three different vessels will thoroughly clean the plates, after which an electric fan is used for drying them. The entire operation requires but a few minutes. The knives can be scoured and polished by passing them between a pair of rapidly-rotating buff-wheels, and an emery wheel is provided for sharpening the steel blades. But the use of the electric motor in the kitchen is not confined to cleaning apparatus. A number of electrically-driven machines have been devised for preparing food. Two of these are shown herewith. One of them consists of a cabbage-chopping machine, and the other is a potato-paring machine. The latter discharges potatoes fully pared except for the eyes, which can readily be cut out by one of the attendants. It will be evident that these are but a few of the different uses to which electric power can be applied, and it is expected that the next few years will add wonderfully to the present variety of electric labor-saving devices for kitchen use.

We are indebted to the *Bulletin* of the New York Edison Company and to the Siemens-Schuckert Works of Berlin for the photographs used in illustration of this article.

New Departure in Animal Study.

BY F. MANDE SMITH.

With practically nothing known of the diseases of wild animals, the establishing of the Infirmary and Laboratory of Pathology for the inmates of the Zoological Garden of Philadelphia is an interesting departure. The office of the Zoological Society is in the quaint little old mansion, called "Solitude," which was built by John Penn, the nephew of the founder of Pennsylvania. Standing rather near the main entrance, this plain and dignified one-story building consists of a central hall, running through it, and four large light rooms. To the right of the entrance is the laboratory. Immediately back of it is the *post-mortem* room. To the left is the infirmary, and in the rear of it is the quarantine room. New arrivals for the collection go at once into the quarantine room, provided they are of moderate size, that they may be examined and watched for a certain period. Smaller animals on the sick list are placed in the infirmary, and, truth to tell, our friends (or relatives), the simia, are in the majority. As a rule, from one to half a dozen may be found in this pleasant room.

In the *post-mortem* room there is a refrigerating plant, a dissecting table, barrels of formaldehyde (one a 10 per cent, the other a 40 per cent solution) and Muller's solution, and a barrel of "remains." It is indeed uncanny to see a section of what is mortal of an animal friend, which one has admired and taken sugar to for years, but the spirit of which has passed on—one hopes to eternal sweets, or fruit, or tenderloin steaks, or whatever it best likes.

Long tables are built into three sides of the laboratory, while at the table in the center there is always some work being carried on. Upon it is placed the microtome, which is an interesting instrument for cutting tissues into sections of tissue-paper-like thinness. Though these sections are usually cut from 1/250 to 1/500 of an inch in thickness, or rather thinness, the microtome has a capacity of 1/2,500 of an inch. This thinness is necessary, that the specimen, which by this time is mounted on a glass slide for use under the microscope, may be seen through.

The specimens as they come from the autopsy are placed in fixing solutions, and then in alcohols. Lastly they go into paraffine, liquid or solid, and after four to eight hours in the incubator, at 52 deg. Cent., or 122 deg. Fahr., they come out imbedded in this remarkable substance, and ready for cutting in the microtome. One or two specimens are taken of each organ, averaging about 14 to an animal. In the *post-mortem* room Dr. Courtland V. White, who heads the staff of this new infirmary and laboratory, dictates changes, and anything abnormal is made a note of. The final touch to the specimens is to mount them on glass, and color them with haematoxyton.

One incubator is full of culture media, and in these cultures many sorts of bacteria are being grown in anything from milk to Japanese moss (agar). One culture is alive with typhoid, another with tuberculosis. There are many of these cultures, and despite their smallness they hold enough deadly bacteria to kill a million people.

