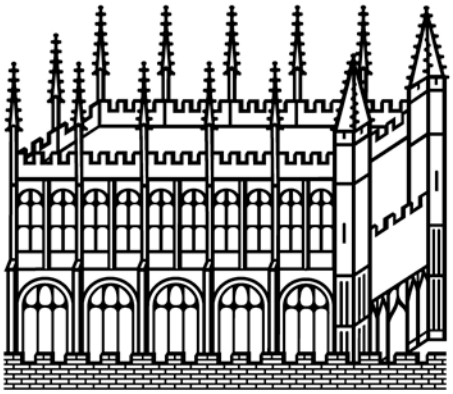

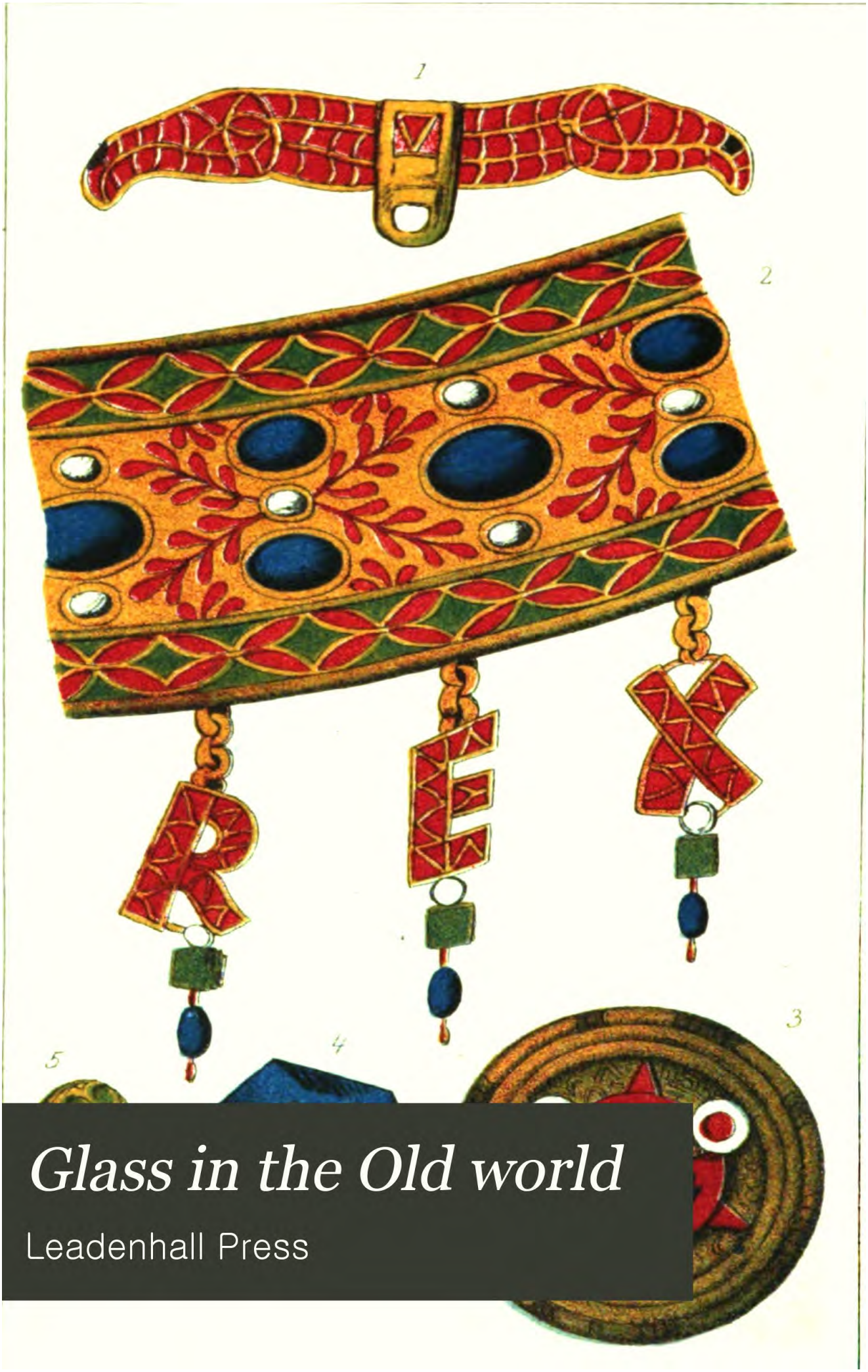

Glass in the Old world

Leadenhall Press

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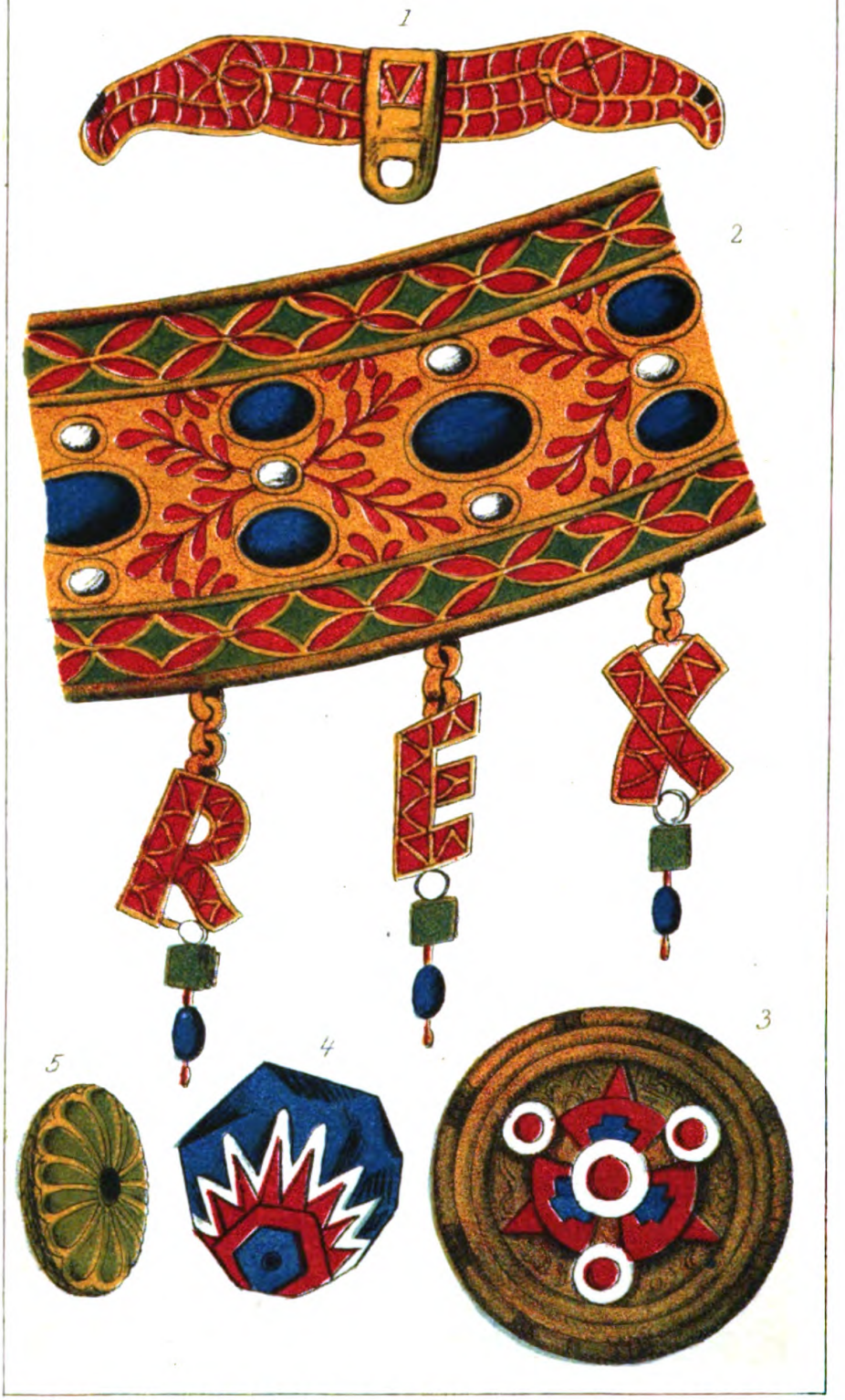
J.P. F.S.A. D.L.

GLASS IN THE OLD WORLD.

Plate VI.



MEROVINGEAN GLASS.

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Glass In the Old World

BY

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PREFACE.

My reason for publishing this volume is that when, a few years ago, I desired to learn something about ancient glass, I found the required information scattered through many books, some of them most difficult of access; the idea then occurred to me of collecting my notes in a convenient form.

The want then felt has been in some degree supplied by the publication of the South Kensington glass catalogue and handbook, but many curious facts remain unnoticed, which to the glass student are useful and interesting. The subjects treated in these pages are by no means exhausted, examples might be almost indefinitely multiplied; but I forbear, remembering the French saying "Le secret d'ennuyer est de tout dire." I have throughout striven to avoid giving merely a dry useless catalogue, but have tried to awaken in the minds especially of my younger readers an intelligent interest in the subjects discussed, which may perhaps induce them to examine more carefully those which most please them; thus, in "imitation gems," or "mirrors," there are paths indicated which would well repay more extended research. For the advanced student this work will present little that is new; it only attempts to recall half forgotten things, to enable busy and ignorant people to realize subjects they have hitherto scarcely thought about. Instead of crying out with fiery

St. Jerome, "Perish all those who have said that which we have to say," I would rather repeat with kindly old Roger Ascham, "If I have sayed amisse, I am content that any man amende it, or if I have sayed too little, any man that wyll to adde what hym pleaseth to it."

It only remains for me to express my great debt to those authors whose works have so materially aided me, and to those many friends for whose help I appealed. I in common with many other students have to record my sincere and grateful thanks, especially, to those ripe scholars at the British Museum, Dr. Birch, Mr. Franks, Mr. Garnett, and others, whose inexhaustible patience so often smoothed away obstacles which seemed insurmountable.

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EGYPTIAN GLASS.

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ANCIENT EGYPTIAN.

"I shall now speak of Egypt at greater length, as it contains more wonders than any other land, and is pre-eminent above all the countries in the world for works that one can hardly describe."—*Herodotus.*

WHEN Bacon, struck by the extraordinary usefulness of glass to civilized man, awarded a foremost place in the "long and fair gallery" of his imaginary Temple of Solomon to a statue of its inventor, he does not attempt to suggest whose form the statue is to assume; and those inquiring spirits who would try to rectify his omission find their search baffled at every turn, behind each name or myth of antiquity stands another, more shadowy and more mythical; and while we try to fix our eyes on the few rays of light that illumine these shadows, and strain our mental vision to pierce the thick mists with which time and superstition have enveloped the whole question, the only tangible figure we meet is that of the Egyptian god "P'tah" (in later ages identified with Vulcan), who looks at us with the slightly mocking gaze of inscrutable wisdom, more immovable than the fabled Sphinx, common to many of these old Egyptian faces. We hold fast by P'tah because in Egyptian mythology he is the artisan of the universe; he hung the sun, moon and stars; he is the visible world coming out of chaos by the force of divine intelligence, the symbol of the soul freed from earthly stains. He is the Roman Vulcan[1]; he invented fire, of which glass is the offspring; his priests were the first known chemists, and from their secret laboratories came all the marvels which the tombs of Memphis and Thebes have preserved to the modern world. They stood on the vantage ground of knowledge, the sole possessors of nature's mysteries at a time when the rest of

[1] Imouthés, or the Greek Æsculapius, is the son of P'tah.

the earth was sunk in darkness. When we remember the time it requires for a nation to emerge from infancy to manhood[1] and reflect on the artistic skill shown in the sculptures,[2] the science displayed in the monuments, and the chemical knowledge in the coloured glass and jewellery preserved in the tombs, and recollect that Egypt was at the apex of her power and civilization between three and four thousand years B.C., we may well feel lost in the endeavour to separate and reduce to order the mass of thoughts and facts that rise before our minds, and feel inclined to believe in Plato's assertion that the arts and sciences had been practised in Egypt for ten thousand years before his visit to that country. For us Egypt is the germ of all civilizations : there may have been older ones, and some hold the Ethiopians[3] to have been the earliest ; but they have left us no bewildering monuments to study, no tangible proofs of high cultivation, such as teem on Egyptian soil. Her far-reaching commerce carried the products of her knowledge far and wide ; and China, India, and the uttermost parts of the earth returned her their choicest treasures. In later times the Greeks earnestly strove to be affiliated to her temples, hoping to be initiated in their mysteries; and under changed names we see her gods and her myths living again in Etruria and Greece. It is among the ruins of Memphis we find the earliest traces of glass, fragmentary indeed as they may well be. Memphis was built by Menes, first king of all Egypt. The priests asserted that gods reigned over Egypt for thirteen thousand years before Menes the Stable mounted the throne. He turned the course of the Nile aside to gain ground for his new city, and the bank of Cocheiche may very possibly have been the one he built ; so engineering must have been understood in his day.[4] Among the fragments of glass found in the ruins are pieces of a solid turquoise blue, probably

[1] Consider the years that must have elapsed for instance between the day when some observing man first discovered a vitrified substance, such as obsidian perhaps, near a volcano, and the invention of the blowpipe or the discovery of materials for making glass, and the day when he was enabled to imitate precious stones.

[2] In the Khedive's museum at Boulak is a wooden statue of the fourth dynasty, which is all but alive ; and the creator of the statue of Chephren, founder of the second pyramid, also at Boulak, had nothing more to learn, had already reached a perfection we sigh after in vain.

[3] They are said to have exposed their dead, painted *au naturel*, in glass coffins for a year, gaining thereby offerings and sacrifices.

[4] Menes was killed by a crocodile ; as in the infancy of religion people always worshipped that which they feared, may not this incident have originated the worship of the crocodile in Egypt ?

used for glazing pottery figures; the brilliance of these blues is unrivalled to this day. The mummies of those ancient tombs wear necklaces of glass paste beads, giving incontestable proofs of the antiquity of that mode of adornment. It must be remembered that opaque coloured glass resembling stone, and called "paste," is a much easier and consequently earlier manufacture than transparent glass, the discovery of which belongs to more modern times than those we are now studying. At Memphis was placed the great temple of P'tah, or Vulcan, and many other splendid buildings. Abd-el-Latif, an Arab doctor, A.D. 1300, gives a poetical and enthusiastic description of the wonderful ruins he saw in this town of which little is left in our day; the grand stones of Memphis were taken to Cairo to build mosques and palaces for the caliphs. The exact date of the town of Memphis is uncertain, as is but natural, considering we are looking back through the mists of some six thousand years. Mariette Bey, quoting Manetho,[1] fixes the reign of Menes [2] in 5004 B.C. Brugsch places it about five hundred years later, and Boeckh some seven hundred years earlier. It has been said there are two hundred systems of chronology for Egypt; but as Mariette Bey, Dr. Birch, and other Egyptologists consider Manetho on the whole the safest guide to follow, I think it easier to keep to his arrangement of dynasties, as I am not trying to settle the much disputed question of Egyptian chronology but striving to trace back the history of glass. Everything leads us to suppose that the priests of P'tah, always occupied with experiments and much favoured by nature in the profusion of pure sand and quantities of kali,[3] (the cinders of which made glass,) not only had factories for common glass, but, profiting by their discovery of the property of oxides of metals which they got from India of

[1] Under Ptolemy Philadelphus, 270 B.C., Manetho wrote in Greek a history of Egypt after the official archives preserved in the temples. Like many others, this history has disappeared, and we only possess fragments, and a list of the kings which Manetho had placed at the end of his work, a list fortunately preserved in the writings of some chronographers. By this list we mount in effect to the time considered mythical among all other peoples, but here we are already in history. The Bibliothèque Nationale of Paris lately acquired a demotic papyrus which M. Révillout has deciphered. It contains part of an ancient Egyptian chronicle compiled apparently under the Ptolemies. This chronicle proves that the ancients were right in maintaining that Manetho's history was based on earlier chronicles, and that the doubts cast on the existence of these have no foundation.

[2] In the Louvre is a scarabeus with the name of Menes traced in gold leaf. Were this specimen authentic, it must be the oldest personal relic in the world.

[3] Arabic name for a plant which contains alkali.

vitrifying different colours, conceived the project of imitating all the precious stones which commerce brought them from that country.[1] These priests placed their glass factories at the very gates of the Lakes of Nitre, in the midst of the desert. There are found ruins of glassworks of the highest antiquity.[2] They must have existed at that far off period when the land now barren was fruitful, or even, if one dares to think or say it, at that epoch more distant still when the waters of some river must have flowed over these parched and arid deserts and the trees we now see petrified and buried in sand were living and growing. From these factories or others like them proceeded probably the treasures lately discovered in the tombs of Memphis, among the ruins of what the French commissioners thought the labyrinth of Fayoum. Some of these tombs are very old. One of the largest and best preserved found in the necropolis of Sakkara at Memphis is the Mastaba[3] of Tih, belonging to the fifth dynasty. The walls are covered with elaborate sculpture representing all the occupations and arts of the time with marvellous skill, considering its date must be about 3900 B.C. On the south side of the tomb are represented all the then known trades, as carpentering, masonry, glass blowing, chair making, and others. This is certainly the earliest representation yet discovered of the manufacture of glass.[4] That the Egyptians were acquainted with the art of making vitreous glaze even before this is proved by the convex pieces of glazed green pottery inlaid with stucco in a kind of mosaic in two chambers of the Step Pyramid of Sakkara. Some greenish blue tiles, about two inches long and one broad, may be seen in the British Museum taken from the jambs of an inner door in this pyramid. There is one black one from the same place. The green glazed bricks from the doorposts were removed to Berlin by Lepsius in 1845. A passage in Manetho seems to say this pyramid was built by a king of the first dynasty.[5] If this be correct it must be nearly the most ancient monument in the world. Some writers say it belongs to the fifth dynasty, but give no more solid reasons

[1] See Note A in Appendix, for ancient authorities concerning commerce with India.

[2] Sir H. Rawlinson states that ruins of glass factories may still be seen at the Natron lakes in Egypt.

[3] A mortuary chapel as well as a tomb; it commonly distinguishes tombs of the ancient empire.

[4] The rock tombs of Beni Hassan date from the twelfth dynasty.

[5] Mariette Bey says by Ouénephis, fourth king of Egypt; he places the first dynasty at 5000 B.C., according to Manetho.

for their belief. Mariette Bey thinks from the unique form of the chambers that they contained the tombs of the Apis, or sacred bull, of the primeval monarchy. If, as is most probable, pottery was the first art invented by prehistoric man, who possibly made clay vessels and dried them in the sun, afterwards perhaps applying artificial heat, he must very soon have observed the accidental vitrification of clay in burning, and certainly whenever we find glazed pottery we may feel sure the maker of it was acquainted with glass. If the Sakkara pyramid dates from the first dynasty, the next in age is that of Meydoum which contains the sculptured name of Senefroo, supposed to be the last king of the third or the first of the fourth dynasty, probably the oldest written name in the world.[1] The tomb of Nefermat, a functionary at this king's court, stands near the pyramid, and contains, besides his statue and sculptures in low relief like those of Tih, some figures, perhaps portraits of his family, incised in the stone and filled in with a sort of enamel of great brilliance and beauty, the men's figures in red and the women's in yellow; the latter colour being softer than the red has been nearly all picked out by thoughtless visitors.[2] In this same group of tombs were discovered the statues of the beautiful Nefert and her husband Ra-hotep, supposed to have been the son of Senefroo. Both these statues wear necklaces; and both, although the earliest specimens of portrait sculpture known to exist, belong to a very high style of art; they are older than the statues of Chephren.

The enormous pyramids of Cheops and Chephren, certainly the best known among the many marvels of Egypt, were unfortunately opened and rifled before modern history awoke. We can only piece together fragments from various sources respecting them. Of contemporaneous history we have a stone inscription at Boulak[3]

[1] This king's name appears also at the mines of Wady Maghâra. It seems that the Egyptians were acquainted with written characters and numerals 4235 B.C.

[2] Fresco painting as well as sculpture was highly advanced in those days. It was from the tomb of the wife of Nefermat that was taken the wonderfully truthful picture of geese pasturing, now at Boulak.

