Within the present century one of the greatest mathematicians and astronomers that the world has ever known, Laplace, lay on his dying bed in Paris. His last words were: "Ce que nous savons est peu de choses; ce que nous ignorons est immense." It takes a philosopher to recognize the immensity of his own ignorance. If Laplace could use those words as he fell asleep, why can we not at least follow him and remain at peace with each other while striving to do our share in increasing human knowledge? Linguist and engineer, historian and chemist, economist and physicist, mathematician and mathematician, our aims radiate from a common center; but friendly and faithful as we may be to each other, our ignorance will still continue to be immense.

W. LE CONTRE STEVENS.

A NEW RADIOGRAPHIC BULB.

RADIOGRAPHIC bulbs have the great drawback of rapidly heating at the cathodic center; and so, when it is necessary to expand great power in the apparatus, the duration of activity becomes limited. Numerous researches have been made with a view to devising a method of cooling the platinum anticathode, or target that deflects the rays; but none of them has given successful results.

MM. Abel Buguet and Victor Chabaud have recently presented to the Academy of Sciences a new type of bulb with a water-cooled anticathode, which is illustrated in the accompanying figure. This bulb is provided with an anticathode formed of a large platinum tube soldered directly to the glass of the bulb. The tube is enclosed as far as the center of the bulb by a glass sleeve that protects it from the inverse induction of the Ruhmkoff coil. It is beveled off at its internal extremity, and the platinum deflector soldered thereto closes it hermetically. A small reservoir of water is connected with the external extremity of the platinum tube. In case it were preferred to make use of circulating water or mercury, all that is necessary is to replace the reservoir of water by an arrangement of two concentric tubes connected with the free extremity of the platinum tube by means of a rubber stopper. The smaller of these two tubes extend through the platinum tube nearly to its inner end.

In operation, the cathodic rays fall upon the obturating platinum plate. As this latter is, through its posterior surface, in immediate contact with the water,

MM. BUGUET AND CHABAUD'S RADIOGRAPHIC BULB.

it is impossible for it to reach a temperature higher than that of the free ebullition of the liquid.

The apparatus is capable of receiving discharges from the most powerful coils, actuated by the most rapid interrupters, without the anticathode reddening, even though the coils were capable of melting an ordinary anticathode in a few seconds. The state of vacuity of the tube undergoes no modification during the operation of the apparatus.

It is possible to obtain and maintain the highest power of X-rays, while the pencil of radiations preserves the composition that is best adapted for each particular application of radiography or radioscopy. For the above particulars and the engraving, we are indebted to La Nature.

ONE HUNDRED YEARS OF ACHIEVEMENT IN AMERICAN GLASS MANUFACTURE.

By C. A. TATUM.

THE art of glass making antedates the appearance of man on earth, having been practiced by Mother Nature herself in that wonderful laboratory that is enclosed in the everlasting hills. It may very truthfully be said that man used glass before he made glass. We find arrowheads and knife blades of obsidian or volcanic glass which might very well have been used by the cave dwellers in the days before the art of glass making had begun to wield a potent influence upon the civilization of Babylon and Egypt and Rome.

EARLY HISTORY.

It has come down to us from Pliny, who covered too wide a field of knowledge to be always reliable, that the discovery of the manufacture of glass was due to substituting cakes of niter for stones as supports for cooking pots. He has it that there once landed upon the coast of Palestine a party of Phœnician merchants, who, finding no stones on which to rest the pots in which they cooked their food, resorted to cakes of niter from their cargo, which they substituted for stones as supports for their pots. The heat of the fire, blending and melting the sand and niter, formed molten glass, which ran before the astonished eyes of the Phœnicians, who had thus discovered a new art.

This narrative of Pliny's must be taken as *ben trovato*, for the disillusionizing chemists tell us that the heat of an ordinary fire is not sufficient to cause sand to fuse, and that it was impossible for the Phœnician

merchants to have generated the necessary 2,500° Fahrenheit by means of their dinner fire. But it is a good story all the same, although it differs from wine in not having improved with age.

He was a poor man, says the brilliant and versatile Kate Field, who, in Seneca's day, had not his house decorated in various designs in glass; while Scæurus, the Aedile, a superintendent of public buildings in ancient Rome, actually built a theater seating 40,000 persons, the second story of which was built of glass. That masterpiece of ancient manufacture, the Portland vase, was taken from the tomb of the Roman emperor, Alexander Severus, and should bear his name rather than that of the Duchess of Portland, who purchased it from the Barberini family after it had stood three hundred years in their famous Roman gallery.