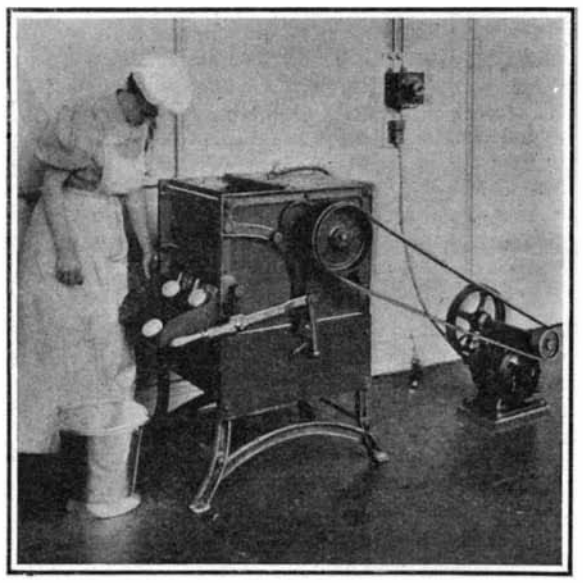
It is hoped and predicted that improved hygienic methods will be discovered, and new serums against dread disease for the benefit of mankind, as well as the lower animals. This new departure has cost $9,000 for the building and $2,000 for the apparatus.

A Substitute for Sponges.

In Algeria, the cultivation of "vegetable sponges" is now making progress. The cultivation of this plant (of which about ten species are known, and cultivated, in the warm regions of Asia and Africa) is fairly extensive in the environs of Algiers and Oran. Prior to maturity the fruit is edible; when the stage of ripeness has been passed, however, the pulp becomes separated from the fibrous matter which then forms the spongy mass termed the "vegetable sponge." Fine specimens, when carefully bleached in a weak lime bath, are sold at from 3½ to 4½ pence apiece. Paris is at present the chief market for most of the vegetable sponges grown in Algeria. They are highly suitable not only for toilet and bathroom, but also for domestic purposes.

Work Standing and Seated.

Is manual labor better done standing, or in the sitting posture? A question as interesting from the individual as from the social point of view. We know that those who practise the trades and the most deli-

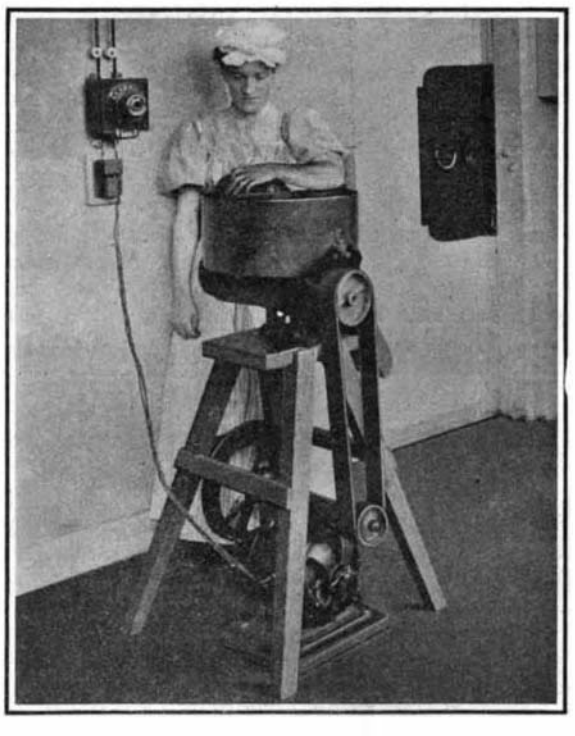


Electric Potato-Paring Machine.

cate arts seated often rise to consider their work with more precision, or to perfect its details. And the physiologists admit, on the other hand, that the standing position is the attitude that best assures stability against exterior forces, and so obtains the best fulcrum in the various activities.

Nevertheless, it was not futile to confirm these somewhat theoretical considerations by experiment. That is what M. Charles Ferré has done by means of the ergograph, an instrument that allows registering the number of liftings of a given weight by the middle finger, and the extent of each movement of this finger. Now, the result of these experiments is to show that work standing is about one-tenth superior to work seated. But, if we compare these works at their beginning and at their end, we notice that work seated is less considerable at the beginning and gradually subsides, while remaining pretty intense at the end; whereas work in the standing position is more intense at the beginning, persists for a long time very high, then rapidly falls.