[3] Another stone inscription in the same museum, discovered when removing the sand from the Sphinx, tells us Cheops gave orders for the repair of the image of the god Amarchis, known to us as the Sphinx (it must therefore be older than Cheops), whom the Arabs still call Ever watchful Father of Terror. The Sphinx was the reverse and antagonist of Typhon, the spirit of light and principle of good overcoming the sterility of the desert, and victorious over Typhon the principle of evil. Mariette Bey says, "the Sphinx has not yet said his last word."

detailing the offerings made to a temple by Khoufou or Cheops, founder of the first pyramid, consisting of divine images made in wood, stone, gold, bronze and ivory. Cheops was the second king of the fourth dynasty; he built the first pyramid 4200 B.C. (?) The Arabs still call it the glorious or splendid throne of Khoufou.[1] Abd-el-Latif says that El-Mamoum, son of Haroun-al-Raschd, A.D. 813–833, was the first who succeeded in penetrating into the tomb of Cheops, but found nothing to reward his search, except a sum in gold coin, just enough to pay the workmen employed, contained in a vessel formed of a single emerald, which the caliph took back with him to Bagdad. Scoffers of the time hinted that the money was placed there by the caliph himself to prevent people from accusing him of wasting the public funds, and moderns are inclined to imagine the emerald vase was made of glass. The Arab historian Ben Abd-er-Rahmân says in 829 El-Mamoum entered the great pyramid and found the body of Cheops. "In a stone sarcophagus was a green stone statue of a man, like an emerald, containing a human body, covered with a sheet of fine gold ornamented with a great quantity of precious stones, on the breast a priceless sword, on the head a ruby as large as a hen's egg, brilliant as a flame. I have seen the statue which contained the body, it was near the palace of Fôstat." Ebub-abd-el-Holem, another Arab, says: "one saw beneath the summit of the pyramid a chamber with a hollow prison, in which was a statue of stone enclosing the body of a man, who had on the breast a pectoral of gold enriched by fine stones, and a sword of inestimable price, on the head a carbuncle the size of an egg, brilliant as the sun, on which were characters no man could read." Mariette Bey thinks these details are so precise as to leave no doubt the mummy of Cheops was found by Mamoum, the body covered with the gilt wrapper and enriched with bright paintings and coloured pastes to imitate precious stones; the ruby doubtless the "uræus," sacred asp, emblem of royalty; the priceless sword may have been a sceptre or a poignard such as are found in tombs of the eleventh dynasty and in that of

[1] It is said that one hundred thousand men, who were relieved every three months, were compelled to labour during thirty years in the gigantic task of erecting these monuments of the vanity of the Pharaohs. Herodotus, who visited Egypt 450 B.C., says three thousand years had not sufficed to efface these memories and the inhabitants yet recounted the maledictions of their unhappy ancestors and refused even to pronounce the names of the constructors of the two pyramids. Modern writers however count these as idle tales.

Queen Aah-Hotep; the statue of green serpentine is often repeated in later tombs. All the discoveries of modern archæology are in favour of the truth of the Arab historians and their account of the discovery of El-Mamoum. If we could accept this testimony it would refer the power of making imitation precious stones in glass to a very remote age. The court poets of El-Mamoum drew gorgeous pictures of the contents of the pyramids. All the treasures of Sheddad Ben-Ad, the great antediluvian king of the earth, with all his medicines and all his sciences, were there. The report of Ibn-abd-Alkohm, as to what was put into them originally by the great king Saurid, is as follows: "in the east pyramid (that of Cheops) divers celebrated spheres and stars, and what they severally operate in their aspects, and the perfumes that are to be used with them, and the books which treat of these matters. In the west pyramid (that of Chephren, built 4000 B.C. ?) thirty treasuries filled with store of riches and utensils, and with signatures made of precious stones (signet rings?), and instruments of iron, and vessels of earth, and with arms which rust not, and with *glass which might be bended and yet not broken*,[1] with strange spells and with several kinds of magical precious stones, with deadly poisons and other things." Though the pyramid may have been empty when El-Mamoum's workmen broke into it, we have no means of learning what had happened in the long lapse of centuries between that time and the age in which it was built.[2]

The collection of scarabei in the British Museum ranges from the fourth dynasty down to the Roman empire; the glaze is generally blue or green. The earliest scarab in the Boulak museum bears the name of Senefroo, third dynasty. Boulak also possesses a blue porcelain scarab inscribed with the name of Mycerinus, builder of the third pyramid, a being venerated and glorified in all ages. Scarabei[3] are found in all materials, porcelain, glazed stone, and glass paste; the oldest scarab in paste at Boulak is of Necho, twenty-sixth dynasty, a magnificent representation of the warrior king standing between Isis and Neith, receiving gifts from them. Neith gives him the image of the god

[1] This is surely the earliest attempt at describing flexible glass.

[2] See Proctor's "Myths of Astronomy."

[3] The scarabeus or sacred beetle was supposed to be the image of the Creator, without commencement and without end; at the same time the symbol of resurrection and the immortality reserved for the soul who has merited this recompence. One at least was placed on each mummy, generally containing the name of the deceased; sometimes many were thrown loosely into the mummy case.

of battles, victory over all his enemies; this charm was not always successful however, as we find him beaten at Carchemish by Nebuchadnezzar. Plate I. 10 is a scarabeus in dark blue glass, from the Rev. W. Loftie's collection; it represents the god Seth; as the worship of this deity ceased in Egypt with the nineteenth dynasty, this bit of glass is most probably at least to be dated thirteen centuries B.C. The painting on the walls of the rock tombs of Beni-Hassan representing the process of glass blowing, so well known to us from engravings, dates from some time in the twelfth[1] dynasty, 2851 B.C. This has long been considered the earliest indication of the art; but the discovery of the sculptured glass blowers in the more ancient tomb of Tih proves that the knowledge of glass belongs to still earlier times. The oldest piece of dated glass at present known is the lion's head amulet in the Slade collection, British Museum (Plate I. 7). It was originally found at Thebes by Signor Drovetti, and is made of opaque blue glass, with an external coating of dark olive green, due to the lapse of time since it was made. The hieroglyphics on the under side represent Sati (Juno) and Neith (Minerva), symbolizing the crowns of upper and lower Egypt with the prænomen of Nuantef, fourth of the eleventh dynasty, 3064 B.C. This is the oldest glass in the British Museum. The town of Thebes seems to have become important in the eleventh dynasty; in the mummy of King Antefaa of that dynasty, found at Thebes, the eyes are of enamelled glass.[2] Eyes of flat glass paste, with black pupils and blue or various coloured lids, are found in numbers in mummy cases. This mystic eye designated "ut'a" indicates a period of time achieved; placed on a mummy it expresses the wish of the soul to arrive safe and whole at the end of its journey. The dead rising from their graves are also represented as "ut'a," Plate I. 9; many other forms of the eye, some conventionalised, are found scattered in tombs.[3] In the British

[1] Osirtasen I., of this dynasty, is sometimes spoken of as "Joseph's Pharaoh," but it is more probable that Joseph entered Egypt during the ninth or tenth dynasties of usurping Shepherds or Semitic kings, a fact that would render the elevation of a Hebrew to the high office of prime minister more easily explicable. Rhone says the Arabs still show Joseph's tomb at the Serapeum, Memphis.

[2] The glass eyes of the enamelled clay lion in the Louvre have all the light and fire of life.

[3] Emblematical of the eyes of Ra which illumine the world; right being sun, left the moon, the former also symbolizing king, the latter queen. Athor, the Egyptian Venus, is called the pupil of the sun's eye.

Museum are many eyes in the Egyptian room, both of men and bulls, some all glass paste, some mixed paste and alabaster. The treasures found in the old tombs of Thebes and Memphis have enriched many European museums. Those more lately discovered are collected in the Khedive's museum at Boulak, where a rich store of ancient glass may be studied. Here are to be seen figures in glass paste of two or three colours. A figure in paste of Ma, goddess of truth and justice (which Egyptians thought were the same thing), has a symbolical plume formed of several pieces of glass and a collar made of a kind of mosaic, long threads of glass joined by heat; also heads of vultures in green paste, the red eye of one is curiously natural. Vulture is the symbol of maternity, the goddess Souvan is the universal mother and has a vulture's head. Some mummies have been rolled in a sort of pasteboard wrapper, covered with a thick coat of fine cement; on this while wet have been traced rich and varied designs, in the style of our modern Southall and Doulton faience, and flat glass paste figures applied to it, also some disks of red opaque glass, with waved lines on them, symbol of the rising sun or arrival of the soul at the happy abode. There are in the museum also some remarkable figures, in paste of various colours, animals, monkeys, and human faces, formed of morsels of coloured glass, each fixed to the other probably by slight heat, a kind of embryo mosaic. A strong magnifying glass is required to distinguish the details; whether any sort of magnifier was used in making them, remains an open question. The pieces of glass are encrusted in a species of cloisonné, not enamel, that being only known at a later period; this is more an inlaid toreutic work, the pastes and stones being cut to the required forms and placed in the cells of gold prepared to receive them. These objects rival the best productions of ancient Greece. Clenched hands with the thumb protruding, in blue and green glazed or enamelled porcelain,[1] are very common, probably portions of figures of Ma.

The small blue and green statuettes, often of enamelled pottery, sometimes of stone covered with a vitrified substance, found so plentifully in tombs, are not images of the deceased; they are the aids furnished to assist the soul, who when arrived at one portion of its pilgrimage beyond the tomb had to cultivate the fields of A'alu, to plough, sow, and reap corn; or they are amulets destined

[1] Closely resembling the Italian charm against the evil eye.

to help magically and make more easy the task imposed on it, for immortality was to be acquired not only by the soul but the body; when the soul after being subjected to many proofs asserted its purity, the body received anew the principle of life which had for a time quitted it; in other words, the Egyptians believed in the resurrection of the body.[1] Flowers, seeds, and fruits strewn over the mummies are symbols of life renovated and renewed; many of these are found in glass pastes, and at a later period in transparent glass, as the brilliant coloured lentiles found in the tomb of the brothers T'aho, which dates from the early Ptolemies. Nilometers, made of coloured glass or other materials, and constantly found with mummies, are emblems of stability, of eternal periods promised to the dead. The tau cross is the symbol of life eternal to the soul, this sign is frequently found also in mummy cases. It is very nearly impossible to determine dates with any certainty in Egyptian history; but the eighteenth dynasty, 1703 B.C., so rich in treasures of artistic glassmaking, may be broadly remembered as the period of the Jewish captivity. The exodus took place in the nineteenth dynasty, under Menephtah, son of the great Rameses II.; he is the Pharaoh who is sometimes represented as having perished in the Red Sea, though his death is not mentioned in Exodus and his tomb is at Bab-el-Molouk with those of his ancestors, and his portrait is now in Boulak museum.

Among the many valuable glass treasures preserved at Boulak the most beautiful are supposed to belong to the eighteenth dynasty, and perhaps one of the most elaborate bracelets is one that was found in the tomb of the mother of one of the kings of that dynasty, formed of microscopic beads of gold and red and blue paste strung on fine gold wire in a symmetrical design of triangles; there are at least two thousand beads in this bracelet, which bears on its gold clasp the name of Amosis. The magnificent jewels now at Boulak, and found in the tomb of Queen Aah-Hotep, 1703 B.C., are alone sufficient to establish the claim of Egypt to a very high civilization. This queen was buried in the reign of Amosis, but her exact relationship to him is not known; she is supposed to have been the wife of Kamés and mother of Amosis. Her portrait at Boulak gives a very fine type of Egyptian face; she is stated by the writing on her tomb to have received the honour of

[1] Perhaps for a second life on earth.

the white crown,[1] and the extraordinary magnificence of her surroundings proves her to have been a person of the greatest importance; her tomb was discovered at Medinet Abou, near Luxor. Among her ornaments is a bracelet in which gold figures appear on a ground of blue paste imitating lapis, as compact and almost as hard as stone. There is a magnificent gold scarabeus suspended from a fine flexible gold chain; the feet, drawn up close to the beetle, are so finely worked, they appear moulded from nature; the body and outspread wings are in tender blue paste rayed with gold lines. Also a cartouche in blue and red paste mosaic, and the head of a sphinx in blue paste. These four are figured on Plate I., 3, 4, 5, 8. A splendid pectoral or breast ornament has the figure of Amosis in a boat with two gods pouring the waters of purification on his head. The workmanship of this object is wonderful, the ground is cut *à jour*, the figures are outlined by a border of gold cloisonné, in which are introduced hard stones and coloured pastes giving the appearance of a rich enamel. A vase is known, in enamelled porcelain, which has ornaments and inscriptions in two colours, giving the name of Amenophis and Queen Taia, eighteenth dynasty. A bracelet and scarabeus of blue paste was found with the mummy of Queen Taia, and a yellow scentbottle, with the name in blue glass of Amenophis. This king could hardly have thought, when he had his name placed on a fragile bottle, and also on the granite pedestal of that Colossus of Thebes, afterwards known as Memnon, that the delicate glass would reach us intact while the granite would bear marks of age. It is of this statue that Pausanias writes: "the Thebans say it is not Memnon but Phanemoph; on one of the legs of the statue, in Greek, is an inscription (with several others) saying, I Publius Balbinus have heard Memnon or Phanemoph giving his divine sounds." This musical statue,[2] after being the wonder of the civilized world for the first two centuries of the Christian era, was silenced for ever by the attempt of Septimius Severus to restore the upper part of the Colossus, destroyed by an earthquake in 27 B.C. On the obelisk of St. John of Lateran, Rome, brought from Thebes by Constantine, is the name of Thoutmes III., eighteenth dynasty (about 1590 B.C.), brother

[1] The white crown is supposed to be the hieroglyphic for light and truth, such as Osiris wears, and denotes the royalty of Upper Egypt. The red crown signified the sovereignty of Lower Egypt.

[2] See Note B for the very curious history of this statue.

of Queen Hatasou; he is also represented, cartouche on head, in the temple of Karnac in the table of kings, ranged with the long dynasty of his ancestors. These two facts give a deeper interest to a lovely little blue and orange glass bottle in the British Museum[1] which also contains his name, and in this instance again glass has borne the weight of centuries as well as granite, though one is an emblem of fragility and the other of strength; Londoners may now study this same name on Cleopatra's needle. We have old authority for the name given to our obelisk, as Abd-el-Latif, A.D. 1190, calls two obelisks Pharaoh's needles. The beautiful glass jewellery now in the Salle Historique, Louvre, Paris, must be familiar to many persons. It was all discovered by Mariette Bey, when at Memphis in 1852 he was searching for the lost Serapeum of Strabo; the account is more interesting than a fairy tale. After overcoming many difficulties both from the nature of the soil and the jealousy and avarice of the government, he succeeded in penetrating into two as yet untouched chambers where the sacred bull Apis had been entombed, and found the finger marks of the old Egyptian workmen who had built up the entrance still impressed on the mortar, and on the thin carpet of sand impressions of the naked feet of the men who 3,200 years ago had laid the mummied divinity in his tomb; at this moment of success he felt with an emotion never to be forgotten that he had not lived in vain. These two sacred bulls had been buried in the reign of Rameses II., the great conqueror and contemporary of Moses,[2] his colossal statue is still to be seen at Memphis.[3] The bones of the bulls seem to have been broken into small pieces before burial, and encased in a (still) strongly scented bituminous substance mixed up with a quantity of funeral statuettes, and the beautiful jewellery now in the Louvre, among them the splendid pectoral bearing the name of Rameses II. and the kestrel (Plate I. 1) and vulture with a ram's head, all formed of pieces of coloured glass cloisonné with gold, and all doubtless the gift of the king laid on the tomb of the dead Apis. Apis was the sacred bull worshipped by the ancient Egyptians.

[1] Egyptian Room. See also the next bottle, called a lekythos, and many others in same case.

[2] He was that Pharaoh for whose death Moses waited to return to Egypt, and father to the Pharaoh of the Exodus.

[3] Abd-el-Latif says one of the colossal statues of Rameses he measured was thirty cubits long without the pedestal, and formed of a single piece of red granite and covered with a red glaze.

Serapis (identified with Pluto by the Greeks) seems to have been a mingling of Osiris and Apis, worshipped by Greeks and Egyptians under the Ptolemies. Hadrian writing to Servinias from Alexandria says: "The Christians worship Serapis, men who call themselves bishops of Christ are devoted to Serapis; all are busy, no man's hands are idle, some making glass, some paper, linen; even gouty and blind persons have some employment." The black glass amulet, so carefully described by Caylus, with the name of Serapis on it in white letters, which pierced through the whole thickness of the ground, would probably therefore not be older than the Ptolemies, when the god Serapis took the place of the ancient Apis.[1] Doubtless among our treasures are preserved many objects of great antiquity, of which it is now impossible to fix the date precisely, in the absence of any knowledge as to where or how they were discovered.

In the temple of Rameses III., twentieth dynasty, at Tel el-Yahoudeh, recently discovered near Cairo, was found a large hall paved with alabaster slabs, the walls covered with encaustic tiles and bricks of most beautiful workmanship, incised and inlaid with hieroglyphics of glass, some of them containing the name of Rameses III.; a pattern in mosaic formed the cornice, and the capitals of the columns were also inlaid with brilliant mosaics. Some of the tiles are of entirely novel character, resembling Palissy ware and representing figures of Asiatic and negro prisoners, a procession doubtless denoting the conquests of the monarch. The figures are in relief, portions of the garments and backgrounds are incised and inlaid with pieces of coloured glass pastes fitted into the incised portions; the features and flesh appropriately glazed, the hair and headdress of coloured pastes; they are fine specimens of torteuric work in relief. Many examples can be studied at Boulak, but a greater number in the British Museum. They are unique specimens of this class of work (Plate I. 11).[2] Indications of embroidery on the draperies of the Asiatic prisoners are shown by the inlaid glass patterns. In the British Museum may be seen the inlaid top of a symbol of life, and also the different blues of the glazing. One great use of glass in Egypt was to form hieroglyphics for inlaying in stone, wood, or

[1] See Baedeker and A. Rhone.

[2] For a more detailed account of this magnificent ruin see Professor H. Lewis's paper in "Transactions of the Society of Biblical Archæology," vol. vii., page 177.

metal. Many stone figures of their deities are so treated. There is a remarkable instance of this work in the Turin Museum, where small glass figures are represented in their natural tints. Egyptian statues were often inlaid with various substances; when with vitreous pastes the portions so inlaid were the extremities, as the fingers, toes, beard, and eyes, collar round neck, bracelets and anklets. The British Museum possesses a great variety of objects in glass for inlaying, such as figures of monkeys and other animals, fingers and toes of men with long plugs at the end for keeping them fixed in their places. Some were fixed with pins of glazed ware. There are some beards of blue glass paste in the museum, one in the coffin of a priest of Horus who has also blue inlaid eyes, the beard and headdress of a king of Thebes a deep blue with a fillet of red paste; so many blue beards and wigs are found that it would seem to have been a fashionable colour, and must have been produced by powder or dye.[1] It would be well to notice some very beautiful figures of the twentieth dynasty that have been used for inlaying, together with many charms and amulets, studs, and medallions, inlaid heads and large bugles. These beads and bugles were extensively used in Egypt. Some mummies, instead of the gilt wrapper incised or ornamented with studs or flat glass figures, were enclosed in a network formed of beads or bugles; there are three mummies in the British Museum so treated; that of Ataineb, besides the blue network, has a scarabeus with extended wings formed of beads. This network probably refers to the recovery of the lost limbs of Osiris from the Nile. Rosellini found in a Theban tomb a representation of three men hard at work threading these beads.