HOW VENICE LOST HER WORLD SUPREMACY.

Venice was without a rival in the art of glass making during the thirteenth century. Miss Field tells the story of how the monopoly was basely taken from the beautiful queen of the Adriatic. "No one," she says, "knows how long the City of the Doges might have monopolized certain features of this art but for a woman who could not keep a secret from her lover. Marietta was the daughter of Beroviero, one of the most famous glass makers in the fifteenth century. Many were his recipes for producing colored glass, and as he had faith in his own flesh and blood, he confided these precious recipes to his daughter. Alas for poor Beroviero! Marietta, after the manner of women, loved a man, one Giorgio, an artisan in her father's employ. History does not tell, but I have no doubt Giorgio wheedled the secret out of his sweetheart.

"Once possessed of these recipes he published and sold them for a large sum, then turning on the man he had betrayed, he demanded faithless Marietta in marriage. Thus it came to pass that the love of a weak woman for a dishonorable man helped to change the fortunes of Venice. The world gained by the destruction of a monopoly, one more proof of the poet's dictum that 'all partial evil is universal good.'

BEGINNINGS OF THE INDUSTRY IN GREAT BRITAIN.

The theft of the Venetian's recipes was not the only factor at work in spreading the art of glass making.

town of Salem that the town advanced to the glass makers the sum of thirty pounds, a sum which is not recorded to have ever been paid back. Thus early in our national career do we find record of an effort to create a boom in an industrial town by offering a bounty to a manufacturer. Somewhat later a glass factory was erected near Hanover Square, New Amsterdam, before the city came into the possession of the English and was given the name it now bears—New York.

PROGRESS OF THE INDUSTRY.

These early efforts to plant glass making on American soil were followed by more ambitious ones, and in 1787 the Boston Glass Company obtained from the Massachusetts Legislature the exclusive right of manufacturing glass in that State for fifteen years. So successful was this company that it was followed by others until, as the years fled by, Boston was able, in 1865, to manufacture glass that was equal to the best flint glass made in England. This was but the beginning of a success that was destined to develop into a triumph. As in other branches of industry America was pre-ordained to lead the world in glass making, both as an art and as an industry of great magnitude.

In the purely industrial processes of glass making many notable improvements are to be recorded. The manufacture of green glass alone has witnessed many changes and the mode of production has been almost completely revolutionized. Where the old method of melting glass in pots took about twelve hours and the melting was conducted after the regular workers left in the evening, the operation of melting being an all-night process, the melting is now conducted differently. By the new process the glass is melted in tanks by a continuous operation, the melting being conducted at one end of the tank system, and the gathering and blowing at the other. The glass turned out by the tank system is lighter in color than the pot glass and, of course, the whole operation is conducted on a more economical basis, the furnace being in full blast day and night, with a day and night shift of blowers.

A marked improvement has been effected in the exterior finish of druggists' prescription ware, the improvement being due largely to the employment of petroleum and coal gas, which, although more expensive than the heat obtained direct from coal, is productive of better results so far as the finished appearance of the bottle is concerned. The stress of competition among glass bottle manufacturers has conspired to the use of methods for lightening the color of the glass, giving a shade more nearly resembling the flint, and doing away entirely with the old green color. The glass thus made is called Dutch flint, and while not equal to the poor flint glass, it is preferred to the ordinary green by the great bulk of customers.

In pure flint glassware the improvements have been in the direction of the manufacture of seamless bottles, while the quality of the glass itself is much superior to what it was ten years ago. The seamless bottles are now made very generally in factories, and the foreign article, which was formerly staple, is now almost entirely replaced by the domestic make.

THE CONSUMPTION OF PRESCRIPTION BOTTLES.

First, let us digress a moment to say that in no other country in the world is the consumption of glass bottles so great as in the United States. The reason for this is to be found in the greater material prosperity of the people of this country as compared with those of the Old World. Here it is not the custom to preserve a bottle after it has once served the purpose for which it was originally intended. In the case of prescriptions particularly, excepting, of course, renewals, a new bottle is supplied with each order, while in Great Britain and on the continent of Europe it is the customary practice for those who have prescriptions put up to present a clean empty bottle with the prescription. In making small or large purchases of liquid medicines the same custom prevails. An extra charge is made for the phial or bottle in all cases where the container is not furnished by the party making the purchase. This has led to the general use of second-hand bottles, which in the United States are usually destroyed, since no one would think of having a new prescription put up in a bottle that had once been used, or of bringing to the drug store and odd sized bottle for a certain specified quantity of a liquid drug.