The standing position, then, favors work and appli-



Electric Machine for Chopping Cabbage

SOME NOVEL USES OF ELECTRICITY.

cation during a long period; but it is certain that this exaltation is followed by a more rapid fatigue. By experiments of the same sort M. Ferré has ascertained, moreover, that a long period of inactivity preceding work diminishes the value of the latter, whereas a short period of inactivity of five or ten minutes is followed by an improvement in the work. After an hour of inactivity work is reduced to its minimum. It seems that the subject is torpid or asleep. Practical deduction: the pauses from work, as between two classes, should never exceed fifteen minutes.—From Illustration (Paris).

FRANKLIN'S SCIENTIFIC WORK.

Rather late in his very active life the tenth of Josiah Franklin's sons had occasion to set down the impressions of his remarkably varied and successful career and to reflect, in a graceful yet simply-worded autobiography, on the meager advantages that he had inherited from his father. Two of Josiah Franklin's attributes were singled out by his youngest son as the most noteworthy in his heritage. "A sound understanding and solid judgment in prudential matters, both in private and publick affairs," was the first; the second was "a mechanic genius" in being "very handy in the use of other tradesmen's tools."

Of Franklin's "sound understanding and solid judgment" historians have written at length; of his "mechanic genius" little is popularly known beyond the picturesque facts of his early days spent in candle-making shops and in printing offices.

Franklin's interest in electricity, the field in which his mechanic genius expressed itself most originally, began in his fortieth year. A Dr. Spence appeared in Boston in 1746 and exhibited some crude electrical apparatus on the mysterious working of which he dilated in popular lectures. Franklin heard him and was interested, despite the fact that Spence was not over-skillful in manipulating his apparatus nor over-illuminating in his explanations. When Franklin returned to Philadelphia he repeated some of Spence's experiments with a glass tube that had been sent over by Peter Collinson, a merchant who had an extensive trade with the colonies and who took a lively interest in the Library Company with which Franklin was actively connected. After a year's experimenting Franklin was convinced that he had made advances of real import and sent to Collinson an account of the first electrical discoveries made in America. Early in that famous scientific correspondence he referred to the "wonderful effect of pointed bodies both in drawing off and throwing off the electrical fire" and told Collinson how a cork suspended by a silk string was repelled after contact with an electrified cannon ball, and how a steel bodkin held near the ball conducted the electricity away from the iron so that the cork fell back and was no longer repelled by it.

The rubbing of a long tube with buckskin proved too tedious in the end, and so Philip Sing, one of Franklin's associates, transformed the tube into a ball, provided it with an axle and a driving wheel after the manner of a grindstone, and thus reinvented the electrical machine.

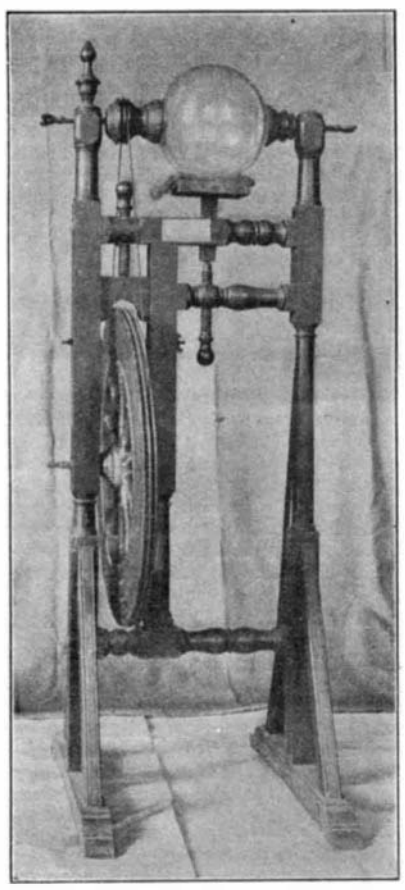
All this was done by a man naturally apt in the handling of instruments, guided only by the books which Collinson had supplied, by Collinson's brief letters, and by Spence's awkward demonstration. Of contemporaneous European work nothing was known. In a way it was fortunate that Franklin knew nothing of the electrical investigations which were then conducted in Europe, for he was thus led to explain in his own way the cause of the "drawing off" action of pointed rods. He proposed a theory that accounted for the observed facts with singular simplicity. The phenomena observed could be explained, he argued, by assuming that there is a certain quantity of electricity naturally belonging to every substance in its unexcited state. If by suitable means that quantity be increased, the substance may be said to be plus or positively electrified; if diminished, minus, or negatively electrified. Adding to this hypothesis the view that electricity is self-repellent and attractive of matter generally, he was able to construct satisfactorily what has since been called the one-fluid theory of electricity in contradistinction to the two-fluid theory of his European predecessors and contemporaries.