There are many Egyptian specimens of beadwork in the British Museum, some formed of very tiny beads. We possess also two pectorals in gold cloisonné in glass, and in the gem room two gold bracelets with the name of Nimrud, twenty-second dynasty, and inlaid figures in pastes on them; besides these, many rings and objects in blue or green glazed porcelain, with the sacred eye and several small glazed objects used as amulets. Common objects in Egypt, these articles were prized objects of luxury to younger nations, and millions of them were made and exported to Greece, Italy, Persepolis, and Nineveh; and Etruscans set

[1] It is said Egyptians so hated red hair that they killed children born with it; so possibly a beard showing such a tint would be dyed. Among other changes, modern taste has altered that idea and red hair is avenged.

them in their exquisite gold filagree work, and they are found in tombs everywhere. One most remarkable of these objects is a bracelet formed of small fish strung together and secured by a clasp. Objects of a talcose schist, resembling Chinese soap-stone, were covered with a vitreous glaze generally of an olive green colour, very highly prized (see the vase of Thoutmes I., British Museum). Subjects are sometimes carved on this substance in intaglio, and the details inlaid with porcelain and vitrified substance of various colours. A painter's palette is known, inlaid with the figure of Osiris. Egyptians carried their love of decoration even to ornamenting their animals. Herodotus says the sacred crocodiles of Memphis wore in his time "earrings made of melted stone," which must have been glass. Many animals show great pride in wearing decorations, and doubtless the sacred crocodiles bore their honours with dignity, and the coloured drops would show well against their brown and horny skins.

Perhaps one of the earliest proofs of the domestic use of glass may be found in the frescoes of Thebes, where glass bottles holding wine are represented about 1500 B.C. A coloured glass bottle has been found, bearing the name of a king 1900 B.C.[1] Wilkinson tells us that large glass bottles holding two gallons were in Egypt enclosed in wicker work; smaller ones were protected by papyrus rushes like our oil bottles; and smaller ones still were encased in leather, just such as we carry on our journeys. All these are preserved in our museums, and prove to us that in this line at least we moderns have invented nothing. Pottery in Egypt never attained great excellence, but was regarded by contemporary nations with the same admiration we bestow on china; the honours of the discovery of true porcelain belong to China, where was produced a ware compact as stone and brilliant as glass. Still some of the cups of varied colours found at Thebes testify to the great skill of the workmen in making what may be called glass porcelain, as partaking the qualities of those two substances and not being unlike the porcelain glass invented by Reaumur, who discovered the art of converting glass into a substance very similar to porcelain. The ware of Egypt is generally either blue or green in colour, and of one quality, transversed by lines and devices of other colours which are not confined to the surface, but frequently penetrate half or entirely through the fused substance,

[1] See M. Deville.

a point in which they differ from china ware where the patterns are applied to the surface only, and perhaps justify the term glass porcelain. Moulding glass was equally practised in Egypt, as we find figures and ornaments evidently cast in a mould. This art was lost till re-invented by Lehmann of Prague (seventeenth century A.D.), who obtained a patent for it from Rudolf II. In reading of these late patents for old inventions one is reminded of the man who cried: "A plague on these ancients! they are always stealing one's good ideas." It is evident the art of cutting glass and hard stones was known in Egypt at the most remote period, as various devices are engraved on beads and vases of the eighteenth dynasty. It may be impossible to settle the precise method practised by the Egyptians in these works; but if nothing remains to show the process they employed, there is abundant evidence left of its effects. The well known bead with the name of Queen Hatasou on it is one example. They must have instructed the Israelites.[1] It is probable their early intercourse with India led them to the knowledge of the properties of the diamond. Pliny says: "lapidaries eagerly seek after diamonds, and set them in iron handles, for they have the power of penetrating everything, however hard it may be, for all gems may be engraved with the diamond." And though Pliny wrote many centuries after the epoch we are now considering, his testimony is valuable, seeing the Greeks and Romans kept alight for many ages the torch of civilization handed down to them by the Egyptians.

[1] Exod. ii. 17 and xxxix. 6.

Plate II.

PHŒNICIAN & GREEK GLASS.

Plate 11.

PHŒNICIAN AND GREEK.

"In a fragment of Sanchoniathon, a very ancient Phœnician author, it is stated that one of the successors of the first high priest was Isiris, who invented the three writings, who was brother to Chna, the first who was ever called Phœnician."—"*Monde Primitif*": *M. de Gebelin*, 1773.

"As if any one was to cover ivory statues or white lilies with clear glass."—*Ovid. Metam.*, lib. v.

IT is difficult to fix even approximately the date when Egyptian products first made their way among Greeks and Phœnicians. Some have held that Phœnicians being among the earliest traders only drew their glass stores from Alexandria, "that rich city," says Hadrian, "in which no one is idle, some making glass, some paper"; but unless there was a more ancient city on that site, before Alexander founded the present one (332 B.C.), that is much too late a date to fix on. Long before then Egypt had established commercial relations with India, and it is unlikely she would so long have neglected to extend her dealings to the nations of the Mediterranean. Herodotus says Pharaoh Necho[1] sent Phœnicians down the Red Sea, who returned in three years to the mouth of the Nile, having sailed round the continent of Africa, 610 B.C. Herodotus also tells us that "Scylax of Caryanda was sent by Darius Hystaspes on a voyage of discovery down the Indus. He sailed down the river to the east and the rising of the sun, till they reached the sea, whence they sailed westward through the Indian Ocean to the Red Sea." The account of this celebrated voyage, known as the Periplus of the Erythrean Sea, is mentioned by Strabo as written by "Scylax the ancient writer"; it contains many allusions to glass as one of the articles exported to India. "Among the Indians as soon as glass began to be known it was preferred before all things, and was exchanged at an exceedingly high rate." This does not bear out Pliny's statement, "that Indian

[1] This is the monarch whom Nebuchadnezzar defeated at Carchemish; he wished to connect the Mediterranean and Red Sea by a canal, but was forbidden by the priests to attempt such a work.

glass being mixed with crystal was beyond compare."[1] No mention is ever made of glass wares brought back from India; but all the names of the merchandise, silk, spices, peacocks, etc., are Sanscrit. It is most probable that later voyages were added to the history of the original Periplus, on account of the great fame of the first voyage. It is somewhat confusing to attempt to separate Judæa and Phœnicia; Sidon certainly never fell into the hands of the Jews, but the Septuagint frequently renders the Hebrew Canaan and Canaanites by Phœnicia and Phœnicians. Sidonians to the north of Judæa and Philistines to the south were equally called Phœnicians by the Greeks. The Phœnicians were celebrated for their silver work; they brought silver in such abundance from Tarshish that they used masses of it instead of lead for anchors! The silver vase with which Achilles proposed to reward the victor in the funeral games in honour of Patroclus was of Phœnician work; so also was the bowl given by Menelaus to Telemachus. Homer refers to every object of art or ornament as the work of a god or a Sidonian. The Bible records their skill in metal work and engraving when Solomon appealed to Hiram, king of Tyre, for assistance in building his temple.[2] It is unreasonable to suppose a people so versed in the art of metal work should have been ignorant of the sister art of working in glass. Professor Rawlinson considers the Canaanites as the original inhabitants of their land, and Phœnicians as immigrants, possibly from the Persian Gulf, as early as the thirteenth century B.C. "This accords with the Greek tradition, which made Phœnicia predominant in the Mediterranean at the time of the Trojan war, and speaks of settlements in Bœotia still earlier, and is late enough to harmonize with Scripture, which does not notice either commercial or artistic Tyre and Sidon till the time of David and Solomon." It has been suggested that at the invasion of the Hebrews the flying Canaanites gained an asylum in Sidon, who thus was enabled to found settlements in Cyprus, Rhodes, and Spain.

[1] Sir G. Birdwood has suggested that this may mean Chinese, as in Pliny's time such geographical confusion was natural.

[2] Lucan says in his "Pharsalia" that Phœnicians invented letters: "Phœnicians first, if ancient fame be true, The sacred mystery of letters knew." For many years it was supposed that by a perverse fate all their ancient records had perished, and they had been deprived of the credit of the benefits their discovery bestowed on other nations who borrowed it. Modern students have however unearthed some of these forgotten inscriptions and deciphered their mysterious characters.

Ronyer thinks "the products of Egypt did not come among the Greeks till the last Pharaohs" (400 B.C.). No exportations took place during the time the Persians remained masters of the country (they were finally expelled 410 B.C.), and they only went to Rome under the Ptolemies (323 B.C.), "when the forgotten recipes of the priests of P'tah were refound, and perfectly executed by Grecian disciples of Egypt." It is most probable that the Persian usurpers preferred enriching their own country with the spoils of Egyptian art, but those envied treasures must have filtered through Persian barriers, or been known long before in Greece and the isles, as Thales, one of the seven sages (636 B.C. ?), and Pythagoras (540 B.C.), and other Grecian philosophers transmitted the learning they brought from Egypt to their disciples, and thence it spread in ever widening circles.[1] To Egypt belongs the merit of having invented these processes, a merit the Greeks acknowledged in becoming her pupils. However this may be, it is certain that to those early Phœnician traders are due all the lovely Greek and other vases, and varied beads and amulets, found in tombs or thickly scattered over every shore "washed by the Mediterranean sea." The glass treasures found in tombs at Rhodes, Cyprus, and elsewhere, beginning perhaps about 800 B.C., do not occur after the Christian era. There is a great similarity in all the glass vases of this time; nearly all are in the form of amphoræ, generally dark blue in colour, or pale buff and white (imitating alabaster), seldom red or green, and often ornamented with a rudimentary decoration of zigzag wavy lines of white, yellow, or pale blue. These lines do not penetrate the thickness of the vessel, but are incorporated with it. Being all meant probably to preserve scents or cosmetics, they present little variety in shape, but the difference of materials in various countries, even in the colonies, would rarely fail to make a difference in products. Caylus, who spared neither time or labour in his researches, strove to establish the exact distinction between the manufactures of Egypt, Phœnicia, Greece, Etruria and Rome, but only succeeded with certainty in recognising specimens of the first and last countries. Our present more extended knowledge, and the great care now generally taken in indicating the localities

[1] "Thoutmes and Rameses chained to their cars all the then known races of mankind; under Greece and Rome, Egypt reigned by ideas as before by force of arms. The philosophy of Alexandria conducted at a supreme crisis the great movement from which grew the modern world. In mediæval ages Arabic art created at Cairo incontestable wonders."—*Mariette Bey.*

from whence antiquities are brought, may enable us to speak with a little more decision. The long pointed vases with one or two handles may generally be considered Egyptian, while the more bulbous shaped jars, often with a spout and one handle, are probably Phœnician.[1] From the great manufacturing cities Phœnician traders spread the knowledge as well as specimens of the art among the isles. It is believed that the island of Lesbos was formerly celebrated for its glassworks. In the British Museum we have bottles and vases from Cyprus and Rhodes,[2] moulded glass from the isle of Meros, and a moulded goblet with oblong beads from the isle of Thera. M. Renan, the great Phœnician scholar, was not fortunate in his late mission to Phœnicia, the glass he discovered being chiefly Roman. Explorers in Cyprus have been more richly rewarded, large stores of glass and other buried treasures having been found there. Phœnicians from Sidon are said to have conquered Cyprus in 1600 B.C., so the art treasures of that island were most probably created in the workshops of this powerful Phœnician city, whose sailors manned the fleets of Solomon. Sidon, the great "artifex vitri," was 200 stades distant from Tyre (where stood the famous emerald columns of St. Paul), and gradually absorbed the trade of the latter place. From the total absence of glass, except as paste jewellery, among the treasures found at Curium, Cyprus, it has been inferred that the Sidonians (at least before the siege of that town, sixth century B.C.) had not learned the art of making transparent glass then well known and practised in Egypt. Had they been in the habit of manufacturing glass vessels for domestic use, some specimens would probably have been preserved with the other treasures in Curium, as such numbers of bottles, vases, disks, and other glass articles have been discovered in later Cyprian tombs. It would however be unwise to fix any date from a single example such as Curium. The introduction of glass vases in these tombs was thought to date about 500 B.C.; but from the pottery found in them more recent excavators are inclined to think they must be earlier; indeed Newton includes Cyprus vases in the arguments by which he determines the date of the Mycenæ antiquities at 800 B.C.[3]

[1] See Plate II. 4, 6, 7, from the British Museum.

[2] The glass objects from Camirus, Rhodes, are so original in character that it is probable they are due to local manufacture, not to importation.

[3] Where coins are found the date is more easily fixed. Many coins of the

Phœnicians were celebrated for making a pure white glass much valued in those days, and this seems confirmed by the fact that very little coloured glass is found in Cyprus; there are a few specimens of light green, pale rose, and some blue with spiral lines on it, and in some cases vases are ornamented with blue bosses; but the greater part of the glass found was colourless, though it is now beautifully iridescent from age. Chemical analysis of Cyprus glass gives results precisely similar to that of Egypt and Rome, and the proportions are very nearly the same as we use now. The art of Cyprus is a mixture of Egyptian, Assyrian, Phœnician, and later Greek, the paste jewellery bears the impress of the different conquerors who have left their various traces in the island. Thoutmes III. conquered Cyprus, so the Egyptian date may be given approximately; but it would be impossible to assign priority to either Phœnician or Assyrian, as though Sargon overran the island in 708 B.C. Assyrian influence there is probably older. An enormous quantity of Greek and Phœnician glass, tear and ointment bottles, seals, beads, and bracelets, jugs and vases of all the usual varied shapes, have been found in tombs in different parts of Cyprus. Numbers of these were discovered and sent to New York by General de Cesnola,[1] but many choice specimens remain in England, some lately bequeathed to the British Museum by Mr. Henderson. Among these is the graceful bird shaped bottle, which may have been an infant's feeding bottle, or used to drop liquids, and the Phœnician vase with two handles, both on Plate II.; the latter is beautifully coloured in zigzag lines of turquoise blue, yellow, and black. Among the numerous bottles preserved in the museum some have stoppers, and some pointed glass sticks as if to stir up the snuff or scent in the bottle, or they may have been used for applying pigments to the brows and eyelashes just as the Arab women apply kohl with metal bodkin-shaped sticks. A large variety of very beautiful Phœnician, Greek, and other glass objects can now be studied with great ease at the British Museum; among them is the flat bottle (Plate II. 2). A similar bottle without handles was taken from a tomb at Sidon. Six objects figured on Plate II. are from the Lawrence-Cesnola collection, all found in Cyprus by Major de Cesnola. The small

early Ptolemies are found with glass; but glass is also found in tombs of much earlier date.

[1] Plate II. 12.

feeding bottle, No. 1; a beautiful pale rose-coloured vase, No. 9; a unique shaped bottle, with long neck and the body pinched in a triangular shape, No. 10. Some of the glass in this fine collection is of marvellous lightness; thus a bottle, No. 5, six inches high, with a long neck and broad at the bottom, weighs one ounce and one eighth; a glass vase, No. 8, five inches high, and measuring ten round, weighs seven eighths of an ounce; a tumbler of the common indented shape, five inches high, No. 11, weighs three quarters of an ounce; and a cup, three inches high, weighs very little over half an ounce. An ordinary English wineglass weighs four ounces and a fraction, a light one weighs 1·998 ounce; an ordinary tumbler weighs 8·5243 ounces, and a light one weighs 4·041 ounces. Greek painted glass is extremely rare; this collection possesses a pointed bottle found at Paphos, with a temple painted on it supposed to be the temple of that city; and a glass disk, in the possession of Major de Cesnola, presents a Venus painted in colours. Gilding is yet seen on some of the glasses. Cyprus is still rich in these spoils of the tombs; a recent traveller[1] relates seeing fourteen baskets full of glass lying at the commissioner's house waiting the decision of the home government as to their ultimate fate. It has been suggested that a local museum might be formed, where these treasures could find a final resting place. We see many of the forms of this Greek glass reproduced in later tombs and in various countries; see a square long necked bottle, Plate IV., which seems to have been a favourite shape for many centuries.[2] No doubt Greek glass is often found in Roman tombs, just as much Roman glass has been recovered from cemeteries in Britain and Gaul.

At the sale of Barbetti's collection of Phœnician antiquities, a few years ago, some hollow rims of glass sepulchral urns filled with water, which had doubtless penetrated either through their substance or through imperceptible fissures in the soldering, during the many centuries they had lain underground, were bought at high prices by antiquarians who believed the wily Italian's assertion that they contained a wonderful perfume with which they had been filled when first made.[3] All traditions, and

[1] "Our Home in Cyprus": Mrs. Scott Stevenson.

[2] Cyprus terracotta funeral vases are reproduced to this day with great exactitude both in form and colour by Kabyle mountaineers in North Africa (see South Kensington Museum). These tribes seem to have no knowledge of glass; they use a vegetable glaze.

[3] C. W. King. He also mentions having seen the hollow spherical

nearly all ancient remains found, testify that glass was first used in making personal ornaments; inlaid coloured pastes, beads, and amulets appear for a long time before the idea seems to have occurred to early workers of converting it into vessels for domestic use. Thus the glass found at Mycenæ was chiefly in the form of ornaments, and though no inscription there was older than 600 B.C. some of the articles discovered by Dr. Schliemann must belong to an earlier date. Among them were disks of vitrified paste, which probably were the decorations of a door or a wall. Disks very similar in character were found at Ialysos, Rhodes, of various sizes and principally turquoise blue or greyish white in colour; they are each ornamented with a rosette in relief, and have all been cast in a mould. They are now in the British Museum, where may also be seen some disks in glazed pottery from Egypt,[1] bearing a great resemblance to those from Mycenæ and Rhodes; it is sometimes very difficult to distinguish between vitrified pottery and opaque glass.[2]

Homer (950 B.C.?) never mentions glass, and only puts golden cups into his heroes' hands; but he distinguishes between those thick earthenware vessels that could bear heat, and the finer more delicate kinds called "apyrous" which broke if touched by hot water; some authors see indicated in these the vitrified semi-transparent drinking cups made at Coptos, Egypt. Herodotus, 484 B.C., had evidently never seen glass except as paste jewellery, which he describes as fusible stone; but Democritus, 460 B.C., who spent five years at Memphis, must have learned something of its nature and may have introduced his knowledge into Greece before Aristophanes, who is the first author who uses the word *hyalus* as applied to glass, wrote his play of the "Acharnians," 425 B.C., in which he makes the Athenian ambassadors sent to Ecbatana say "they were made to drink a generous wine out of cups of gold and of glass"; and in a later play, the "Clouds," he

portions of stems of Venetian glasses nearly filled with water which had doubtless penetrated in the same way as in the urns; and curiously enough the marks made by the successive deposits of rising liquid on the interior of the glass exactly imitate the natural layers of an agate.

[1] The Greek colony of Sais in Egypt was founded in the seventh century B.C. This extended colonization may account for the similarity in the products of Egypt and Greece.

[2] Mr. Newton has described in the *Academy* the discovery of similar articles at Spata in Greece. It is impossible to say if these articles are Greek or Phœnician. The rosette ornamentation of the disks may be Egyptian, as pottery disks similarly ornamented have been found in Egypt. Their date is probably about tenth century B.C.

makes one of the characters suggest to Socrates (whose teaching he derided) to efface an obligation to pay five talents, when in the very hands of the bailiff, by melting the wax of the tablets on which the debt was recorded by means of that brilliant transparent stone with which chemists burn things by presenting it to the sun. Crystal was never so common in Greece as to be found in every chemist's shop. The Florentine scholiast notes upon Aristophanes' "Clouds" that in Greece glass was made from some plant, ("we give the name *hyalus* to the production of a certain plant which, being burnt and liquefied by fire, is used in the manufacture of vessels,") and compares "kyron" (crystal) to it.[1] Theophrastus, writing in the fourth century B.C., only speaks of glass as made by fusion out of a particular stone, so it would not seem as if the actual process of manufacture could have been much known at that time; he does understand something about colouring it however, as in his work on "Stones" he says: "If too, glass, as some say, is formed from a vitreous earth, this also takes place by condensation. But its greatest peculiarity is that, when mixed with copper, besides aiding its fusion and admixture, it has an extraordinary quality in giving a difference to the beauty of the colour."

There is some reason to suppose that enamelling was practised about this time. In a tumulus near Kertch, Crimea (ancient Paneticapæum), were discovered the remains of a great chief and his wife, probably the ruling potentate of that country; with them had been interred servants, horses, and quantities of treasure in the form of jewellery. Among the latter were found medallions of green and blue enamel; also a mitre headdress with an electrum plate, on which were four Greek women seated on garlands of lotuses, the stalks of which were entwined to serve as seats and backs; the bottom of the mitre was ornamented by small enamel rosettes. The chief also wore a gold enamelled necklace. From the form of letters found in this tomb and other circumstances it has been supposed that the burial must have taken place not later than the fourth century B.C.[2] In the word "hyalus" the Greeks seem to have included not only glass but everything that was of a crystalline colour, all pellucid bodies such as ice, and even gums, as Lucian uses the same word in describing the Indians anointing their dead with balsamic gums.