BOTTLES IN USE IN THE BEGINNING OF THE CENTURY.

For prescription use practically only two kinds of bottles were in general use at the beginning of the century. In composition these bottles were of the commonest kind of green glass, while as to shape and appearance they were either long and slim like a phial or of a squatter form, round, and thicker than the phial. The neck varied considerably in both width and length and the lip was thin and irregular, making it difficult to deliver the medicine evenly. The size of the drop was never the same with any two phials, and the shape, or rather absence, of lip on the phial made it difficult to cork properly, a trick generally contriving to steal over the side and disfigure the label. In those days the label was usually secured by one end to the neck of the phial by a string, the free end bearing the directions for giving the medicine flaring out at right angles to the phial itself.

The use of these bottles continued until fairly well on in the century, and they constituted about the only style of prescription bottle that was then available for the pharmacist.

THE DAWN OF IMPROVEMENT.

The old octagon shaped bottle had a certain vogue about 1825, but it did not completely replace the phial form. The awakening spirit of the century, which demanded improvement and still improvement in all the arts and trades, was felt equally in the apothecaries' business. Efforts were put forth in various directions looking to the improvement of the store, and the form and style of boxes received an equal share of attention. The old fashioned phials and octagon-shaped bottles were gradually discarded and the manufacturers began to furnish bottles of a more attractive appearance, an oval shaped bottle being among the earlier innovations in prescription ware. The bottles then began to be finished with a heavier lip, and the size of the mouth was regulated to a uniform model. Tools were used in

About 1450 a number of Venetian glass makers were thrown into prison in London on finding themselves unable to pay the money penalty imposed upon them by the Council of Venice for the offense of plying their art in a foreign land. Seeing no other way out of the difficulty, they asked that they be accorded the privilege of working out their fines—a project which was in accord with the views and wishes of the English king. The artisans were freed and allowed to work out their fine, and thus the beautiful art of glass making was added to the growing industries of Great Britain.

INEVITABLE GROWTH OF THE INDUSTRY IN THE UNITED STATES.

Step by step, gradually but inevitably, the art of glass making has been gravitating toward the United States of America, where the progress in the art has been such as to practically make us independent of the rest of the world. With due humility and all fairness, lest we grow over vain of our remarkable progress in the art, it must be said that we started with a vast and rich store of accumulated lore.

Equipped with better sand, Bohemia made clearer and whiter glass than Venice, thus wresting the laurels away from her, to lose them in turn to England when that country discovered flint or lead glass. The genius of American chemists has solved successfully the problems connected with the proportions and kinds of ingredients which go to make the best glassware, and thus by successive steps the nucleus of the art has been heading this way until it has finally established itself among us for an indefinite stay.

THE FIRST FACTORY IN AMERICA A GLASS FACTORY.

The first factory built upon the American continent of which we have record was a glass factory. It was erected near the English settlement of Jamestown, Va., and began its career with a humble output of bottles. There was no protection in those days, nevertheless the first manufactured articles to be exported from this country were none other than the bottles from that glass manufactory in the forests of Virginia.

This pioneer factory having died a natural death, was succeeded by others, some of which engaged in the manufacture of beads for the Indians, who have ever had a passion for these showy baubles. The Pilgrim fathers having settled in Massachusetts, the glass making art soon found a footing there, but does not appear to have thrived mightily, for we find in the records of the

place of the old hand work and more regular results were thereby secured.

LATER IMPROVEMENTS.

The next improvement in prescription ware was brought about in the substitution of flint for the common green glass. The first flint glass prescription bottles made their appearance about 1861, and from that time on the styles of prescription bottles began to increase and the finish to improve.

The first marked improvement in the shape of prescription bottles was the introduction of a tall four-sided bottle with beveled edges, which was called a French Square, and almost at once became popular all over the country. This was followed about 1867 by the appearance on the market of lettered bottles, that is bottles bearing on one side in raised letters the name and address of the pharmacist, accompanied in some cases by devices, monograms, etc. The lettering was molded on the bottles by means of a special device known as a plate mold. This consisted of a metal plate made of varying sizes to fit the various molds used in casting bottles of different shape.—American Druggist.

THE NEOLITHIC EPOCH IN ANCIENT EGYPT.