Curiously enough modern physicists are reverting to Franklin in their negative-corpuscle theory. The idealistic school of English scientists, headed by Thomson, Lodge, and Crookes, account for negative electricity by the discharge of a negative corpuscle from a positively-charged body. Just why this action should take place we are no better informed than was Franklin. In two hundred years we have advanced not very much beyond him, so far as the philosophy of static electricity is concerned. Of the electric spark and of lightning we know but little more than he did.

We need not here repeat the story how several persons before Franklin's day had detected the resemblance between lightning and electricity, but that no one had yet entertained the magnificent idea of examining the suggestion experimentally; how Franklin proposed to present a long, pointed conductor to a thunder cloud in order to withdraw the electricity from it, if any it had; how in France instruments constructed in accordance with his principle proved the expected identity; how almost simultaneously he himself in Philadelphia succeeded by means of a kite; and how he applied his discovery in the lightning rod. We may be permitted to observe, however, that his kite experiment is one of the most brilliant examples of luck yet recorded. To attempt the extraction of lightning flashes from a lowering sky was almost suicidal. Even at this late day timid persons occasionally fly to feather beds, sit on glass-legged chairs, or find refuge

in rubber boots, during thunder storms. A repetition of Franklin's experiment cost his immediate imitator his life.

The correspondence in which Franklin outlined the experiments which were subsequently crowned with such conspicuous success was offered by Collinson to the Royal Society for publication and almost derisively rejected by that body. Later the letters were published by Dr. Fothergill, widely circulated and translated. To the credit of the Royal Society be it said that, some years afterward, it elected Benjamin Franklin an honorary member and bestowed on him its highest honor — the Copley medal.



Franklin's Electrical Machine.

Franklin's scheme of erecting lightning rods to conduct atmospheric electricity to the ground and thereby protect buildings was at first hotly opposed. After the utility of the lightning rod was established by abundant proof, another wordy war was waged as to the advisability of employing pointed or blunt conductors. Franklin advocated the pointed rod; against him was arrayed a regiment of English electricians. Because the controversy affected his own royal abode, Buckingham Palace, a wise monarch whose philosophic intellect had once marveled at the culinary feat of introducing apples into dumplings, graciously considered the matter, decided that pointed conductors "were a republican device calculated to injure his Majesty," and ordered the substitution of ball rods for the revolutionary but more practical pointed conductors. "The king's changing his pointed conductors for blunt ones," said Franklin, "is a small matter to me. If I had a wish about them it would be that he would reject them altogether as ineffectual."

Franklin's dramatic kite exploit added a new interest to the Leyden jar. Ladies and gentlemen of fashion at the courts of England and France, instead of whiling away their evenings at piquet and bezique, rubbed glass tubes, stood on insulated stools and extracted sparks from one another. Franklin became so identified as the conqueror of the lightning that artists produced engravings of him in which he is pictured as the center of Louis the Sixteenth's admiring court, crowned by noble ladies; or in which he is represented imperturbably seated near an open window with forked flashes darting across an ominous sky.

Franklin's own work with the Leyden jar led him to adopt the correct view that the connected coatings "served only like the armature of the lodestone to unite the force of the several parts and bring them at once to any point desired," and that the electricity existed only on the glass.

Franklin's contributions to science are not limited to his electrical discoveries and inventions. Out of many such two deserve special mention. They are the course of the North American storms and the effects of the Gulf Stream.