[1] Hesychius defines glass as *eidos hyalou*, a species of hyalus.
[2] "Archæological Association," vol. xiii.

Thus when Herodotus speaks of a fossil glass out of which the Ethiopians dug coffins for their dead, we who understand by glass only a composition made by fire think this must have been some kind of bituminous varnish used perhaps to fasten the wrappers round the corpse. A fossil cannot be glass, but it may have been some vitrified substance[1] found in the neighbourhood of volcanoes and formed by subterranean fires.[2] Diodorus, writing about four centuries later, says: "In Ethiopia they make glass so abundantly that it serves for all the tombs." When Augustus saw the body of Alexander in a glass coffin it must have been something transparent. Strabo, 54 B.C., says: "Alexander's body was first placed in a golden coffin, but Seleucus, king of Syria, 358 B.C., his friend, had it removed and placed in the glass coffin which Augustus saw." Yet glass must still have been very rare, as Mnesiptolemus, the court annalist of King Seleucus, describes his royal master as drinking out of a bowl of "molten gear," as if the article were such a novelty as only befitted the use of a great and wealthy monarch.[3] Drinking cups must soon have become more known, as Pausias of Sicyon, 360 B.C., painted "Drunkenness," with her face showing through the transparent glass from which she drinks.[4] That glass was used in architectural ornamentation at a very early date seems proved by the coloured glass still seen in the capitals of the portico of the temple of Athena Polias on the Acropolis of Athens. This temple, the Erechtheium,[5] was commenced by Pericles; it contained the sacred olivewood statue of Athena Polias, the most ancient known; the building was suspended in the Peloponnesian war, 409 B.C., according to an inscription now in the British Museum. Herodotus does not allude to its unfinished state, so the principal parts must have been completed before his time; it was finally finished 393 B.C. This glass decoration of capitals was probably directly derived from the Egyptian method of inlaying hieroglyphics; and the next step, to glass panels and

[1] Obsidian or volcanic glass was extensively used in Mexico.

[2] Ronyer thinks it may have been a salt gum, still found in Arabia, such as was used for walls in Carhès, or that transparent stone still employed for windows, or that alabaster brought from Cappadocia of which Nero built a transparent temple; or it may have been obsidian, still abundant in Ethiopia, and which Mayol says was used for sepulchres.

[3] "Athenæus," x. 40.

[4] There is a copy of this work still extant in Florence. Pausanias says the original was in the grove of Æsculapius in Epidaurus.

[5] This celebrated temple was dedicated to Erechtheus, one of Homer's mythical heroes, said to have been an Egyptian.

mosaic pictures for walls, which the Greeks are supposed to have invented, would have been an easy one. In the temple of Diana at Ephesus were discovered (during the excavations) some small gilt disks, which were covered with a thin layer of glass, to preserve the gilding, possibly the germ of what we call "Christian glass."

Phœnician decadence must have commenced before the seventh century B.C., when rising Greece, following the law of nations, was gradually seizing on the failing power of her older rival and seating herself on the vacant throne of Phœnicia. Phœnicians were more celebrated for making glass than pottery. Greeks preferred working in clay to glass; the ease with which clay could be made into the vases which remain for ever types of elegance to us, the purity of form which could not be obtained so well in glass as by the clay worker, appealed more to their sense of beauty. So the traces of Greek art are not so much found in the fabrication of glass objects for use, as in the mouldings of opaque glass, fixed on coloured vases, where the artistic hand of the Greek has left an impress not to be mistaken. All our gem cameos we owe to their skill, with the thousands of paste intaglios, which followed as a natural sequence, and which are now found preserved in mummies in Egypt, dug up from buried temples in Rome; for almost wherever a Greek has left the print of his footsteps we find these proofs of his extraordinary artistic skill and endless wealth of invention.

The hundreds of Greek vases found in nearly all museums prove that they were acquainted with the art of glazing from the earliest dawn of their civilization, as some glazed vessels found in tombs date from the tenth century B.C. This glaze is fine, thin, and lustrous; the recipe for making it is lost, but the black glaze is supposed to be a volcanic substance, spread over the vase like a varnish, and fused by baking; there is no lead in it, and it will not yield to acids or to the blowpipe, but it is inferior to modern glazes as it is permeable by water. Great numbers of bottles containing ointments and perfumes were placed with the favourite drinking cup of the deceased in his tomb. Many of these doubtless were employed for toilette purposes during lifetime; some of various materials, and of very elegant form, were lachrymatories, "tear bottles," such as are alluded to by Ovid; others possibly received the blood of victims sacrificed to the manes of the dead; and many were used for the purpose of anointing the

body after death; as Anacreon, 560 B.C., laments as useless all the libations and ointments poured out to honour his corpse. In the basrelief representing Meleager's funeral is seen a woman approaching the pile, and from a large vase pouring balsam into a smaller one with a tube. The immense importance attached to these funeral rites by the Greeks induced them to lay their best and rarest gifts beside the honoured dead. When Agrippina, 158 B.C., brought to Rome the ashes of Germanicus in an urn, it was received with royal ceremonies in its passage from one country to another, the authorities ordering it to be crowned with flowers and followed by crowds who accompanied it from one post to another. Plutarch also attests the same thing in speaking of the funeral urn of Demetrius, 325 B.C. It is this ancient custom of placing the choicest treasures in the sacred depositories of the tomb that has preserved such priceless and fragile treasures of art to us, and enabled us step by step to follow, and in a great measure trace out, the civilization of antiquity.[1] The question of whether Greeks used magnifying glasses or not must be decided by the nature of the works they have left us, as we find but little help from their authors. Democritus, 460 B.C., is said to have recognised that the milky way was an assemblage of numberless stars; could he have done this without artificial aid to his eyes? Plautus, 254 B.C., seems to have seen glasses of some kind used, as he makes a girl say, "My mother conducts me to the circus, when I return to the house he (my lover) follows me with his glasses, as it were by stealth, as long as I remain in sight." It has also been suggested that Plautus alludes to spectacles when he speaks of "Faber Ocularius"; the same expression also occurs in an inscription by Aldus Manutius, in which mention is made of a certain "Patrochus, faber ocularius." But this term is supposed now only to indicate those craftsmen who supplied glass eyes for statues. Modern spectacles were invented (or re-invented) by Salvino d'Armati, of Florence, at least that fact is engraved on his tombstone, dated 1317. A few years

[1] There is still preserved in the Vatican a shroud of "linum asbestos," a substance indestructible by fire, and considered equal in value to pearls, which was used to keep the bones separate from the ashes of the funeral pile on great occasions. Should cremation become general in England, doubtless "linum asbestos" could be revived also. At the dispersal of the Hertz collection in 1859 two of these asbestos shrouds were sold, said to have been found near Carthage; one was contained in a glass cinerary urn, and held the bones of a human being, the other was supposed to preserve the mingled bones of a warrior and a horse.

earlier Gui de Chauliac, after giving various recipes for eyesalve, says, "If these are not successful, recourse must be had to spectacles."

Workers in glass, as they became more numerous or perhaps more ambitious, stamped the name of their native town, as well as their own designation, on their productions. "Artas the Sidonian," in both Latin and Greek[1], is read on vases of the most rich and beautiful colours. This name occurs in the British Museum on a broken blue glass handle. Doubtless he was a renowned artist, as sometimes he places on his work simply "made by a Sidonian," as if he were too well known to require a more distinctive title, at least the glass is precisely the same in both instances. We have also "Victor of Sidon" on another broken handle. These names were stamped on the *poucier* as the French call it, the piece of glass placed at the handle of cups, to enable the thumb to take hold easily; and as the handle was the thickest part, many of them have survived the vases to which they belonged. Lucian finds nothing to which he can compare the brilliance of a young girl he is praising save the glass of Sidon. In the British Museum we have a moulded glass cup, having stamped on it, with the name of Ennion, these words, "Remember this, O buyer"; it was found in Cyprus. This same artist's name appears on a lovely vase found in the ruins of Panticape, Kertch, which is now at St. Petersburg, and two smaller ones from the same studio were found at Modena, so it is evident his work was widely renowned and he may well have been proud of his name. M. Deville, from whose untiring industry the history of glass has gained so much, has found the names, or stamps, of sixty workers in glass, against four thousand makers of pottery. Sometimes the same name appears both on glass and pottery, as though the artist worked equally in either substance. Among these workers is the stamp of one glassmaker from Rhodes; but, strange to say, not a single name positively known to be from Alexandria, that busy centre of fabrication, has come down to us. Carthage has been more fortunate; "Jules Alexander Africanus, citizen of Carthage, artist in glass," says his tomb, established himself and his family at Lyons in Gaul, and died seventy-five years

[1] This blending of the two languages would seem to place the work as late as the Antonines. Besides the name we sometimes find a beardless emperor's head crowned with laurel like Augustus; this cannot be later than Hadrian, the first emperor who allowed his beard to grow.

old. The sack of Carthage by the Romans at the close of its final siege, 146 B.C., was so complete that nearly every vestige of that once famous city has disappeared, its only remains are ruined walls and mosaic pavements. Having been founded by Phœnicians it would naturally excel in all their arts, and G. Rawlinson attributes to the Carthaginian trade many of the glass objects found on the north-west coast of Africa. The opulence and wealth of the city may be inferred from the fact that its inhabitants dedicated to Astarte a purple mantle embroidered with figures and sacred emblems in gold, for which they had paid £26,000. When it was brought among other spoils to Rome it eclipsed all known precious objects. Athenæus says there were several such robes in Carthage. The only glass found by M. Falbe during his researches in Carthage was in a tomb at Thapsus, where a very beautiful patera of glass was enclosed in a terracotta vase with figures, lamps, and other objects, which are all now in the royal collection in Denmark. The inscription on the vase was in both Greek and Latin, and its conical form resembled those found at Paphos. Tyrian Carthage was rased to the ground; the "artist in glass" whose tomb is still preserved in Lyons probably emigrated then from the later Roman Carthage, which after a time rose on the site of the older city, from which also the tomb at Thapsus most likely dates.

It is supposed that the Greeks learned divination by means of victims, from the Egyptians; but they practised it also by means of glasses. Potter[1] describes one method which was performed by the help of water, thus: "They filled certain round glasses with clear water, about which they placed light torches, then invoked a demon, praying in a low murmuring voice, and proposed the question to be asked. A child was generally put to observe, with great care and exactness, all the alterations in the glasses, at the same time desiring, beseeching, and commanding an answer, which at length the demon gave by reflection from the water, representing what should come to pass." The same author says one variety of the game of "cottabus" was played with a large vessel full of water. On the surface of the water a number of empty phials were swimming; into this the players flung wine out of cups, and he who succeeded in drowning the greatest number of phials gained the prize. Greek dice were originally the knuckle bones of sheep; sometimes they were made

[1] "Antiquities of Greece." 1818.

in the same form as the bone, of stone, metal, ivory, or glass. Sir G. Wilkinson had one of glass found in Athens, only two thirds of an inch long. The game of dice is represented in a painting at Herculaneum, and also in sculpture; it came probably from Egypt. The use of the hourglass[1] was well known to Greeks, and is many times alluded to by their authors. In Athenian courts of justice, the plaintiff being placed on the left and the defendant on the right of the tribunal, both spoke on their own behalf; and lest they should weary the court they were limited to certain spaces of time, measured by an hourglass filled with water instead of sand. To prevent fraud, an officer of the court when the proceedings began distributed an equal share of water to each side. When the glass ran out the speaker was silenced; if any interruption intervened the glass was stopped for the time, and if any person had finished his speech before the glass was empty he might make over the remainder of his time to a friend. Some of these ancient practices might surely be introduced with advantage in modern assemblies. Lucian (A.D. 120) constantly refers to the use of the hourglass. In the "Portrait" we read: "It is your turn to speak, now the water flows for you, so without delay begin immediately"; "You have been very long, and much beyond your glass already." Also in the dialogue of the "Fisherman," Socrates says: "What shall we say if this man is condemned without giving him the chance of the hourglass?"[2] There are numerous allusions to glass in Lucian's works. Thus, in his burlesque history of the moon, he tells us: "The rich among them have garments made of glass, but very soft. The poor have woven brass (which, by pouring a little water over it, they so manage as to card it like wool). The king made me a present of two glass robes and two brass ones." In the Islands of the Blessed[3] we read "the baths were large houses of glass, filled with warm dew, and perfumed with cinnamon."

An amusing passage is found in the works of Pausanias, the

[1] It was called clepsydra, and was a glass vase filled with water which escaped by a small hole at the bottom drop by drop. As the water subsided a needle fastened to a cork indicated the hour by the numbers engraved on the sides. Greeks used this timepiece at the theatre, the bar, and also in private houses.

[2] Our preachers used to measure their discourse by an hourglass with sand; some of these yet remain, in country churches.

[3] The voyages of the Phœnicians beyond the Straits of Hercules and their discovery of the Azores seem to have given rise to the fiction of the Islands of the Blessed, with which the Greeks combined the notion of the Elysian Fields.

great traveller, A.D. 125, in which he describes the Styx in Arcadia as a "river which gave death to man or animal who drank of it, dissolved metal and pottery, and broke by simple contact glass, crystal, or murrhine," a true river of hell.[1] The Styx was a waterfall at Nonacris, in Arcadia, afterwards transferred to the unseen world by poets; it was the highest waterfall in Greece; the ancients swore by its waters, which they considered poisonous, and they were supposed to destroy all vessels except those made of the hoof of horse or ass. This belief continues to the present day, as the villagers declare that no vessel can hold the water.

There are various allusions to glass in the banquet of the learned of Athenæus, who wrote early in the third century A.D., but his books are a treasure house full of references to earlier writers. He collected such a mass of material for his work that he consulted eight hundred books of comedy alone. He refers to the celebrity of the isle of Lesbos (the birthplace of Theophrastus) for glass drinking cups, and also says that in the isle of Rhodes they formed a paste of clay, with the ashes of reeds, and myrtle, flowers of saffron, balm and cinnamon mixed together and burnt in an oven, till it became a transparent vitrified material, but so delicate that vessels formed of it could not hold hot water or be put near the fire without breaking. This description resembles that given by Homer of the "apyrous," so much more delicate than earthenware. Athenæus also notices the use of glass for domestic purposes when he writes: "After we had drunk, a glass goblet of two cubits in diameter, placed on a silver stand, was served up, full of roast fishes of every conceivable sort that could be collected"; and again when he describes a wedding feast at Macedon, where was produced a plateau of glass nearly one yard and three quarters in diameter. "Greece having been instructed by the Phœnicians became in her turn the teacher of Rome."

[1] Pausanias adds: "The fountain of Caynæthaenses is beneficial, and an antidote as it were to he noxious qualities of the Styx."

ROMAN.

"It is no easy matter to give novelty to old subjects, authority to new, to impart lustre to rusty things, light to the obscure and mysterious, to throw a charm over what is distasteful, to command credence for doubtful matters, to give nature to everything, and to arrange everything according to its nature."—*Pliny.*

THE great city of Rome, though her children love to call her eternal, was not founded till 753 B.C. The young capital soon gave proofs of its vitality by absorbing the neighbouring country of Etruria, whose arts and sciences it adopted in a great degree, and doubtless among these new refinements the glass of Etruria would not be neglected. It is supposed that 536 B.C. is the earliest date at which glass was introduced into Rome. When we remember the immense stores of glass preserved in Pompeii, that does not seem too early a date to fix on. Before that time, however, Romans made pottery for domestic use, which must have been glazed. Dr. Birch tells us a corporation of potters made black ware in Rome in the time of Numa, 700 B.C.[1] Juvenal alludes to its use when he says, "Who dared then to ridicule the black saucer of Numa?" Persius calls it Tuscan pottery, and Martial says that Porsena, 507 B.C., had a dinner set of this ware. The first Roman embassy went to Greece[2] in 228 B.C., and we may suppose before that time Phœnician commerce would have brought Egyptian glass and Grecian fictile wares to administer to the wants of rising Rome. Her armies probably carried back spoils from the siege of Syracuse, after the death of Archimedes, 212 B.C., who must have brought glass-making to some perfection if the tales told of his celebrated celestial sphere are to be credited. It is alluded to by Ovid, but our knowledge of it chiefly rests on the epigram by Claudian,

[1] It is said when Numa was entertaining some guests the plain food on the earthenware dishes was turned on the appearance of his spouse, the nymph Egeria, into a banquet fit for the gods, served on vessels of gold, in order that her divinity might be made manifest to the most incredulous.

[2] Greece finally became a Roman province, 146 B.C.

Plate III.

ROMAN GLASS.

written some five centuries later: "Jupiter, on seeing the heavens enclosed in a little globe of glass, laughed, and thus addressed the gods: 'The power of mortals, has it then arrived at transferring in play my work into a fragile sphere? Behold, an old man of Syracuse arrogates to himself, by his art, the principles of the heavens, the harmony of material, the laws of the gods. His audacious industry already puts his world into motion; his mean hand has succeeded in emulating nature.'" Archimedes is also said to have set fire to the Roman fleet by means of a burning glass, though great doubts have been thrown on this story as well as that of the sphere; concave mirrors, whether of glass or metal, made by moderns, are not nearly so powerful as was said to be this one constructed by Archimedes.[1] Another representation of the heavens and starry bodies made of glass in Rome at a somewhat later date is quoted by Mr. Nesbitt from the "Acts of St. Sebastian," believed to be written by St. Ambrose, A.D. 397. An astrologer is introduced, who says: "I have a chamber wholly made of glass, in which the whole system of the stars, with the calculation of their movements, is artificially constructed, and in the making of which my father Tarquinius is known to have expended more than two hundred pounds of gold." Egyptian glass found its way to Rome plentifully under the Ptolemies, and received its Latin name from the Coptic word "varos."

Cicero, 106 B.C., is the first Latin author who refers to "vitro" as a common importation from Egypt, along with other merchandise, such as linen, paper, etc. Lucretius, 95 B.C., (whose works Cicero revised,) when trying to explain the transparency of glass, says "the pores are directed in straight lines," and also "there are emanations which can penetrate stone, iron, silver, and others which can open a way through the pores of glass."[2] Though the accounts of Virgil's mirror (70 B.C.) may require confirmation, yet the beautiful lines in which he associates the grove of Angitia with the glassy waters of the Fusian lake are well known, and Horace, 64 B.C., pays no extravagant compliment to his favourite Bandalusian fountain when he says it is "brighter than glass," the art of the glassmaker of those days not having acquired the power of producing the crystalline pureness we are accustomed to expect. Horace frequently alludes to glass; he

[1] The burning mirror which Buffon composed of a number of pieces of glass had no effect beyond two hundred feet.

[2] This does not agree with Sir D. Brewster. See last chapter of this work.

adorned his room with pictures painted on glass, an example doubtless followed by others, and when writing to his friend Mecænas, wishing to show the extreme simplicity of his home, says, "here you see only country made glasses." After this time the material was distinguished as "vitrum" by Latin authors (who gave analogous names to everything transparent, whether liquid or solid), and became in great request and esteem in Rome, whose inhabitants had till then been content with clay. Poets and orators of the Augustan age constantly speak of it in such terms as to prove it was an object with which every one must be familiar, the word "vitreous" is used in every sense relating to the brilliance and fragility of glass. We may judge how plentiful it had become in Rome when Scaurus, who held the curule ædileship in 58 B.C., built his celebrated theatre in which he made a display of magnificence such as had never been known before. The scena of this gorgeous theatre was divided into three tiers, each tier containing one hundred and twenty columns; the under row was formed of marble, 38 ft. in height, the uppermost one of gilded wood, and the middle row of glass; probably the columns were covered with glass panels.[1] Pliny says "such extravagance was unheard of even in later times," and he seems to suggest would not have been permitted even in the houses of the most exalted citizens. In after days, when misfortune befel Scaurus, he vainly appealed to the fickle populace by the memory of those splendid fetes he had provided for their amusement.