TRAVELERS, virtuosos and scientists, even, who have visited Egypt, have, up to the present, scarcely ever employed themselves in collecting flints bearing, to a greater or less degree, traces of an intentional cutting. With all their time and resources, they have not had enough to allow them to search for, uncover, free from rubbish, study and admire the numerous monuments of its long history. And had they desired to bring home some precious souvenir of their excursions through so many ruins, how could they have hesitated in the selection of the objects to collect? On all sides were offered to them carved and engraved stones, thousands of works of art, statuettes and jewels which were telling witnesses of the life of a people during ages, and which, in the beauty or strangeness of their form, preserved something of the mysterious attraction of the old ideas, obscure opinions and lively passions of their makers.

Almost everywhere in Egypt, it suffices to excavate with patience in order to be sure of bringing to light at least one curious relic or of finding the wherewithal

METHOD OF SHAPING THE NEOLITHIC AXES OF EGYPT.

to fill the showcases of museums. And such certainty of obtaining results and a recompense for one's efforts, in pursuing the routes that had already been followed, was well calculated to induce investigators to remain therein and not to enter those arduous paths that lead out of the domain of known history. Explorers have, therefore, properly followed the same route along the Nile, where life was active and where the vestiges of a brilliant past are innumerable. They have followed it without deception, if not without effort, their collections, which have been abundant, are constantly furnishing new food for our impatient curiosity. Nevertheless, they have not exhausted the monumental wealth accumulated upon the Nile. In the presence of numerous vestiges, all entering the limits of history and all accumulated in the same isolated place, every one has had the impression that this Egyptian civilization, so marvelous by its antiquity, so complete from its origin, so slow in its evolution, and so persistent despite external disorders, arose there all at once, miraculously attended with all those attainments, resources and arts that are everywhere acquired with great trouble and only gradually and tardily. Even now, when the subject is discussed, the instantaneousness and simultaneousness of the advent of all the elements of Egyptian culture are admitted. There has been nothing to prevent such an illusion, and we have as yet but little to dispel it. But we are, nevertheless, beginning to have something. In the presence of its historic past, so long and so old, no one dared to speak of the prehistoric past of Egypt; but, at present, such is no longer the case. Objects that have hitherto been scorned by reason of the rudeness of their form and the coarseness of their material are now collected. It has come to be understood that works of art are not everything in the life of a people, and that the supreme crowning of long efforts, produced at length, after numerous difficult attempts, do not teach us the history of these attempts. In the remoteness of the past, isolated with their work of a low order, which formed their support, they are like a magnificent mist stretched across the dark void of a desert scene. What has allowed us truly to understand their development has been the gathering around them of this work of a lower order by explorers, who, leaving the banks of the sacred river, not a very long time ago, went into the nearest desert far from the pyramids. The humble flint, discussed and scorned, was now sought for, and the harvest at

once proved rich. We are now upon the track of an entire past wholly unknown, up to the present time, and that, too, the prehistoric past of ancient Egypt.

Through the few instruments and workshops discovered, we already know that man was here in [quaternary] times and occupied the heights at the foot of which the Nile excavated its bed. He inhabited the plateau that now forms the desert. From these eminences he gradually took possession of the river, in measure as the latter deposited its fertile ooze, which it obtained from the sea of Lower Egypt, and with which it supplied also the marshes luxuriant with vegetation that occupied its shallow coasts. While this fertile soil was thus forming and man was taking pos-

KNIVES OF YELLOW FLINT.
(One-half natural size.)

session of it, there was created in his hands what we have called the "Neolithic industry"; and while this industry was developing, human tribes were covering entire Northern Africa in great numbers.

In the statistics of the discoveries and prehistoric stations drawn up by M. de Morgan at least 53 different localities are noted in which tools have been gathered or the presence of Neolithic stations was otherwise indicated. These stations cannot have been the site of villages of isolated tribes. They cover the whole of Egypt, at least from the vicinity of Cairo, on the southwest. They bear witness to the existence of quite a dense population, which, at all events, occupied especially the left bank of the Nile, from the confines of Nubia to those of the delta, and which became so greatly developed there as to reach a definite and stable civilization.

Let us for an instant examine the innumerable stone tools gathered in all these stations. It is to be remarked in the first place that the proportion of the axes that are entirely polished is not large; in fact, it is quite small.