He relates the circumstance of his meteorological discovery in a letter dated February, 1749:

"You desire to know my thoughts about the northeast storms beginning to leeward. Some years ago there was an eclipse of the moon at nine o'clock in the evening, which I intended to observe, but before night a storm blew up at the northeast and continued violent all night, and all the next day, the sky thick-clouded, dark and rainy, so that neither moon nor stars could be seen. The storm did a great deal of damage along the coast, for we had accounts of it in the newspapers from Boston, Newport, New York, Maryland, and Virginia; but what surprised me was to find in the Boston papers an account of an observation of that eclipse made there, for I thought as the storm came from the northeast it must have begun sooner in Boston than with us, and consequently prevented such an observation. I wrote to my brother about it, and he informed me that the eclipse was over there an hour before the storm began. Since which I have made inquiries from time to time of travelers and of my correspondents northeastward and southwestward, and observed the accounts in the newspapers from New England, New York, Maryland, Virginia, and South Carolina, and I find it to be a constant fact that northeast storms begin to leeward and are often more violent there than to windward. Thus the last October storm, which was with you on the eighth, began on the seventh in Virginia and North Carolina, and was most violent there."

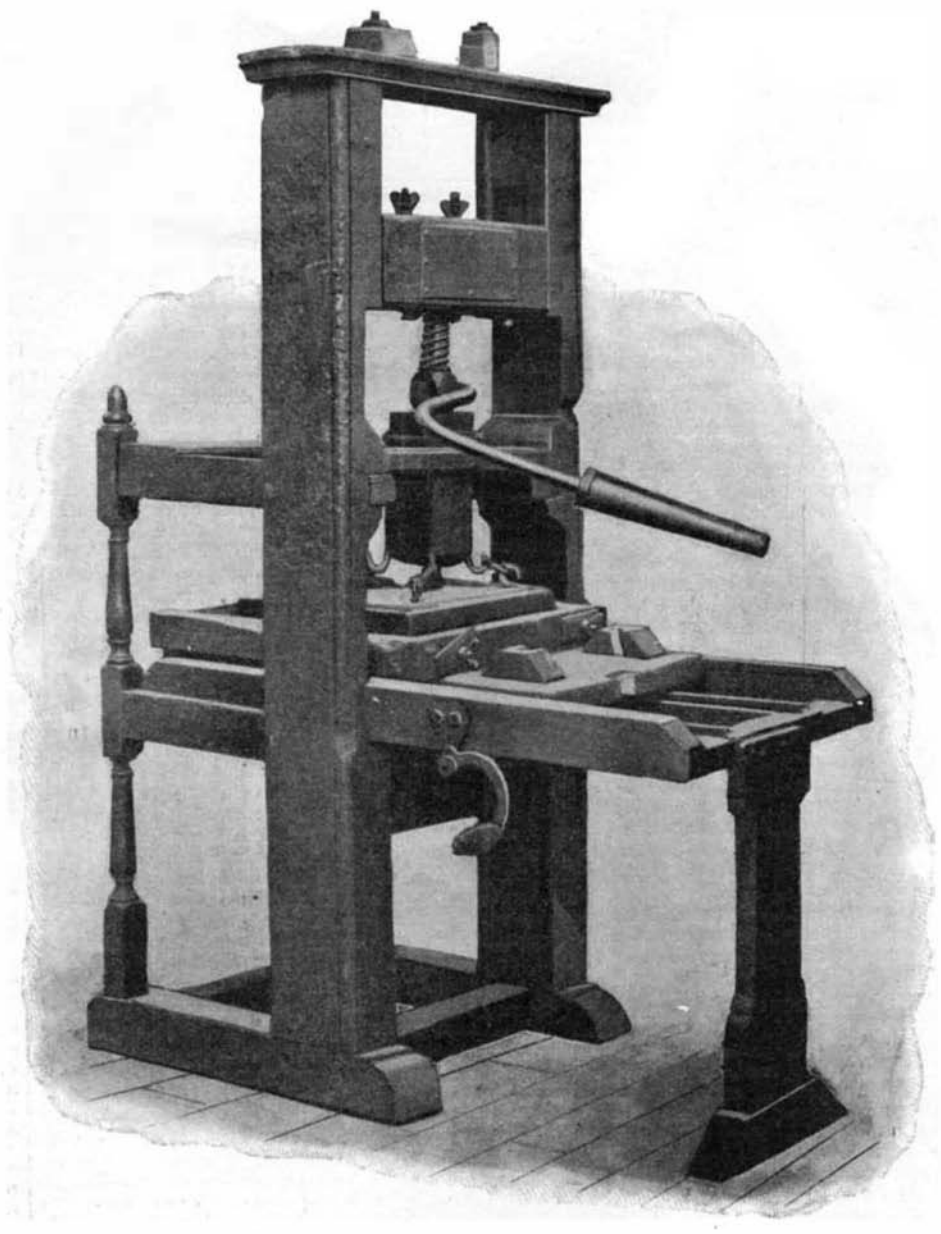
Now we know that almost all the chief atmospheric disturbances of this continent pass in an easterly or northeasterly direction toward the Atlantic Ocean. It follows, then, that the approach of these storms can be foretold by telegraph, and so with minor disturbances at variations in atmospheric pressure.