Egypt was made a Roman province in 30 B.C. by Augustus, who ordered that glass, linen, and wheat should form the tribute sent from the conquered country. But this tax, far from being oppressive, became the source of great wealth to Egypt, as the taste for glass increased so quickly in Rome that the amount of tribute soon became much too small to satisfy the enormous demands made upon it. The quantity sent only excited among the Romans so great a passion for greater varieties that all the factories of Sidon and Memphis failed to satisfy their caprices. The sudden development of luxury in imperial Rome gave an extraordinary impetus to the Egyptian workmen, who strove to satisfy the refined tastes of the conquerors of the world. Under this pressure they produced real masterpieces, and the consumption of glass became so enormous that at last the very workmen were

[1] Three thousand bronze statues placed between the columns completed the ornaments of the scena. The theatre held eighty thousand persons.

obliged to come and settle in Rome, to supply more easily the thousand phantasies of that great market. When it is remembered that porcelain, though made in the East, was at that time totally unknown to the Romans, who were acquainted with nothing more decorative than red Samian ware or the black and painted earthen wares of Tuscany, we may imagine the delight with which that luxurious and pleasure loving people, weary of the monotony of gold and silver table services, would welcome the brilliant hues and myriad forms of this new addition to the splendours of their banquets; no wonder they demanded novelties in such quick succession that the factories themselves had to be removed to the imperial city. For a long time the Romans were ignorant of the means by which the beautiful effects they so much admired were obtained; but they strove to imitate them, and at length succeeded under Augustus in establishing in their city those factories which in less than a century afterwards became perfect and celebrated. At first probably only the foreign workmen practised their secret processes to please their masters, but they would soon have made pupils through whom the knowledge spread everywhere. As the Romans, fired with envy at the success they saw, applied themselves earnestly to improve the materials they possessed, it was soon discovered, partly by money, partly by experience, that although the ingredients were so pure in Egypt they owed their superiority to keeping the glass a long time in fusion, to remelting the frit, and cooling it by slow degrees. This important point it was which gave to the glass of Egypt a crystallization which added much to its strength. It was the knowledge thus acquired of complete fusion and perfect purity which raised the fame of their factories till they rivalled those of Memphis, and the Romans threw away their gold and silver to drink out of glass cups. That these factories were established under Augustus we infer from Strabo, 54 B.C., who says he "was told by a workman in Alexandria that it was impossible to make glass so well in Rome as in Egypt, on account of a peculiar earth which could only be found in the latter country"; but afterwards he adds that so many ingredients had "been discovered in Rome, and such improvements made in the colouring and process of working, especially in making glass of a crystalline appearance, that you might buy there a cup and a dish for half an as."[1] Romans used glass for an infinity of purposes,

[1] In Cicero's time the as was worth three farthings of our money.

both for use and ornament, and also for their games. Ovid, 43 B.C., advises a lover "to allow his mistress to take his glass pawns of two colours at the game of chess." Glass dice were also used, and Caylus describes a female head in blue glass, with a headdress of different material, and also a frog in blue glass, both beautifully moulded and about two inches long, and evidently meant for some game, perhaps draughts. Roman ladies used glass balls to cool and whiten their hands; as the glass grew heated, they changed the ball. The poet Propertius, 51 B.C., describes "Cynthia, demanding the present of a peacock feather, fan, and cooling balls for her hands." An alabaster urn, which was found in Rome, contained sixty glass balls, which gave rise to many discussions as to their probable use; they were most likely the cooling balls of a Roman belle. The female figure painted on an amphora found at Nola, apparently throwing coloured balls in the air, is most likely playing with her own cooling balls, and not with worsted as has been suggested.

The poets of the Augustan age contain many references to the use of glass at banquets. Wine, and also water, was placed on the table in large caraffes,[1] or bottles much the same as ours, and slaves poured it into the drinking cups of the guests. Horace tells us some masters on rising from table made a small mark on the bottle, to be sure the slaves did not touch the wine. Varro, 116 B.C., "wisest and most learned of Romans," says "wine is called water in the glass." Cicero tells us he only likes small glasses; while the wealthy Roman, Nasidianus, who gave a supper to Mecænas which Horace so unmercifully ridiculed, cries "that wine demands the largest glasses." Horace himself calls for the largest glasses, to drink to the victories of Augustus. These large glasses, "calices majores," were reserved for the heat of summer, and lumps of snow or ice put in to cool the wine. Snow was then used for cooling water, and hawked about the streets of Rome in summer much as it is to this day. We have accounts fifty years before the time of Alexander, of snow preserved for use in hot weather, but Greeks sometimes also cooled water by evaporation, keeping boys all night employed in moistening jars for that purpose. Most Eastern nations understand cooling water by evaporation. The guests at a banquet might, if they chose, claim the privilege of emptying a glass for each letter in the name of the person whose health they drank. The habit of wishing good

[1] One of these large decanters is preserved in the Musée of St. Germains.

health to a friend by drinking wine yourself seems as old as the manufacture of wine itself.

Seneca, born a few years B.C., had evidently seen imitation emeralds made "from pebbles by means of fire"; he also observes the magnifying effect of glass balls filled with water, saying, "letters though of small size and obscurely written, when seen through a glass ball filled with water, appear large and distinct. Apples floating in a glass of water seem finer and larger than they really are." He attributes this effect to the water. He thus describes a sort of prism: "a rod of glass drawn out straight, and knotted after the fashion of the staff used in drilling recruits, with many angles, which, if it receives the sunlight transversely, reflects colours such as we see in a rainbow." It is Seneca who contrasts the early simplicity of baths in Scipio's time with the luxurious extravagance then fashionable. "But who is there now, who will condescend to take his bath after this fashion? He seems a poor mean fellow in his own estimation, if his walls do not reflect him in their large and costly mirrors, if the Alexandrian marbles are not set off with[1] Numidian mosaics, if they are not bordered all round with a highly artistic colouring after the manner of a painting, if the chamber is not hidden with glass." After upbraiding the modern luxury of Rome, he observes philosophically, "it signifies little to a man to drink from a brilliant glass, but much to be good." When writing to his friend Posidonius, he wishes much he "could show him a workman blowing glass,[2] and making it take by his breath all kinds of shapes which the cleverest hand could not attain to." Surely his "testâ perlucente" may now be allowed to mean glass!

During the excavations made by the French some years ago, at the palace of the Cæsars, a great deal of fragmentary coloured glass was found. Mr. Nesbitt describes some thick pieces of opaque glass, which had evidently formed part of a pavement. Among the quantities of scraps of various patterns disinterred

[1] The marble of Numidia, giallo antico, golden yellow with reddish veins, was the most highly prized at Rome for its colour. The pavement of the Forum consisted of this beautiful marble.

[2] It is probable a bubble of air imprisoned in a mass of glass may have given the first idea of that simple instrument, the metal tube of the glass-blower; it is seen on Egyptian monuments 2000 B.C., and was possibly then not a new invention. Glass blowing with the breath was practised from the days of Egypt till 1824, when M. Robinet, of Baccarat factory, invented the Robinet pump, by aid of which large cylinders may be manufactured; he received a gold medal and a pension from the directors of Baccarat.

were so many of one especial design in shades of green, that it was supposed among the visitors to have been the favourite domestic service of the imperial household, which we may well imagine absorbed its full share of the Egyptian tribute. No doubt Tiberius, A.D. 14, carried all the refinements of Rome with him to his retreat in Capri, where the legends of his luxuries and cruelties still hang round the many now ruined palaces he built on the island.[1] Besides the fragments of glass always found among Roman ruins, and the daily tribute of cubes of mosaic which every tide washes up to the feet of Capri children (who make a trade of selling handfuls of them, mixed with coral and shells, to visitors), rare objects of art such as gem cameos, bas-reliefs, are still unearthed by peasants from these almost untouched ruins, and privately sold to tourists. In this way a beautiful cameo vase, described to the writer as shaped like the Naples vase, with two handles, and made of blue glass with white cupids on it, has been lost to the Italian government. These ancient treasures belong by law to the nation, and the finder of such an object is rewarded; but no law can always prevent a peasant from disposing of his spoils to the highest bidder, without the trouble of reporting his discovery to the municipality and the certainty of having to wait for his payment, while the tourist who carries off such a treasure is probably quite ignorant of its real value, great part of which is derived from the locality where it was found. That Capri vase is possibly now lying forgotten in some dusty collection, whereas, had it been properly verified as coming from a palace of Tiberius, it would have been the most ancient known of its kind, and consequently highly interesting to the antiquarian and to all glass students.

To the age of Caligula, A.D. 37, may be referred some of the many cups embossed with figures of gladiators opposed to each other, with their names written beside each figure.[2] Fragments of such cups have been found in widely differing localities, some bearing the same names, some with different combatants opposed to each other. Similar cups have been found at Chavagnes, Vendée; at Chambery, and at Lillebonne, and also at Hartlip;

[1] Among the many bad actions recorded against Tiberius it is well to cite one good act; he sent back to Heliopolis the jet statue of Menelaus, which had been brought to Rome by a governor of Egypt.

[2] These gladiator cups are generally blown, and of common glass; possibly they were prepared before the combat, and the victors' names added afterwards.

and a fragment at Vienna gives similar names. It would seem that these cups must have been much prized by their owners, and carried with them far from Rome. These popular heroes were probably well known favourites, and their names have been immortalized by a more enduring "press" than ours. Possibly these cups were prizes, or were made in memory of some specially interesting combat. Among their fragmentary remains is found the name of Columbus, of the faction of Mirmillous, who, having been conqueror over a gladiator of the opposing faction of Thrace, was slightly wounded. Caligula, who violently supported Thrace, furious at this victory, had poured into the wounds of Columbus a poison which with cynical barbarity he called by the name of his victim, columbien. Caligula treated with the same cowardly cruelty another gladiator named Proculus, whom he compelled to descend into the arena to fight against the Thracian faction, but when Proculus was proclaimed victor Caligula caused him to be strangled, after exposing him covered with rags to the derision of the women. Any notion of fair play had no place in the mind of this despotic monster, who met a well merited fate at the hands of his own soldiers. Many glass cups have chariot races engraved on them, with the victors' names written above the figures. Our custom of giving cups for racing prizes seems to be derived from the ancient Roman sporting world. Glass must very soon have become plentiful enough in Rome to be cheap and consequently despicable; we read that Messalina, wife of Claudius, A.D. 41, openly sold the right of citizenship in Rome with such shameless indifference that report commonly said it could be purchased for two cracked drinking cups. Dion Cassius, a century later, repeats this accusation against the government of his day in nearly the same words; "the right of being a Roman citizen, once held so dear, has now fallen so low it is given to the first comer for a few cracked glasses."

The climate of Rome, so much more rigorous than that of Egypt, soon led to the invention of window glass.[1] Transparent substances of various kinds were used for this purpose, but very early in our era glass must have been applied to windows; of this the ruins of Pompeii afford many proofs. Besides using glass so much in their houses, it would seem the Romans understood how to apply it with advantage in their gardens, as Columella, an

[1] See chapter on Windows.

agricultural writer, A.D. 50, says, "if you want early cucumbers, you must put them during winter under glass, exposed to the sun." He also tells us how he infused bad wine, mixed with grapes, mustard seed, vinegar and salt, in a glass jar, besides mixing also, in glass, honey with onions and vinegar, but neglects to explain the use of these mixtures; he recommends, for the preservation of fruit and vegetables, straight bottles with wide mouths, and advises a number of small bottles rather than a few of large size. Many examples of these are found in Pompeii. Another writer, Vegetius, required a glass cask, to mix properly the thirty different ingredients of a certain medicine for horses; he gives the names of all the materials, and cites Chiron as the original inventor of the compound, so even in the days of Chiron horses must have been subject to ailments. Among these ancient recipes we are told that oxydized iron nails were to be kept in glass, for the cure of blear eyes. Roses were sometimes pounded with oil and wine in a glass jar, and placed in the sun to give them medicinal properties. Again we find that a certain plant was to be steeped with vinegar in glass, and used for making morose people gay; unfortunately the name of this useful plant is not given. The large quantity of glass manufactured in Rome may be inferred from the fact that many poor people made a living by collecting broken pieces, and selling them to be mixed with sulphur and used in soldering iron to stone. Deville says that sulphur is still used for this purpose, and it would be interesting to try a mixture of glass with the sulphur. Martial, Juvenal, and Statius all allude to this practice in their poems, so it must have been a well known habit among the "chiffonniers" of Rome. Sometimes this debris of glass was utilized, as it still is, by being melted up and re-made into common glass.

Nero, A.D. 54, who indulged in every luxurious taste that the Roman world could procure for him,[1] was an enthusiastic collector, and, passionately fond of glass, he encouraged the manufacture of large pieces of enormous price. In his day were made glass cups so light that they were called pterote, "winged," from their lightness, not from their having two handles. Nero gave £60 for two of these glasses, but the price diminished as they grew more common. Martial, A.D. 43, calls them "glass clouds"; many

[1] The magnificent palace he built for himself after the great fire of Rome had panelled ceilings and gilt walls, inlaid with gems and mother-o'-pearl, and Nero deigned to exclaim he was at last lodged like a man.

glasses are preserved in museums which are so light that, were the handles removed, they would be really the "nimbus vitreus" of the poet. Nero's example doubtless stimulated rich Romans to give extravagant prices for glass, crystal, and murrhine vases, to place on their tables at banquets. The bowl, supposed to be of murrhine,[1] which Petronius broke into atoms before his death, to prevent its falling into the hands of Nero, who would have inherited it, has been valued at £50,000. Nero placed the precious fragments under glass, and exhibited them to the people to excite their compassion, and to express his grievous complaint against fortune. He afterwards gave a larger sum of money for a smaller bowl. In a fit of childish rage on hearing of the revolt of Galba, Nero himself smashed two crystal bowls, "scyphi," engraved with subjects from Homer. This fact proves that the engraver's art was still flourishing in Rome. We repeatedly read that Nero, being short sighted, used to view the gladiators' combats through an emerald ("smaragdo spectabat"); this must have been hollowed out at the back, and thus have acted as a concave lens to assist him in watching the distant combat below, from his seat in the amphitheatre. There is little doubt his example would have been at once followed by all who were desirous of distinction. Seneca notices the use of a green beetle for the same purpose, as old engravers used emeralds to refresh their eyes when fatigued. Strabo had observed that at the end of a tube an object appears larger. In the Naples museum is a convex glass, found in Pompeii, of a pale green colour, one inch and three-quarters in diameter, with the edges ground as if for setting; with this glass were also found some engraved stones. Half of a similar glass was found in London among Roman remains; it has been conjectured that these glasses were employed in engraving the gems, and were therefore part of the artist's stock in trade, but Mr. King suggests they were meant to receive impressions themselves. Still it appears impossible to imagine that the finer gem cameos have ever been engraved without the aid of magnifying glasses, as it requires the help of a strong one to decipher the tiny names on some of them. Aristotle and Pliny both understood the faculty

[1] The passion for collecting expensive objects of art was perhaps greater in ancient Rome than it is even now; the murrhine vases accumulated by one senator, and seized after his death by Nero, were sufficient, when arranged as a spectacle for the people, to fill a large theatre in the palace gardens. The subject of murrhine is too long to be discussed here, all notices connected with it will be found in the chapter on murrhine and flexible glass.

possessed by both glass and crystal, when in the form of a sphere, of lighting combustible things. On the lighthouse of Alexandria one of the Ptolemies placed a telescope by means of which you could see ships a great distance off. This famous telescope was one of the seven wonders of the world. Arab writers assert that this telescope was not made of glass, but was a concave mirror 3 ft. 9 in. large, composed of a mixture of metals; but when we consider the extreme difficulty of translating with exactness technical terms into living languages, we perceive how much greater the task must be of rendering the dead ones correctly. Hipparchus says Pliny had invented instruments by which he could see and count the stars, and calculate their size, their distance, their phases, and their movements in space. In the Sevres museum is a small disk of pure white glass, cut convex; it has been judged an optical glass by experts; it was found in the tomb of Queen Berenice of Cyrene,[1] of the third century.

Wine used in the luxurious feasts of the Romans was principally kept in large clay amphoræ (of which hundreds have been preserved to this day). These amphoræ were carefully covered with gypsum, on which was inscribed the age of the wine, the farm where it was made, the name of the consul of that year; "O my amphoræ," says Horace, "born with me under Consul Manlius." That these amphoræ were sometimes made of glass we find from the "Supper of Trimalchio," where Petronius[2] writes; "then they brought amphoræ of glass, carefully sealed with gypsum, on the top of which was fixed the label with these words, 'Falerno of the consulate of Opimus, of 100 years.'" Some amphoræ have only "Dulce" stamped on them as if to define the quality. Bottles which have contained wine are found, stamped "Misce," mixture; the stamp "Mite Merum" is also known; sometimes only "M. D." is found on bottles, which may mean "merum dulce." Deville gives many of these stamps and suggests explanations; as "Ardite et R. M. D.," which may mean "Ardite, recondite

[1] Celebrated for the beauty of her hair, which she dedicated in the temple of Arsinöe, for the safe return of her husband from Syria, and which Conon of Samos says was turned into a constellation.

[2] Petronius Arbiter, though one of the dissolute companions of Nero, seems to have been a man of letters and worthy of better things; he opened his veins and died A.D. 66, and before his death sent a sealed paper to Nero, supposed to be his "Supper of Trimalchio," in which Nero and his court are held up to ridicule; one of the stories of flexible glass, in this work, is noticed in the chapter on murrhine and flexible glass.

merum dulce," "Pay attention and close this good wine." The immense extravagance displayed in the variety of perfume and cosmetic bottles used by Roman ladies must have been extraordinary. Juvenal describes a beauty of the day as so plastered with ointments, pomades, perfumes, and essences of all sorts, that you could scarcely tell if it was a face or a plaster you beheld; do modern belles follow such an example, or take warning by it? At the baths the Roman ladies took their own slaves and toilette apparatus with them, and doubtless rival beauties vied with each other in the profusion and variety of the perfume and ointment bottles they displayed.[1] Not only women but men also required quantities of these luxuries in their baths, where the rich surroundings were in accordance with any extravagance on the part of the bathers. Seneca's description of a bath has been already given. Statius, A.D. 61, in speaking of the bath of Etruscus (the son of a freedman), shows that the love of splendour had not diminished; "the chambers glitter, the ceilings of coloured glass reflect the forms and very sensations of those who enter." The large marble tazzi, about eight feet in diameter, called "labrum," such as the one now in the Quirinal, were originally the labra of public or private baths, and Baccius says some labra existed made of glass; they were probably used to throw cold water from brass or silver tubes on to the head of the bather. To the Romans the bath was a daily necessity; the sum it cost was so small that many persons bathed seven times a day, and boys under fourteen paid nothing. When shall we arrive at such a state of civilization?

These countless varieties of perfume and toilette bottles, after serving their owners during life, were generally buried with them in death, and it is to these funeral spoils we owe so much of our knowledge of the ancient world. All our principal museums display numerous examples of the singular wealth of fancy of these old workmen, whose artistic sense must have been highly cultivated. Besides the bottles which the mourners placed beside the cinders of their friends, we also find the goblets and cups with which they poured wine and milk on the funeral pile. Among the quantity of phials rescued from tombs some still contain a colourless liquid, possibly tears, as Ovid says, "the soft white ashes drink up the ointments mixed with tears." Some of

[1] See Plate III.

these are very small, hardly half an inch high. In the Louvre is one of these funeral bottles, wrapped carefully round with dried reeds, evidently to protect the precious balm within. Many of them have the name of the maker or of the essence they contained stamped on them; one bottle has a plant like a radish on it, and we know that essence of radish was once highly esteemed as an eyewash; sometimes the stamp represents a sick person in a chair, or a figure which may be the chemist distilling the balm. On bottles supposed to be for presents a heart and "Amor" is stamped; but whatever shape these essence bottles assume, the sides are always very thick, so as to make a good show while holding very little liquid, the mercantile spirit being much the same in all ages. One bottle found in Italy bears the stamp "Firmus Hilari Etylæ," and on the sides the drawing of a plant; a similar stamp has been found at Athens, which looks as if the essence or the firm making it were well known. Deville gives an ingenious interpretation; he thinks that Etylæ was a well known beauty, whose name was given to the essence, as we call scents after the names of Ninon, Phryne, and translates the stamp, "Firmus to the gay (amiable) Etylæ"; there are numerous other stamps known, which may be variously interpreted according to taste.

