulcer. It was not long before experiments were being made with a view of controlling these secondary effects, and to develop,

if possible, their curative properties. It was argued that if these rays have the property of changing healthy cells, they should also have the property of bringing about a corresponding change in degenerate or diseased cells.

During the past four or five years a large number of more or less authenticated or reliable reports have been published, and at the present time the X-rays have firmly established themselves as having marked curative properties.

So far as known, the X-rays are applicable in but a limited number of diseases, and even here there appear to be isolated cases, where, for some unknown reasons, the X-rays do not act as promptly and as satisfactorily as in others. The reasons for this are no doubt to be found in the fact that medical men have not as yet been able to demonstrate the underlying causes, or the action of the X-rays on the various pathological conditions. A considerable amount of work is, however, being done in this direction, and it is to be expected that in the near future physicians will be able to say why and how this particular form of energy brings about changes in pathological conditions, and also be able to say in which particular conditions the X-rays will be of use as a therapeutic measure.

Until such time as physicians have some definite knowledge as to the limitations and possibilities of the X-rays, it will be well to be conservative in their use, with a view of avoiding any injurious after-effects from possible abuse.

In summing up the present applications and uses of the X-rays, it will be safe to say that as an additional means for making a complete and satisfactory diagnosis, in a variety of medical as well as surgical affections, this new form of energy has more than come up to the expectations of those most interested, and bids fair to be even more satisfactory in the immediate future.

For technical or applied scientific purposes they have probably not developed along the lines in which it was at first expected they might find application; but even here they have found uses, and these uses are constantly increasing.

As a therapeutic measure for the relief of suffering and

the cure of a number of chronic and usually discouraging conditions, they bid fair to eclipse in usefulness and applicability any one curative agent that has been added to the armamentarium of the physician for a decade at least.

No attempt has been made here to even indicate the effect that the discovery of these rays has had, both directly as well as indirectly, on purely scientific theories or investigations. Suffice it to say that they have materially broadened the horizon of positive scientific knowledge, and have in some cases shattered theories that were considered well-nigh unassailable.

In conclusion, just a few words as to the man to whose acumen, scientific training and pioneer work on the borderland of the great unknown we are indebted for much of that meager knowledge that we possess of the X-rays at the present time.

Wilhelm Conrad Roentgen was born on March 27, 1845. After the usual preliminary education he attended lectures at Utrecht and later at Zurich, where he obtained his doctor's degree in 1869. He appears to have been a favorite student with Professor Kundt, and the following year, when that professor assumed the chair of Physics at Würzburg, young Roentgen went with him as his assistant. In 1873 Roentgen went with Kundt to the University of Strasburg. Two years later he was made lecturer on mathematics and physics at the Agricultural Academy in Hohenheim. The following year he was back at Strasburg, and in 1879 he was made professor of physics and director of the physical institute at Giessen.

From here Roentgen was transferred to the University of Würzburg in 1888, where, on November 8, 1895, he made the discovery that has made his name familiar throughout the civilized world. After the announcement of this discovery he was knighted by the King of Bavaria, who also offered him the professorship of physics in the University of Munich, which he now holds.

Roentgen has received recognition, medals and honorary memberships from scientific societies all over the world.

Among the acknowledgments of a more practical nature

that he has been the recipient of, it may be well to say that in 1901 he was awarded the Nobel prize instituted by the late Alfred Bernhard Nobel, the inventor of dynamite, for the most important invention in the domain of physical science.

Altogether it may be said that the active life of Professor Roentgen has been one of close application to the exacting details of his chosen branch of science, and the merited recognition he has received for making what appears to be indisputably his discovery but illustrates that the world, after all, is quite willing to reward patient, honest workers who are willing and able to demonstrate that they are capable of doing something that no one else has done before.

---

#### STEAM TURBINE INSTALLATION.

A unique steam turbine installation is about to be made at the Cumberland Mills, Portland, Me. Most of the current for the present electric drive is supplied by a water-power plant, and the balance by a steam-power plant. The new steam turbine will be used for relay purposes, trouble being sometimes experienced with the water-power system, due to irregularity of water-supply. The turbine is 540 horse-power, taking steam at 165 pounds pressure, after it has traversed the distance of 350 feet separating the boiler-house from the engine-house. Before entering the turbine the steam will be superheated about 100° F. by means of an independent superheater, fired by waste hydrogen gas rising from electrolytic baths used in the process of manufacturing at this plant. The gas has heretofore been a waste by-product. The steam "economy" will be about 13.5 pounds per electrical horse-power hour, which means about 11 pounds per indicated horse-power hour.—*Iron Age*.

---

#### FRENCH LAW OF EMPLOYER AND EMPLOYEE.

A law still obtains in France, under which any workman who divulges information regarding a secret process practised in any industry, to a foreigner, or even to a Frenchman resident abroad, commits a penal offense, and for such is liable to a sentence ranging from two to five years' imprisonment and a fine from \$100 to \$4,000. He is furthermore subjected to from five to ten years' police supervision after his release from jail. Even the communication of such information to another Frenchman resident in France is punishable though the sentence in this case is not so severe, the sentence varying from three months' to five years' imprisonment, accompanied by a fine ranging from \$3 to \$40. On the other hand, a French employer is entitled, without reserve, to any invention or discovery made by a workman in his employ that is within the scope of the work undertaken at the factory —*Scientific American*.