The Gulf Stream was, of course, known long before Franklin's day; but he it was who caused the first chart of it to be made; the first who showed its splendid proportions and its geographical and climatological importance; the first to detect its most salient characteristic (its high temperature), and the first to introduce the thermometer as a means of fixing its location.

It is not amiss to regard Franklin as the first American heating and ventilating engineer; for between the years 1740 and 1745, his scientific investigations had for their purpose the prevention of the wasteful use of fuel. His researches caused him to make a careful study of all the different methods of house heating, with the result that he invented the Pennsylvanian fireplace, which brought about a great economy of fuel and a properly heated room. The real Franklin stove is not the contrivance which has masqueraded under that name; it was an apparatus which took cold fresh air outside of the house, and after warming it in passages kept hot by the escaping gases of the fire, finally discharged into the room. Had this old Franklin fireplace been enlarged and slightly altered and placed in the cellars of our houses, it certainly would have become the prototype of all our hot-air furnaces. Dur-

Houdin's Bust of Franklin.

ing the eighty-four years of Franklin's busy life he devoted at the most only seven or eight to scientific study. Unprovided with measuring apparatus, he must be regarded as an experimental philosopher rather than as a scientist in our acceptance of the word. He could only guess shrewdly at the probable causes of the effects that he observed because he had no instruments of precision at his disposal. It remained for Galvani and Volta to provide a more promising means of studying the phenomena of electricity with the exactitude demanded of science.



Benjamin Franklin's Printing Press.

FRANKLIN'S SCIENTIFIC WORK.

New Method of Preserving Fruit.

L'Illustration has the following:

"We know that the difficulty of preserving fruit lies in the rapidity with which pulpy fruits are impaired under the action of the organisms, fungi, and bacteria living upon their surface. Starting from this point of view, some English scientific men deduced from it that if these micro-organisms could be destroyed the period during which the fruit could be maintained in excellent condition would be considerably prolonged.

"The method which has furnished the best results to these inventors rests upon the immersion of the fruit in cold water containing three per cent of the commercial solution of formol. If fruits with soft pulp (like cherries, strawberries, and grapes) be in question, they dip them for ten minutes merely in said solution; then they steep them for five minutes more in cold water; and, finally, they spread them out upon a wire gauze or any other convenient arrangement, there to drain and dry. But when the fruit has a peeling or skin that we do not eat, there is every advantage in submitting it merely to the formol solution.

"Experience has shown that fruit having undergone this treatment has remained absolutely sound, when a like quantity of fruit of each kind (taken for proof) had become moldy and decomposed in a space of seven days for the cherries, four days for the strawberries and grapes, and ten days for the pears.

"M. Truelle, in making known these facts to the Society of Agriculture, remarked that this treatment could be applied to wine-press fruits, whose greatest enemy is decay."

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1906, by Munn & Co.]

Vol. XCIV.—No. 17.
ESTABLISHED 1845.

NEW YORK, APRIL 28, 1906.