Romans drank hot or lukewarm water medicinally. Martial says to an advocate exhausted with pleading in the Forum, "Thou speakest much, and drinkest half turned away warm water in glass phials."

In the Beugnot collection is a small glass phial stopped with silver, and wrapped in a leaf of the same metal, and enclosed in a case of gold; within this dainty receptacle a young patrician Roman, following Nero's example, has deposited the first hairs of his beard.[1] The brilliance of glass excited the admiration of the old poets, "Candidior vitro!" they exclaim. The extent to which it was used may be inferred from the constant allusions to it in the poems of Martial, and Juvenal his contemporary. Every kind of marble now known and many which exist no longer for us, as well as every sort of precious stone, was successfully imitated in glass and made into every conceivable shape and kind of cups and vases at Rome, except those called "allasontes" with prismatic

[1] Lucian says at Hierapolis the young men, on the occasion of first shaving their beards, place the hair in boxes of gold and silver, and leave them in the temple, each with a name on it: "My hair and my name on it are still in the temple."

colours imitating the opal, which came from Egypt only. Among the enormous variety of cups the Romans had at their command were the myriad patterns of mosaic afterwards called "mille fiori," formed by cutting slices off prepared rods, and moulding them with melted glass of a different or a transparent colour into any shape required. As much ancient glass is a great deal harder than modern, may not this have been done by making the slices forming the pattern of very hard glass, and the transparent body of the cup of glass that would fuse at a much lower heat.[1]

These cups were often afterwards fashioned on a wheel, to finish and refine their shapes. Some were made in patterns like madrepores, some successfully imitated the pulp of an orange, others were made entirely of "vitro de trina," threads of opaque white or yellow glass twisted in rods of clear glass, and the cup formed by welding together the rods so made, as may be now seen any day at Murano; but this kind never approached the perfection of Venetian latticelli glass.[2] Many particoloured cups were edged with a border of vitro de trina, some were moulded and afterwards very skilfully undercut, or blown and then pinched into ribs as pillar-moulded glass, which was thought quite a modern invention till fragments were dug up in London, Boulogne, and many pieces found in Rome, thus affording another instance of "ancients stealing our ideas." There was an entire vase of this kind at the Polytechnic, and several in the British Museum; masques and ornaments were added to the handles, bearing the makers' names, as in the Sidon cups. Another common variety was transparent brown, and orange or violet glass, mixed with opaque blue and white, in lines and waves to represent agate and onyx; these are imitated with marvellous fidelity; sometimes the last shade of yellow was put in with gold leaf to heighten the effect. The modern reproductions do not equal these in beauty. Mr. Dodwell was the first to form and bring into notice a collection of glass fragments of cups found in Rome; repolished, they seemed like rare and unknown agates. In the hands of lapidaries in Rome, as well as in many private collections, may be seen necklaces and ornaments made from these

[1] A perfect reproduction of a vase in this style made at Murano is in Sir W. Drake's collection; but the great expense, anxiety, and trouble connected with its manufacture (when commenced it cannot be left for a moment, however many hours its manipulation takes) would prevent articles of this kind ever becoming common.

[2] See chapter on Italy.

fragments that are indescribably beautiful; it was the extreme richness of colour in these ornaments which first drew the attention of the writer to the subject of ancient glass. These wonderful combinations of hues were multiplied till the fickle Romans began to weary of their very beauty, and prefer drinking from plain glass so pure it was difficult to tell it from crystal. The crystal glass brought from Egypt had a greater tendency to crack when touched by hot water than the kind made in Rome, a fact Martial notices in his Calices: "we are no common wrought specimens of mere glass, nor is our jewel work broken by hot water." The same author tells us cups were made in three ways in Rome: first, by blowing into a mould or otherwise; second, smoothed and polished in a lathe inside and out; third, cut in basrelief as a cameo. Romans complained that the foreign glass "threw out a light growth of saltpetre," and preferred blue glass as it was more free from bubbles and never threw out a salt. The "diatreta" of Martial were glass cups cut or engraved either by the wheel or the hand; these elaborately wrought cups were so difficult to make, and accidents were so common,[1] that jurists found it necessary to define accurately the circumstances under which the workmen became liable for the value of the vessel destroyed or left unfinished. "Here you see the skill of old Nile, making cups so exquisite that the author in trying to add a new beauty often spoils them." The fear of breaking these expensive glasses took away from the pleasure of using them, and poets, who are rarely ignorant of how to enjoy themselves, preferred common ones: "Young slave, take away these chiselled cups from burning Egypt, and give me, with a hand that has nothing to fear, ordinary drinking glasses!" But though much glass came from Egypt a great deal was made in Rome. Very early in the Christian era glassmaking had become so important an industry that an imperial edict assigned to the artisans a special quarter near Mons Cœlius, next to the carpenters. "Though the Nile boat brings you your glass cups, mine are bought in the Flaminian Circus." It is Plutarch who tells us that "tamarisk wood is the best for the glass furnace." The quantity of glass used in Rome must have been incalculable, even the poor people had plain white glass which was very cheap;

[1] Dr. Pantohsck, of Hungary, sent to the exhibitions of Paris and Vienna an imitation of a diatreta vase, the only one he succeeded in finishing, after breaking thirty-four.

Juvenal writes, "a slave will present to you these glasses of the people, bought for a few as;" and Martial says, "it is of no account, Flaccus, if you break this glass." Tacitus the historian, A.D. 80, says that deformed or broken cups were called glasses of the cobbler of Beneventum, in allusion to Vatinius, a deformed and contemptible person who, from a cobbler's stall, passed at once to court and the favour of Nero. Martial and Juvenal both allude to this court favourite. "Receive these glasses, vile remembrance of Vatinius the cobbler, the beak being too long"; and, "Thou shalt empty this glass, being named the cobbler of Beneventum, all broken, and already claiming its mixture of sulphur." The four-lipped cup of Juvenal refers to the same man. Some cups were encrusted with "specillata patinæ," to take the place of the jewels with which Romans loved to decorate all their surroundings. Some are found of the same form as those now used to feed children and invalids with, and were probably used for the same purpose. Some cups had serpents twisted round them in such a manner that the head touched the lips of those drinking from them. Martial alludes to these when he says, "Serpents on thy glass! you think you are drinking wine, you are drinking poison," which might be a motto for a temperance lecturer. Nero himself never drank anything but iced water, which had been previously boiled and congealed in glass; and it is to this habit he alluded in his last words when, flying from his pursuers, he saw himself reduced to drink the water of a muddy pool, "This then is Nero's potion." The continual references to glass in the poems of Martial and Juvenal are alone sufficient to prove how general was its use in Rome early in our era, as both these authors died in the first half of the second century. But more unquestionable evidence, were such required, is furnished by the testimony of the many thousand glass articles rescued from Pompeii and Herculaneum.[1] These cities were destroyed by a great eruption of Vesuvius, A.D. 79, during the reign of Titus, when Pliny the younger was eighteen years of age, and his earliest writings describe his experience of the eruption. His works are full of allusions to glass. In his "Natural History" he explains the mixture of nitre and magnet stone in its manufacture (Beckmann supposes this to be manganese), and adds: "In a similar manner too, brilliant stones of various descriptions came

[1] See chapter on Pompeii.

to be added in the melting, and then shells and fossil sand; some authors tell us that the glass of India is made of broken crystal, and that in consequence none can be compared to it. It is fused with light dry wood, Cyprian copper[1] and nitre being added to it. It is melted like copper in adjoining furnaces, and the masses it forms are of a swarthy unctuous appearance. These blocks are again fused in the furnaces, and there their colour is given to them. The glass is now either blown into forms, or turned in the lathe, or engraved as silver is. This was the ancient mode of making glass. But now the white sand, which is very soft, found at the mouth of the Volturnus in Italy, and which extends for six miles along the shore between Cumæ and Liturnum, is pounded with a pestle and mortar. Then it is mixed with three parts by weight or measure of nitre,[2] and when fused it is passed into other furnaces. There it forms a mass called 'ammonitrum,' and this again is melted and becomes pure white glass. And at the present day in Gaul and Spain sand is treated by a similar process." It is to Pliny we owe a recipe for mending broken glass which is still in use, "white of egg mixed with quicklime is the best material for this purpose." He had noticed that glass balls exposed to the sun's heat will set your clothes on fire. Pliny speaks with admiration of a beautiful opaque blood-red coloured glass[3] called "hematin," also of white, murrhine, hyacinthine, and sapphire colours, besides some of the very deepest black, like Ethiopian obsidian, which was used for making dishes on which to serve food; black seems to have been a favourite colour for dinner services since the days of Numa. Rome made great strides in making large pieces of glass in imitation of obsidian. Pliny, when alluding to the statue of Augustus and the four elephants in the temple of Concord, made in this material, says they were considered as miraculous. The glass which approached the nearest to the purity of crystal was the most esteemed, as to make glass quite free from bubbles and imperfections requires long fusion in large furnaces, and as the Romans made it in small factories it was generally full of impurities. Much glass was made in Rome by amateurs, which would account

[1] What Cyprian copper means has never been accurately settled.

[2] There must be some mistake in this quantity; such a recipe would make very defective glass.

[3] The Louvre has lately acquired a small hematin vase, found at Constantine. The Gauls used this colour to enamel bronze; we are not yet in possession of the secret of this shade of red.

for a great deal of its imperfection; they did not hold with Cicero, who echoed the old pure-blooded Romans in saying, "all workmen exercise an ignoble profession." Still, with all the difficulties of manufacture, crystal was so beautifully imitated that it was astonishing the value of real crystal did not diminish but seemed to augment. A crystal bowl sold for £1500. The imitation almost expelled real crystal, however, from use at banquets, as both host and guests were more at their ease with the less expensive material. Pliny says in his time glass drinking cups had quite superseded those of gold and silver, but he still, with all this activity of glassmaking in Rome, calls Sidon "artifex vitri"; he tells one of the many stories relating to flexible glass, and also explains that there was a great difference in engraved glass between the mechanical work of the wheel and the manipulation of the skilled artist, a distinction we might expect from a man of Pliny's quick observation. He speaks of filling in the roof of the temples with glass, to give more light, and when describing the theatre of Scaurus says: "in the baths which King Agrippa built at Rome" (Agrippa also built the Pantheon about 60 B.C.) "he coloured the plaster work with encaustic, and adorned the rest with stucco. Doubtless he would have lined rooms with glass panels had they been then invented." Yet it is Pliny who says, "we invent nothing new, we do not even attain to the height of old inventions." After speaking so much of the profusion of glass made he says: "still, with all this luxury of glass, amid all this wealth, in sacrifices libations are not made from murrhine or crystalline, but from earthenware 'simpuvia,' the greater part of mankind use earthenware." The Greeks believed that the amethyst preserved its wearer from drunkenness (the Hebrews thought it caused dreams); Pliny says the idea arose from the jewel approaching the colour of Falernian wine without quite reaching it. Possibly it is to this superstition we owe the many fragments of violet drinking cups found in Rome. Violet or purple seems to have been the most favourite colour for the ground of the "mille fiori" vases. Among the various colours usually found in any collection of Roman glass are generally eight or ten shades of blue, usually opaque, varying from lapis to turquoise; there is one beautiful shade of transparent sapphire, several different tints of green opaque, some violets, very few reds and those not pure or brilliant in colour, and some opaque yellows and oranges.

The art of the Roman workmen had now succeeded in giving the greatest possible variety and richness to the form of their cups in engraving, enamelling, and colouring their numerous drinking vessels, which gave them great wealth from the exorbitant prices they demanded for their wares. Opalescent glass seems not to have been made in Rome, as Hadrian, A.D. 117, when he visited the busy glassmaking city of Alexandria, sent home to his brother-in-law Licinius two valuable drinking cups given to him by an Egyptian priest, which he calls "calices versicolores," telling him to give them to his sister, and only to use them on great feasts and solemn occasions. Though the Romans may have been unacquainted with the art of making opalescent glass, they practised all the other processes, they knew how to colour with oxides, to make pure glass like crystal, to enamel by laying on colours with a brush and applying just the right amount of heat to make them adhere, without penetrating the body of the glass. Though few examples of enamelling have been preserved, enough remains to show that the Romans understood the art, and when we remember that enamel colours corrode more easily than ordinary glass on account of their containing more metallic oxides, and nearly all Roman glass is found buried in damp ground, it is not surprising that but few specimens still remain. Two cups found at Vaspelev in Denmark are decisive examples.

Apuleius calls cameo glass "skilfully ornamented glass"; he is probably the same person who in Hadrian's time used to place large glass goblets on his festive board, mingled with those of gold, silver, and crystal. The poet Lucian, A.D. 150, tells a singular story of the death of Servianus; he was three times consul, and married a sister of Hadrian's, but was put to death with his grandson in his ninetieth year by Hadrian lest they should aspire to the crown. "Though many have met their death from too close acquaintance with the linings of their cups, the singular mode pursued by Servianus may be worth notice. It happened that he possessed very large goblets of the finest glass. Now when he was assured that there was no hope of living left him, he broke the largest of the bowls, and using one of the fragments made an incision in his throat with the broken glass. So without dagger or lancet his death was worthy of a man and a hero." The emperor Verus, A.D. 161, had the singular taste of flinging large pieces of money about in the wineshops of Rome, during his nocturnal orgies, that he might have the amusement of hearing

the glasses break ; this imperial trait shows us that glass was used in the small taverns of Rome. Verus is said to have admired very thin glass, and always himself drank from a remarkably light glass, calling it Bird, a name he also gave to his favourite horse from its light swiftness. To this reign may be referred a singular marble inscription found at Rome respecting the game of glass balls. The great expertness of Romans at this game is alluded to by Quintilian, A.D. 40, who says, "it is miraculous at the game of ball to see the balls returning as of themselves to the hands which have thrown them, and travelling as commanded." [1] The inscription is as follows : "It is I, Ursus Togatus, who first played with talent the game of balls of glass, to the applause and acclamations of the people in the baths of Trajan, Agrippa and Titus, and often in those of Nero. It is I ; unite yourselves, players of the ball, cover with flowers the statue of your friend, pour out the dark Falernian, sing in chorus the old professor of the ball who has vanquished so brilliantly his predecessors with a skill without rival. But I must allow I have been beaten in my turn by Verus, three times consul, my patron, not once but many times." [2] These eccentricities of Verus must have scandalized the grave Marcus Aurelius, his associate on the throne, who was so careful of the state funds that he sold by public auction vases of the imperial service. St. Clement of Alexandria, A.D. 180, is the first Christian bishop who anathematises the growing luxuries of the day, especially in glass work ; he uses no unsparing hand. "This passion for all sorts of glass only belongs to fools ; yes, this pretentious useless vain glory of engraving on glass, which tends to nothing but to break them and cause to tremble those who carry them to their lips, ought to be crushed by our institutions." This stinging anathema made little impression on the studios of Alexandria, which continued to make and send out richly worked glass. The earlier poets compared their favourite fountains to the brilliance of glass ; somewhat later the simile was transferred to the eyes of a beauty ; thus Philostratus, A.D. 200, writes to one whom he desired to please : "Your cups are of glass, but in contact with your hands they become silver ; when you take them with three fingers, and

[1] The maidens called arrephai who lived in the temple of Athena at Athens had a space round their habitation for their "sphæraistra," or place for playing at ball ; the game was considered part of the education of old.

[2] Ambrosius, A.D. 340, and Claudian, 395, both speak of glass balls used for entrapping wild beasts. Can this have been a sort of lasso ?

lift them to your face, the glass takes an inexpressible light but cannot efface the brilliance of those eyes." Lampridius tells a story of the emperor Heliogabalus, A.D. 218, who wishing to play a joke on some of his parasites invited then to a great feast, (the extravagant gluttony of these feasts was renowned in Rome,) and placed them at a table covered with meats and fruits of the most rare and beautiful kinds, but they were all formed of glass of the most perfect imitation, which left them dying of hunger; to complete the joke, they were invited to wash their hands after this Barmecide's feast. The same tale is told in another form, in which the imitations are of pottery.

The wise and moderate sovereign, Alexander Severus, A.D. 222, always drank from plain glass himself, only exacting that it should be pure and brilliant; he also used small glasses at his feasts, even to drink the health of his hero Alexander the Great, unless the guests expressly demanded large ones. The important guild of glass workers were known under the name of Collegium Specularium; the commonest things they made were utensils for the table, and these glass vessels were placed in the inventories among the most precious furniture, for Paullus, consul in this reign, tells us "they used earthenware, wood, glass or brass, even as household furniture. Glass dishes and drinking cups are included under furniture, just as earthenware is, and not only those of the common sort but those of high value also." The "vitriarii" ranked with the guilds of carriers, coachmakers, gold and silver smiths, and other artisans, whom Lampridius tells us A. Severus taxed in order to raise money for his baths. This tax, which existed in the time of Aurelius and long afterwards, was a sort of ancient excise, highly injurious to industrial art, and was probably one of the causes which led to the ultimate removal of the factories from Rome. It was in the (supposed) tomb of A. Severus and his mother, opened in 1644, that the well known Portland vase now in the British Museum was discovered. The tomb was about three miles out of Rome, and the vase was at first supposed to be formed of a single sardonyx; it was only on closer inspection it was found to be made of dark blue glass, with exquisite cameo-like figures carved out of a superimposed layer of opaque white. The Portland vase is always referred to as the most beautiful known specimen of the glass engraver's skill; a careful description of it with its modern copies is given in the chapter on cups.

Though discovered near Rome there is little doubt the Portland

vase is due to Greek and not Roman skill, and should be ascribed to an earlier date than A. Severus. The Naples vase, of precisely the same style of workmanship, was entombed in Pompeii in A.D. 79, and we have no proof it was then a new vase; this style of vase probably belongs to the best period of Greek art, and, costly though they must always have been, they were by no means uncommon, judging by the numerous fragments met with in the hands of dealers, among the countless pieces of buried glass which the yearly tillage of the ground around Rome yields to the peasant. Though the crop, if we may so call it, is not so abundant as it once was, the soil is still rich in treasures. A few years ago the writer collected a quantity of fragments, principally from tobacconists who exchanged their wares with the contadini for antiquities, and the glass pieces were arranged in bowls according to size, and sold at very moderate prices. The market women in the Navarino also rarely failed to have a little store of "cosi antiqui," ready for inquirers. What the original quantity must have been may be guessed at, when ages of research have failed to exhaust that teeming treasurehouse, the soil of Rome. Among the fragments of cameo glass thus discovered, a few pieces are found in which two or three layers of colour have been used; the most common sculptured layer is however milk-white, and the ground usually blue, either transparent or opaque; sometimes it is brown, and in a few cases so dark as to appear black. Besides vases, larger pieces are to be seen in museums which have aparently been slabs used for decorative purposes. Gallienus, A.D. 260, though he himself only drank out of golden cups, refusing to use glass than which he thought nothing could be more vulgar, yet found when he wished to send a present to his friend Claudus nothing better than ten Egyptian glasses worked in different manners. How little the world has changed! do we not now select a dozen Venetian glasses, all worked in various manners, for wedding or birthday gifts? It was Salonica the wife of Gallienus, who was cheated into buying a false pearl by a fradulent trader on whom her husband took so whimsical a revenge. The ordinance of Aurelian, A.D. 270, that glass should form part of the Egyptian tribute, shows conclusively that the Roman factories were unequal to the task of supplying the demands made on them, and that the manufacture of glass in Egypt and its importation into Rome still continued in the latter half of the third century. The historian Vopiscus, who wrote the life of Aurelian in A.D. 291, and also that of Firmus the

friend and general of Zenobia, says of Firmus that his extravagance excelled all who went before him. "Many stories are told of this man's wealth, for he is said to have covered the walls of his rooms with squares of glass, fixing them by means of bitumen and other plastering, and to have possessed so many manuscripts that he often declared in public that he could provision an army with his papyrus and glue." Vopiscus also relates of the emperor Tacitus, A.D. 275, that he "vehemently admired curious and delicately worked glass," and though an instructed man of letters he had a passion for grotesque shaped and much undercut glasses; to his age probably belong the vases in the form of grimacing heads and those covered with large tears found in tombs, also the very tiny ones in the shape of a bunch of grapes,[1] dried dates, and analogous forms. This emperor of eccentric tastes had the good sense to be proud of his descent from the historian Tacitus, and was so anxious to preserve his writings from oblivion that he had them all copied ten times every year and placed in public libraries. In 354 St. Chrysostom says that rich people put beautiful glass on their tables; and if to conform to the extravagance of the time they used silver vases, they took care the interior was lined with glass. They were not content with plain glass, but had elegantly shaped handles with spiral and serpentine ornaments. The impost laid on the glass trade, or perhaps the little esteem in which the manufacture was held under Gallienus, seems to have damaged the factories. It was laid down in the Coda Theodosianus that "we enjoin that the artificers of the trades comprehended in the annexed schedule, tarrying in whatsoever city, be excused all public burdens; if indeed their leisure be spent in thoroughly learning their crafts, that they may be the more eager both to become themselves more skilful and instruct their children." The glassmakers appear in the number. Winckelmann thinks that far more glass was used in the old than in the modern world, and when the quantity of specimens left are considered this does not seem an exaggerated assertion. The notices of pavement and wall panelling will be found under mosaic; the fragments of cups and vases are countless, and besides these an enormous quantity was required for toilette and funeral purposes, for games, children's toys, rings and ornaments, window panes, and water clocks and hourglasses. A

[1] See Plate III. 12, 14.