The polishing of flint, then, does not appear to be a characteristic of the Neolithic industry in Egypt as it

FLINT KNIFE WITH A GOLD SHEATH.
(Museum of Gizeh.)

does in Europe. In certain localities, such as El-Toukh, the shaping of these instruments remained so rude that, if they had not been found mingled with Neolithic objects, they might have been considered as Chellean axes. M. de Morgan, indeed, thought it a question whether they ought not to be classified in the quaternary. The genuinely Neolithic types quite strongly recall those of the Danish Kjekken-Møddings, since they are narrow on the side designed for the handle and wide on the cutting side; but one of the faces is plane. The edges are quite finely touched up. M. de Morgan believes that these axes are peculiar to Egypt. With them are classified some flaked axes that have

the form of the polished ones. There are no flint axes that are entirely polished; flint axes having a polished cutting edge have been found at Faydoun. M. de Morgan has discovered these nowhere else but here. The wholly polished axes are of hard stone, such as diorite, serpentine and hematite. They belong to Upper Egypt, where, however, it was the simply flaked axes that were in current use. As a whole, and apart from the specimens cut after the introduction of metal, these Egyptian axes very closely resemble the types of the south and center of Europe and of the north and center of Africa and Syria. The Egyptians had, moreover, a special method of forming the cutting edge of their axes. This edge, having been once formed by small flakings, with a single blow delivered at the side, they removed the whole of this first edge by a large transverse flaking, which left as the final edge a very sharp bevel. Polishing was incapable of giving so sharp an edge, and that is, perhaps, why it was so little employed. By far the most common tool in the Neolithic stations of Egypt was the blade of flint. This possesses various forms and dimensions and must have been used for a host of purposes. But the most widely distributed form is that of the knife. The cutting of the knife is often of extraordinary perfection and of great boldness. There are knives of which the cutting edge is very sharp and regular, and that reach a length of about eight and a half inches. "The Neolithic stations of Europe," says M. de Morgan, "furnish nothing to be compared with these large knives, while the Magdalenian of the Dordogne presents touched up flakings in all respects like those of Egypt. There are, nevertheless, Egyptian blades sharp on both sides that exhibit the greatest analogy with the Robenhausian of Europe. Finally, there are true knives with convex blade and a straight, thick back. There are some even with a shank for hafting and with a handle shaped out of flint. Their aspect is so much like that of our metallic knives that one would be tempted to believe, as has for a long time been believed without any accurate proof, that they remained in use during the first period of history."

There are large blades so strongly curved as to resemble a sickle. These come especially from Abydos and El-Amrah, and are chipped with such regularity

PREHISTORIC TOMB OF THE NECROPOLIS
OF EL-AMRAH.

that the flakings, symmetrically removed on each side of the median line, give the face a scaly appearance. The Museum of Gizeh possesses one of these pieces, which is provided with a sheath of stamped gold four inches in length.

Workmen who were capable of attaining the manual skill necessary for such a manufacture were also capable of learning how to carve cups and statues with very rudimentary tools. Despite the diversity and abundance of blades and knives, there are also in the Neolithic stations of Egypt scrapers of all shapes and of all the forms of Europe. Those of Abydos, which are double and worked out of a two-edged blade, are absolutely identical with the scrapers collected in the caverns of Dordogne, in the Solutrean and Magdalenian strata. There are no scrapers peculiar to Egypt.

The Egyptian spear and javelin heads are especially of the Solutrean type, save that, instead of having a straight cutting edge, they are provided with very fine saw-like teeth, as in the Neolithic of Scandinavia and Denmark.

The Egyptian arrowheads all have the form of those that belong to the Neolithic of Europe. There is, according to M. de Morgan, no comparison to be established. The types are identical here and there. It is assuredly a remarkable fact that all the forms are common to Egypt and Europe; and it is all the more remarkable that in Egypt even there is a complete difference between the Neolithic and Pharaonic arrowheads. These latter must have continued in use up to an epoch bordering upon our era. They are simply very small chipped flints that were not shaped especially for the purpose for which they were used. They have nothing in common with the Neolithic arrowheads, which were shaped with great care and art. "From the numerous representations of arches found upon the monuments, we know that these sharp flakes have always been in use, while the heads do not seem to have been employed by the Egyptians long after the beginning of the ancient empire."

The primitive Egyptians manufactured genuine saws from flint, as well as from bone; and from small flints they made sickles with denticulated blades. These remained in use during the ancient empire up to at least the third dynasty. Their abundance proves the extent