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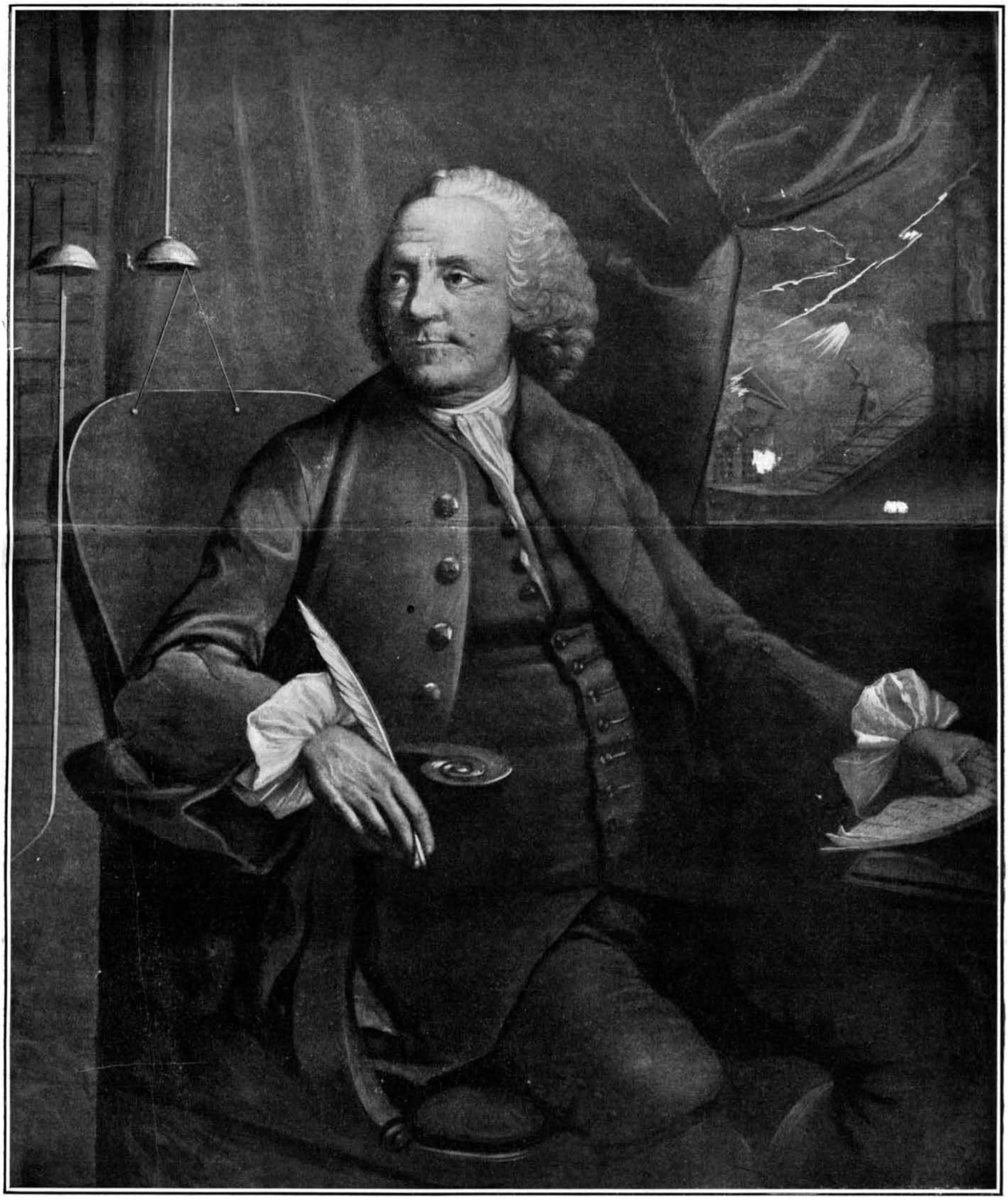
$3.00 A YEAR.



From a mezzotint by E. Fisher, after the Mason Chamberlin portrait.

[See page 350.]

Your affectionate Friend
& most obedient Servant
B. Franklin