Roman hourglass containing sand was found near Mayence in 1846 with fragments of the bronze capsula by it. It is certain that larger prices were given for exquisite glass objects in those days than in ours. The brilliant success of the Roman factories excited the envy of the provinces in Gaul, Spain, and Britain; we find the Romans carrying their accustomed luxuries with them[1] wherever their victorious arms penetrated; and introducing the manufacture of glass wherever the materials could be found to feed their factories, they searched far and near for means to make them flourish. It may be noted that those nations who to the possession of materials added the greatest knowledge of chemistry were those who rose most surely to eminence in the manufacture. But in all cases the most recherché processes of the art appear to have been transmitted by uninterrupted tradition from the earliest workers till they were forced to take refuge from barbarian invasion in Venice. The arts followed the fate of the empire, revolution which enfeebled its splendour was fatal to them. Glassmaking and enamelling, both born in Egypt and communicated to Greece and Rome, were transplanted to Byzantium and then destroyed, or hid themselves from the barbaric hordes who overran Europe, and reappeared in later and more tranquil times.

[1] Fragments of the same pattern both in moulds and colour are found at so many places in Gaul and Britain, that it is difficult to imagine they were not all made at the same factory.

ASSYRIAN.

"We need never indeed be startled at finding Aryan analogies in examining the old Babylonian terms, for there is abundant proof of a primitive Aryanism anterior probably to the development of the Sanscrit in the construction of the cuneiform alphabet.—*Prof. G. Rawlinson's notes to "Herodotus,"* vol. i.

IT would be impossible to say when the art of glassmaking was first introduced into Assyria. Millions of small glass objects, ornaments, amulets, etc., were early exported from Egypt to Nineveh, Persepolis, and other great cities. We find traces of vitrified glazing, showing advanced knowledge of the art, in very ancient buildings. Glazed and enamelled bricks, or tiles, glazed on the narrow edge with small patterns, are found in Nineveh; one now in the British Museum represents a sandalled foot indicating a figure twelve inches high. Whole walls at Nineveh were composed of enamelled tiles, forming a mosaic pattern of considerable dimensions. Their flux and glazes are made of silicate of soda with lead, coloured by metallic oxides. Corbels of blue faience are found among the same ruins, also glazed corbels like an extended hand, inscribed with the name and titles of a king. Glazed architectural ornaments were common to both Assyrians and Babylonians. Ctesias, 401 B.C., says: "three circular walls at Babylon were ornamented with glazed ware, representing animals highly coloured, the hunting and warlike exploits of Queen Semiramis and her son Ninyas." Bricks still found there confirm this account. M. Oppert found numerous fragments of glazed bricks, blue, white, yellow, black, and a few red, the ground vitrified and very hard; these fragments had evidently formed part of a large design, which seems to have been slightly modelled in the clay before it was glazed, many white letters on a blue ground appear to have formed a frieze round the hunting scene; he gives an inscription from the tower of Borsippa, in which Nebuchadnezzar says, "I have written in the frieze of the porticos the glory of my name." In an inscription now in London the same king says, "I have

ornamented the doors all round with writing, and drawing, made in glazed stone." The palace doors were no doubt ornamented with a garland of glazed bricks round the roof, in the same manner as two doors in a palace at Khorsabad built by Sargon, where M. Place found the roof of the gateway still decorated with blue and white glazed bricks, on which were portrayed bulls and lion killers. M. Thomas was fortunately able to copy this design before the destruction of the roof. Another inscription, in London, announces that "Nebuchadnezzar has restored the pyramid, and the tower, with gold, silver, precious stones, glazed bricks, and perfumed wood of rare kinds." M. Oppert opened some tombs at Tell Amran, in which he found many glass objects, chiefly small vases, jewels, and children's toys; he thinks they belong to the Parthian age. In a temple at Warka (ancient Ur of the Chaldees: Gen. xi. 31), Babylonia, Mr. Loftus found glazed tiles, with stars having seven rays; their colours were black, white, yellow, blue, and green; he also found there a pavement of vitrified slabs, and many glazed terracotta lamps. Warka would seem to have been the necropolis of Babylonia, as whole mountains of coffins are still reposing there; these coffins are of a curious slipper shape, and closed with a lid; they are made of earthenware, glazed with a blueish green enamel, the sides are ornamented with stamped figures of warriors (see British Museum; case 62), Mr. Loftus assigns them to the Sassanian[1] period. Mr. Layard brought from Nineveh many small glass objects, now in the British Museum; among them a seal of Sennacherib, portions of a glass statue, and some beautifully iridescent bottles from Kouyunjik.

Bricks recently found at Hillah bear the name of Nebuchadnezzar, 600 B.C. Like all ancient conquerors it was the habit of the Assyrians to carry off, besides captured treasures of art and wealth, all the most skilful workmen from every country they subdued, and they probably collected expert artisans from all parts of Asia and Egypt. They must have been acquainted with the art of inlaying, as blue glass, lapis lazuli, and other coloured substances are found let into ivory tablets from Nineveh. The first glass found in Nineveh by Mr. Layard had the name of a Khorsabad king on it; this vase was unfortunately lost or stolen at Bombay. It was not till his second visit in 1852 that he discovered the

[1] Word derived from Sasan, the father of Artaxerxes, a native of Persepolis, about A.D. 229.

greenish glass bowl now in the British Museum bearing the name of Sargon, king,[1] with a winged lion; this places the date 722 B.C. and is the oldest known specimen of transparent glass as yet discovered, none from Egypt being it is believed earlier than the Psamettici, sixth or seventh century B.C. The Sargon vase has been blown in one solid piece, and then shaped and hollowed out by a turning machine, of which marks are still visible.

At the same time were found two larger vases, of alabaster, both inscribed with Sargon's name; they were probably all used for holding ointment or perfume. With the bowl was also discovered a rock crystal lens, with opposite concave and plain faces; it seems to have been ground on a lapidary's wheel, and has been conjectured to be an early specimen of a magnifying or burning glass. The focus is small, only four and a half inches; but whether this particular lens was a magnifying one or not, it appears certain the Assyrians must have known and used some kind of magnifier from the fact that several of the inscriptions found are too minute to be read, so could not possibly have been formed without the aid of some kind of magnifying medium. The lens was discovered buried under a heap of fragments of beautiful blue paste, apparently the enamel of an object that had perished. Blue glazed pottery, and many glass bottles and vases of the usual elegant shapes, were also discovered on the mound, some coloured, some ribbed or otherwise ornamented. Analysis of this coloured glass shows a knowledge of chemical science we might expect from a people so closely connected with Egypt and Phœnicia as were the Assyrians.[2] Prof. G. Rawlinson thinks "the art of Assyria has every appearance of entire nationality; the habit of borrowing skilled workmen would introduce into the royal city fabrics from every nation who owned her sway, but we may fairly assume that the bronze vases, glass bottles, carved ivory, engraved gems, jewellery, arms, etc., were the handiwork of Assyrians."

[1] The antiquities lately sent from Lake Van, Armenia, to the British Museum by Mr. Layard chiefly consist of the bronze architectural ornaments of a palace; their value is enhanced by the fact that they are the only relics at present discovered of the art of that kingdom. Among the inscriptions not as yet wholly deciphered appears the name of a king given by Sargon as one of his opponents. If this is the same Sargon whose name is on this vase, it would fix the date about the same time. The city of Van, or Mennai, mounts to a very high antiquity, having certainly been in existence in the tenth century B.C. It was the people of Van who in conjunction with the Medes overthrew Nineveh, 609 B.C., and put an end to the Assyrian empire.

[2] Among those who traded with Tyre in blue cloth and broidered linen were merchants of Asshur or Assyria. (Ezek. xxvii. 24.)

There is undoubtedly much Assyrian art among the Cyprus treasures, but it is difficult to separate it precisely from Phœnician, or to assign a priority to either, as both nations were from remote times skilled in industrial art. In the ruins of the palace of Babylon at Kars were lately discovered vases and bottles of gilt glass, supposed to be of Assyrian origin. Among the ruins of Nineveh M. Botta found a round glass bottle or phial, ornamented with oblong black spots melted into the glass; the same kind of tear-sown bottles were afterwards made at Pompeii, and many centuries later Venice gained renown by her celebrated "gaufres de Venise," which only reproduced the older work; but as it was clearly impossible for the Venetian workmen ever to have seen the Pompeiian or Assyrian glasses, it was probably in all three cases a legitimate invention, only another instance of "ancients stealing our idea." Modern travellers speak of the ground for a mile round Hillah as a mass of broken pottery and glass, and Mr. Layard says: "on all sides fragments of glass, marble, pottery, and inscribed bricks, are mingled with that peculiar nitrous and blanched soil which, bred from the remains of ancient habitations, checks or destroys vegetation, and renders the site of Babylon a naked and a hideous waste."

The Italian author Perrini and some others have attributed the invention of glass to the vitrification of the bricks used in building the tower of Babel, a fact which would not escape the notice of the children of Noah, and scattered over the world they would carry the knowledge without one nation more than another being positively the inventor. Arts only grow up gradually. Carrying on this idea it may perhaps be interesting to give a glance at the accounts of that imposing ruin on the west bank of the Euphrates which tradition and history alike unite in calling the tower of Babel. In describing this ruin Sir R. Porter says: "that the first stupendous work was suddenly arrested before completion, we learn, not only from Scripture but from many ancient authors; while heathen traditions support the facts, all agree in stating that the primeval tower was not only stopped in progress but partially overturned by thunder and lightning. To Nimrod is ascribed the first foundation of the city with its mountain tower, not two hundred years posterior to the deluge. After its desertion by the son of Cush we hear no more till Semiramis, widow of Ninus,[1] rebuilt the city; but the temple of Bel or Belus

[1] Mythical founders of the Assyrian empire, about 2182 B.C.

was not erected in its renowned state till Nebuchadnezzar, early in the sixth century B.C. Probably Nimrod[1] has been worshipped on the same spot ever since the deification of its first founder. The cement holding the bricks of the ruin together has become so hard that nothing can separate them. Masses of fine brickwork of an immense size are lying on the ground, changed to a state of the hardest vitrifaction. In many may be traced the gradual effects of the consuming power which has produced so remarkable an appearance, exhibiting parts burnt to that variegated dark hue seen in the vitrified matter lying about in glass factories; while through the whole of these awful testimonies of the fire (whatever it was) which doubtless hurled them from their original elevation the regular lines of the cement are visible, and are so hardened in common with the bricks that when the masses are struck they ring like glass. The base of the ruin near these masses is quite free from such changes, and in its original state; whence I draw the inference the consuming power acted from above; the heat from its amazing effects must have burnt with the force of the strongest furnace; and from the general appearance of the cleft in the wall, from which these vitrified masses have fallen, I should be inclined to attribute the catastrophe to lightning from heaven." It is singular that the more modern brickwork of the temple of Belus is quite distinct from that of the ruined tower. There must have been an observatory on this spot from very remote ages, as Prideaux says: "when Alexander conquered Babylon, Callisthenes the philosopher who had accompanied him found among its learned men astronomical observations from 1903 years back, 2233 B.C., to that very time. This testimony Callisthenes is reported to have sent to Aristotle. Berosus (contemporary with Alexander) says: 'a great tower was erected there, and the winds assisted the gods in overthrowing the city. The gods introduced a diversity of tongues among men, and the place was called Babylon on that account,' its name being a Greek form of the Hebrew word 'babel,' which means confusion." Herodotus, who visited Babylon, describes the tower of Belus as still existing. Many other ancient authors describe Babylon as of immense size, and Benjamin of Tudela, A.D. 1160, describes the ruined tower of Babel struck as he says by lightning from heaven, and surrounded

[1] His name in Hebrew signifies "rebellion," and he was called Bel or Baal, Supreme Lord, by the Chaldees.

by traces of buildings and streets for thirty miles. Emanuel de St. Albert, about 1620, saw the tower of Babel and mentions the fallen masses of brickwork, so vitrified that it was impossible to separate a single brick from the mass. The extreme interest of this subject will I think excuse the length of these extracts, though some authors now are of opinion that Belus was not Babel.

HEBREW GLASS.

"A knowledge of the law is difficult to acquire, and is as easily lost as brittle glass."—*Talmud, treatise Chagigah*, fol. 15 a.

FLAVIUS JOSEPHUS says the art of making glass was discovered by some Israelites, who set fire to a wood and soon found the heat became so great that it melted the sand and made it pour down the mountain. Thence arose the power of making artificially what had been done accidentally.

Michaelis, writing in 1754, when those wonderful sealed books of antiquity, Egyptian tombs, were little known, also attributes the invention to the Hebrews and cites many passages of Scripture to support his assertion. He says the word translated "crystal" in Job xxviii. 17 [1] is *zechuckith*, which all learned rabbis before Christ interpreted as "glass," saying they never had another word for it. St. Jerome translates it "vitrum." Syrian, Greek, and Latin versions render the word as glass, and Scott considers our version "crystal" as questionable. Some interpreters use the word "diamond," thinking it means something very precious; but though glass is now cheap and plentiful it was not so always, in old times vases of glass and crystal were rare and costly; besides, before people knew how to polish diamonds they were probably not so much esteemed as they are now. It is on the shores of Palestine, near Tyre and Sidon, that traditions older than history, all relating to glass, cluster thickly. They especially cling round the river Belus, whose fabled waters rising from mount Carmel flowed in a deep and sluggish stream down to the sea near Ptolemais. This sacred river, consecrated by many religious rites, was thickly charged with pernicious mud, and poisoned man or beast who drank of its turbid waters. The name Belus, [2] known to us

[1] Job is supposed to have been anterior to Moses; some authorities place him later, and say the name typifies "suffering Israel."

[2] Belus, a son of Poseidon; he was the ancestral hero and national divinity of many eastern nations, from whence his legends became transplanted and mixed with Greek myths.

through many classical authors, does not occur in the Bible, but it is Hebrew, and possibly derived its name from the running together of its sand into glass.[1]

If it was not nameless among the Hebrews it is probably referred to as Sichor by Josephus, when he describes the boundaries of the tribe of Asher.[2] Some think the name Sichor (also given to the Nile) was applied to it from its abounding with crocodiles, more probably from its turbid stream (Jer. ii. 18). Shaw gives its modern native name as "Kar-Dana," perhaps "unhealthy river," from its muddy waters. Pliny says "there is in Phœnicia near the foot of mount Carmel a marsh called Cendivia, the river Belus takes its rise from this place." Michaelis believes the Cendivia of Pliny to be identical with the waters of Megiddo of Scripture. When Isaiah speaks of "the seed of Sichor, the harvest of the river is her revenue" (Isa. xxiii. 3), and when Moses giving the blessing to Zebulun and Issachar says, "they shall suck of the abundance of the seas and of treasures hid in the sand" (Deut. xxxiii. 18, 19), do they not allude to glass? Jacob promised Zebulun some profit from ships and commerce (Gen. xlix. 13). Jonathan and Salaman ben Isaac say: "the tarith (a fish) and the white glass, products of the sea and the sands, these were in the lot of Issachar and Zebulun, as has been said in the tract Mezillah." The passage is in fol. 6. 1, and there they say the Rabbi Joseph explained the "sands" so extolled by Moses as referring to "white glass." By "the hidden treasures of the sand" Jewish interpreters all understand "glass," and regard the making of glass as one of the three benedictions promised by Moses to Zebulun. This universal tradition of Jews can only be explained by the announcement of Moses to this tribe, and the glassworks which from time immemorial were established on their shores. Old authors agree that the sand of Belus traversing the land of Zebulun was the best known for making glass. Moses must have been acquainted with the invention when he instructed the Zebulunites in the riches of their land; these knew of it also, as they comprehended

[1] For Belus, which would be Bel in Hebrew, בל, has evidently taken its name from "pouring out." And this true and primary signification of the verb בלל, which afterwards gave us the word "confusion," is often found in Hebrew Scriptures. Ps. lxxii. 12; Exod. xxix. 40; Lev. ii. 5, 7, ix. 4.—*Commentarii Soc. Göttingen*, tom. iv., p. 302.

[2] One of the Arabic names for glass is *aser*.

perfectly well in this sense the words of Moses, and established large glassworks in their country (or carried on those already working), the products of which were carried by the Phœnicians into many lands. Tyre and Sidon (2750 B.C. ?) were flourishing cities many centuries before the Hebrew invasion of Canaan (1450 B.C.).[1] Their glass factories were among the most celebrated of the age (some authors have regarded them as the first established in the world), and they preserved their reputation and their prices under many Roman emperors. The children of Israel however, who had been more than three hundred years in captivity in Egypt, would surely not require to learn glass-making from the Phœnicians, as Moses who was learned in all the wisdom of the Egyptians must certainly have acquired that knowledge in their mysterious land. Pliny in his oft quoted story of the invention of glass says that "some merchants having landed at Belus, and making a fire on the strand to cook their food, and as there might not be any stones convenient for raising their cauldrons, they placed beneath them lumps of saltpetre from their ship, and these being ignited, when the sand of the shore mixed with them, there flowed from thence a transparent liquid stream of a new and as yet unknown substance, and this was the origin of glass." Merret as a practical worker ridicules this story, and says no nation ever did, or ever will, make glass by burning in the open air kali, or any other plant or material proper to make it; however strong the fire may be, the extreme heat of a furnace only can produce it, and he scoffs at the idea that merchants trading in saltpetre should not have known better than to take blocks of so inflammable a substance to support their pots on, far more likely in the heat to melt and upset the pots than to support them. Very likely they did take from thence a quantity of sand and kali (glasswort, a plant which grows there, used in making glass), and were possibly the first merchants in glass, or more probably they were carrying saltpetre from Egypt (where it abounded) to some of the already established factories. Such an accidental fire must have been of frequent occurrence in eastern countries, where sand and plants containing alkali (as reeds, bamboos, or straw) are plentiful; so if it be possible to

[1] St. Augustine was the first to point out the strong resemblance between many Phœnician and Hebrew letters, and many scholars since have observed it; a natural result when two nations lived close together, and probably interchanged their arts as well as the produce of their industries.

make glass in the open air it must often have happened. As M. Sanzoy observes that a heat of 1000 to 1500 degrees is required before the materials of which glass is composed can enter into fusion, it might well be doubted whether the production of glass in the open air is a possibility. On the other side Mr. Nesbitt tells us that he has in his possession a lump of impure weak glass formed by the burning of a stack of wheat in Lincolnshire.[1] It is said that the large meteoric stone now in the British Museum, which fell in South America, was found to have melted the sand round it into glass, but then certainly that was a fire never lit by mortal hands.

Strabo, a century before Pliny, and then Tacitus, speak of the sands of Belus as being inexhaustible. "The sacred river Belus, though it has only a beach of 500 paces, has always been an inexhaustible mine for glassworkers; between Ptolemais and Tyre the beach is covered with particles of sand, of which they make white glass; they pretend this glass will not melt on the river, but only turns into glass when it reaches Sidon." Chevalier Jancourt writes: "in this ditch of sand if you throw metal it instantly becomes glass, and the sands of Belus when thrown into the furnace become glass, but taken back to the ditch become sand again." Josephus writes: "at the mouth of Belus near the tomb of Memnon is a singular thing, a circular ditch full of vitrifiable sand; numbers of ships are always coming to take away cargoes of this sand, but it never grows less, as the winds, in intelligence with the sailors, bring back sand as fast as it is carried away; the sand in this ditch is really changed into glass, but when it is carried away it becomes sand again." The sand being thrown by the sea on the beach, dried by the sun and full of salt, becomes covered with crystals of salt, as may be seen in Egypt in many places. Abbé Moriti, who visited Belus in 1767, said, "its narrow bed mixed its sand with abundant particles of glass." The abbé was probably deceived by the salt crystals. The sluggish waters of Belus brought down from mount Carmel sand and clay which when tossed about and purified by the action of the sea, sufficed to produce glass for several centuries. Modern travellers still describe the white sands of Belus heaped on each side of the stream. Sir J. Maundeville says in 1322, "men comen fro fer watre by shippes and be londe

[1] See "Vitrified Forts": Scotland.

with cartes, to fetchen of that gravelle." It was long believed that Belus gave the only sand proper for glassmaking, and this belief probably restricted the manufacture and would account for the rarity and value of the article. At all events this brilliant sand was found close to Sidon, and the inhabitants used the gifts which nature gave them, and their reputation spread over the then known world, ages before Pliny called her "artifex vitri." It would be interesting to have the sand of Belus analysed, as has been done by M. Balard in the salt[1] marshes of the Mediterranean. One more legend concerning Belus is found in Ælian (time of Hadrian), he says, "Xerxes son of Darius having disinterred the monument of Belus belonging to fabulous times found there a coffin of glass in which lay stretched his body, bathed in olive oil."

When Solomon was building his temple, 969 B.C., he agreed to furnish wheat and oil for the use of the household of Hiram, king of Tyre, in return for workmen and materials for building the temple. Hiram provided the pilots and mariners for Solomon's fleet; these were the usual relations of a commercial with an agricultural people. When Cyrus, 535 B.C., permitted the Jews to rebuild their temple, Tyre and Sidon again assisted Ezra (iii. 7). It is only natural to suppose that among the workmen sent from those great Phœnician cities (even then past the zenith of their commercial prosperity) there would be some skilled in the manufacture of the bottles, beads, and vases for which they had a celebrity so widely spread. Prov. xxiii. 31 would seem to imply that in Solomon's day people used glass drinking cups, and took pleasure in seeing the colour of the wine through their transparency. The ancient Hebrew ceremony of marriage was not complete without breaking the glass cup out of which the couple had drank. Bernard[2] says the remainder of the wine in the cup was thrown on the ground in sign of joyfulness; then the empty glass was given to the man, who threw it with all his force on the ground breaking it in pieces, in order to signify an idea of death joining with joy, which breaks us like a glass and so prevents any feeling of pride in man; the assembly at the same time cry out "It is well."

[1] Some glassmakers at Valenciennes have collected the sand from the beach at Dunkirk, to make into bottles; this sand contains forty-five parts of silica, doubtless the Belus sands contain more.

[2] "Religious Customs of All Nations." Amsterdam, 1723.

All eastern nations took great delight in pavements of glass and crystal. In chapter 27 of the Koran we read of the court before the palace of Solomon, "the floor or pavement being of transparent glass laid over running water, in which fish were swimming." Again Mahommed and his imitators relate that "the throne of Solomon was placed on such a pavement of glass, and when the Queen of Sheba approached it she thought they were real waters and consequently gathered up her robes." St. John in Rev. iv. 6 attributes a similar pavement to the throne of God, and Ezek. i. 22 speaks of the terrible crystal or ice the throne rested on. Moses (Exod. xxiv. 10) saw "under His feet a paved work of sapphires," literally bricks of sapphires; perhaps a tesselated pavement of glass, the colour of the stone. The Hebrew רקיע, a name for heaven, does not signify the expanse or firmament, but the pavement on which stands the throne of the Father. Moses is not accountable for the error of those who have determined the heaven to be solid, perhaps from hence has arisen the error of the Pythagoreans concerning the solid globes of the crystalline heaven. That Hebrew houses had windows we learn from Jer. xxii. 14 and Ezek. xli. 16; but it does not appear that these windows were glazed; St. Jerome writing of the temple of Ezekiel says "the windows were made after the fashion of a net, like to lattices," so that they were not closed by talc or glass, but by shutters of wood worked in relief or inlaid.

The mirrors of the Hebrews were of brass; the Israelitish women had to appear in full dress at the tabernacle for Divine service, so it was necessary for them to have their mirrors after the Egyptian fashion, and in Exod. xxxviii. 8 we find Moses collecting the brazen mirrors of these assembled women to make the laver of brass. Job xxxvii. 18 speaks of the sky spread out which is strong "as a molten looking glass." We find the Israelites versed in all the arts of the Egyptians, and using them for the fabrication of the many marvellous objects connected with their worship imposed on them by Moses; among these arts we notice engraving on stone (Exod. xxxix. 6); they wrought onyx stones enclosed in ouches of gold graven as signets are graven with the names of the children of Israel, to put on the shoulders of the ephod, also each of the twelve stones of the breastplate was graven with the name of a tribe of Israel and among these stones was a diamond. The Egyptian commerce with India (whence these precious stones were procured) seems to have been carried on also

by the Hebrews. Dr. Vincent[1] thinks prior to the siege of Tyre, 588 B.C., the whole commerce of India and those countries was in the hands of Tyre except in the reign of Solomon who, though he exacted a tax on the produce brought, had no fleet in the Mediterranean,[2] a circumstance which gave Tyre a monopoly of all the communication with the western world. That Solomon had communication with India receives a curious traditional confirmation from the fact that among the Indian troops lately sent to Malta were some black Jews from the coast of Malabar, who claim to be descended from those Jews whom Solomon sent to India to collect gold and spices. I am indebted to the kind researches of the Rev. A. Löwy for the following remarks on glass in the Talmud. "It remains an open question whether '*zechuchith*,' in Job xxviii. 17, means glass or another substance of high value. In the post biblical Jewish works the term is invariably applied to the signification of 'glass.' In the 'Mishna,' that is the first collection of the rabbinical dicta and decisions as compiled in the second century of the Christian era, the incidental allusions to glass are mainly to be found in the treatise 'Kelim' (vessels or instruments). From the references there made it is evident that the rabbins were well acquainted with the manufacture of glass, and that the article was produced in the land where the Mishnaic teachers of the Jews resided. It would therefore not be too much to assume that glass was manufactured in Palestine at an early period, that Jews were engaged in its manufacture, and that they were skilled in giving it such shapes as were suited to the taste and the requirements of the period. The rabbins attached the greatest value to the production of white glass, and according to their traditions the art of making white glass ceased at the time of the destruction of the temple (see Talmud, treatise 'Sotah,' fol. 48. 6). The articles of glass were used for ornamental and for domestic purposes, and seem to have been regarded as precious things of which one ought to take great care. In the Gemara, that is the ancient comment and discussion which is appended to each paragraph of the Mishna (Mishna followed

[1] In his edition of the "Periplus," of the Erythræan Sea.

[2] In Solomon's time the Phœnicians had already brought their trade from India and Arabia through the Red Sea, and his offering them a more convenient route thence through the valley of Petra enabled him to enter into an advantageous treaty with and to obtain a share of the trade from that jealous merchant people (Prof. G. Rawlinson's "Herodotus," vol. ii.) This would explain the discrepancy between "Solomon's fleet" and his having none.

by the Gemara constitutes the Talmud) there are frequent references to glass as an article of manufacture, of commerce, of domestic use, and of ornament." In the twelfth century we read of twelve Jewish glassmakers at Antioch and at New Sûr (the Arabic name for ancient Tyre), four hundred Jew shipowners and manufacturers of the celebrated Tyrian glasses. Tristram in his "Land of Israel" says that in excavating at Tyre numberless fragments of shapeless but variously coloured glass were found which, by their solidity, suggested the idea that they were the rejectamenta of ancient glassworkers. Eraclius especially directs that Jewish glass is to be used for painting on glass, it was probably a glass which contained lead. In Christy's Museum, Victoria St., may be seen some bangles and glass articles from Hebron in Palestine; and in Burckhardt's "Travels in Nubia" (1814) he states that though the better sort of glass beads sold in Abyssinia are of Venetian manufacture, yet the greater part are made at Hebron, near Jerusalem, which furnishes the whole of southern Syria, the larger part of Egypt, and of Arabia, with glass ware. Now as we know the Crusaders brought back from the wars and re-established in Europe the making of glass, we may surely imagine that glass manufacturing in Palestine has gone on in almost an unbroken line since the days of great Sidon! Captain Warren in his "Underground Jerusalem" says, "Glass has been manufactured in Hebron since very early times, and though there are so few references to it in the Bible, our excavations attest it was in use at a very early date and most common during the Roman period. We found broken pieces of glass among pottery at many of the old ruins of Gaza, Askalon, Tell Jema, Ashdod, and other places; and though there was nothing to distinguish their age, they had at least as much claim to be considered ancient as the pottery itself. That glass need not have been unknown in the country from the earliest date is apparent from the facility with which the stone of the country will forge when subjected to heat. I have a piece of stone found near the Dead Sea, with a drop of blue glass clinging to it, apparently the effects of a fire lighted among the rocks. The sand now used at the factory at Hebron is found somewhere inland, it is not brought from the sea shore. A large quantity of glass mixed up with pottery of the fourth century was found in a drain which led from the southern end of the temple enclosure." Bede's notice of the glass windows on Mount Olivet, Jerusalem, is given in the chapter on Windows, and in the "Safar-

namah" Nasir, after describing the glass mosaics, goes on to speak of the Church of the Holy Sepulchre, Jerusalem, where there are "portraits of Jesus sitting on an ass, put up in several places, as well as those of the other prophets, Abraham, Ishmael, Isaac, and Jacob and his children (on whom be peace!); they are anointed with oil of Sindarus daily, each picture moreover is covered with a large plate of transparent glass of the same size as itself, so that the portraits may not be at all hidden, and this they place there to prevent the dust from settling on the painting, the glasses being cleaned each day by servants." There is nothing more surprising in the writings of this Persian traveller of the eleventh century than his extreme toleration for the religious beliefs of other people: "where David offered up his contrition and it was accepted, I too, Nasir, offered up my prayer at the same spot to the Almighty"; "also here is deposited the cradle of Jesus, I myself offered up my devotions there." The coloured lamps Nasir describes are spoken of by Mr. Conder[1] as still burning, and much of the glass mosaic remains, though injured; and the hillocks round Gilgal are full of broken pottery, glass, and tesseræ, the remains of the religious establishments that once covered the plain.

Dr. Birch tells us that glazed vessels are found among the ruins of Warka[2] (ancient Erech?) supposed to have been made by Hebrews, as many of a precisely similar character have been discovered in Jerusalem and other parts of Palestine; some of these are referable to later times. It has been conjectured that the Jews understood the process of glazing by litharge. The Jews in the middle ages, especially in Italy, made clandestinely quantities of false gems, probably from ancient glass. It is to the Jews we owe this preservation of the glass industry of the ancients.

[1] "Tent Work in Palestine."

[2] Jewish faces of the ninth century B.C. are depicted on the bronze gates lately sent from Nineveh by Mr. Rassam, from the temple of the god Makkin.

PERSIA.

"Among the Persians, that man only uses an earthenware cup who is dishonoured by the king."—*Ctesias, Persian historian*, 401 B.C.

THE ancient Persians conquered and occupied Egypt for many centuries, and, like other victorious nations of old, took captive and carried away from their fallen enemy's country all the most skilled workmen and artists, and employed them in building their famous cities, Persepolis and Susa. It is therefore to these ruined buildings we look for the earliest indications of glass. Persepolis, for a long time the capital of Persia, is said to have been founded by the renowned Jemsheed. It is interesting to us as the scene of Esther's history. On the overthrow of Egypt, Cambyses (529 B.C.) brought from Thebes not only all its richest ornaments to adorn his palaces of Persepolis and Susa, but is said to have carried off captive no less than six thousand workmen of various kinds. No wonder, as says Curtius, "Persepolis now became the wonder of the East, no other city existed in the world that could be compared to her." Here was situated the celebrated palace built of cedar, which was certainly in existence in the time of Darius, 521 B.C. Strabo speaks of the great beauty of this palace, which was burnt by Alexander at the instigation of Thais, or to avenge, some say, similar injuries inflicted by the Persians on Greece. Among the ruins, which are still very extensive, Minutoli says one finds to this day numerous fragments of glass mosaics, doubtless the work of those old Egyptian captives. On the central platform of Susa Mr. Loftus says, wherever the ground was opened, fragments of baked clay and glass were turned up.

The Persians made glass prior to Alexander's victories, as Aristophanes, 400 B.C., describes the Athenian ambassadors to Ecbatana as stating, "in Persia they were everywhere made to drink a generous wine, out of glass and golden cups." In the South Kensington Museum may be seen fragments of glass and old

pottery from the ruins of ancient Rhey or Rhages (Tobit i. 14), which was first known in history as the place where the Jewish exiles were sent, but it was in existence long before Cyrus; Strabo says it was rebuilt by Greeks. Some idea of its ancient magnificence may be gained from the Persian account which states that fifteen thousand caravansaries were too few to accommodate all the merchants and travellers who resorted to its bazaars. A curious fact is mentioned by Sir H. Rawlinson concerning the rock sculptures at Behistun, of the time of Darius, 516 B.C. It was evident that after the engraving of the rock had been finished a coating of siliceous varnish (in fact a glaze) had been laid over it, to give a clearness of outline to each individual letter, and to protect the surface against the action of the elements; this varnish is of infinitely greater hardness than the limestone rock beneath it, as it still adheres in portions to the broken surface, and shows the characters with sufficient distinctness, though the rock beneath is perfectly honeycombed and destroyed.

All lovers of ancient art are acquainted with that remarkable specimen of Persian glass work preserved in the Paris Bibliothèque, the well known cup of Chosroes I. It is a shallow bowl consisting of a central medallion, apparently of crystal, on which is sculptured in relief the figure of Chosroes, king of Persia A.D. 532, the same effigy that appears on his coins; around it are three rows of circular medallions, or disks of glass, red and white alternately, the spaces between filled in with green; the whole of the glass is ornamented in relief, and has evidently been cast in moulds; the medallions are united like the parts of a painted window, but by fillets of gold. There is no reason to doubt that the cup itself was one out of which the monarch was accustomed to drink. As late as 1638 it was believed that the disks were garnets, jacinths, emeralds, crystal, and white sapphires. The original owner of so rare a drinking cup could, it was supposed, be only Solomon, and the figure at the bottom was believed to be the Jewish king. It is of Sapor, A.D. 260, king of Persia, that we are told "he had a celestial sphere made in glass, so large that this king seated in the middle could observe the motions of the stars," which sounds like an echo of the sphere of Archimedes. The city of Ctesiphon was taken by Arabs in the reign of caliph Omar, A.D. 637, and the treasures collected there for four hundred years fell into the hands of Sa'ad the general. The royal palace had a portico of twelve marble pillars, 150 ft. high. In the

spice magazine were found glass vases containing stores of musk, camphor,[1] amber, gums, drugs and perfumes. In one room was a carpet of white brocade, 450 ft. long and 90 ft. broad, which had a border worked in precious stones to represent flowers, the leaves of emeralds, the buds and blossoms of pearls, rubies, sapphires, and other gems. The magnificent decorations of this palace have excited the notice of many authors. Theophylact of Simocatta says Greek materials and Greek workmen were employed in its construction by Chosroes I. Ed. Thomas thinks Chosroes II. brought Roman artists to complete the works, and Tabarie says the whole was designed by a native artist, Ferbad.

We know very little of Persian mediæval history; those fragments of her art productions which have been preserved are of the very highest class, and are eagerly bought up for museums and collections.[2] It would appear the manufacture of glass continued through the middle ages, as we hear that Sanjuk, shah of Persia, 1140, caused the body of the prophet Daniel to be placed in a glass coffin at Susa. The beautiful enamels of Persia are well known, and their delicate lace-like perforated porcelain, filled in with a clear glaze, has been celebrated in England ever since the days of Horace Walpole as Gambroon ware.[3] The glazed pottery of Persia is perhaps better known than her glass, it is distinguished for its harmonious colouring and the extreme brilliance of its glaze. Sir R. Porter describes the mosque at Tabreez, erected by Ali Koja in the twelfth century, as covered inside and out with lacquered tiles, adjusted in elaborate and intricate figures; the colours were green, dark and light blue, with Arab letters in gold, and a broad band of such letters in white, with flowers interwoven of green and gold, wound round the entire extent of the building. In the royal palace of Tabreez every part not painted was covered with mirrors, and the windows were filled with variegated coloured glass. Porter also visited a superb mosque

[1] The Arabs, mistaking this for salt, mixed it with their bread.

[2] It is interesting to notice, as showing the advanced state of civilization in early times in Persia, that the first record we have of a striking clock is of the one presented by the then king of Persia to Charlemagne, A.D. 800. It was made of wood; a needle moved circularly, rudely dividing the hours and marking the four divisions of the day.

[3] It is asserted by high authorities that this is the only true porcelain ever made in Persia, all the rest being imported from China; the evidence is however hardly conclusive, yet many well known patterns are called by the names of great Persian families, and the presence of beds of kaolin signalized by a recent traveller would seem to prove that no want of materials prevented a local manufacture in Persia.

at Sultania, built in the fourteenth century, "in which the whole interior was covered with various coloured tiles, with much gilding; the whole Koran is said to be here written, but it requires the practised eye of a Mussulman to distinguish the letters midst the labyrinths of arabesques which surround them." The so called Shah Abbas tiles, so dear to the hearts and purses of modern collectors, are most probably referable to this date. The glaze[1] on these tiles must have been of so thick a quality it could scarcely flow over the surface, and large knobs of glass are left at the edges and on the inequalities of the pattern.[2] The advantage of this system is obvious; these tiles are as fresh now as they were six centuries ago, while our modern productions with their poor thin glaze will hardly stand the wear of as many years without deterioration.

The favourite mode of adorning buildings during the middle ages in Persia must have been by means of mirrors, judging by the specimens left at Tabreez, Ispahan, and other places; and it seems still a Persian custom to fix plaques of glass to walls as a decoration. Where the mirrors were made we have no means of ascertaining; but Ibn Batoutah, 1332, talks of "clusters of lamps made of glass from Irak."

Nearly all the best works of Persian art are attributed to the time of the great Shah Abbas, 1585, and many dated objects bear out that theory.[3] His superb palace at Ispahan, with the magnificent group of buildings attached to it, remains to attest the splendour of his court and the encouragement he gave to the arts. The celebrated Chabar Bagh (four gardens) belonging to this palace, approached by a bridge of forty arches, is composed

[1] Sir G. Birdwood says the ancient art of glazing earthenware has come down in Persia in an almost unbroken tradition from the period of the greatness of Chaldæa and Assyria; the name "kasi" by which the art is known there and also in India is the same Semitic word, "kas," glass, by which it is known in Arabic and Hebrew.

[2] Large quantities of tiles similar to these were wantonly destroyed at the breaking up of the great mosque of Algiers, to make room for the modern French cathedral, only those few which recorded texts from the Koran were preserved from religious motives by an old Moor; for fear lest they should be desecrated, he refused to part with them to me, though I promised to preserve them under glass. The eagerness with which English people purchase these relics amazes the French, who seem unable to appreciate them. The disastrous wholesale destruction of works of Arab art in Algiers is a great loss to the world, and a great stain on the French name, as also their conduct as to the tablet on the Dog River. (See Trans. of Soc. Bib. Arch. vol. vii., p. 336.)

[3] He is reported to have sent to China for workmen to instruct his subjects in the art of making porcelain.

of terraces filled with large plantain trees and marble tanks; on each side are four paradises, with eight magnificent kiosks, profusely adorned with paintings in gold and silver, and mirrors. In front lies a fine square, 700 ft. long; it was till last century the great market of Persia. On one side stands a large mosque, with a splendid gateway and mosaic door, the ground azure, the patterns in gold, silver, red, white, and green. Never was seen anything so fine as these patterns, and copies of them would give a thousand designs for embroidery. On the other side is the entrance to a large bazaar, which was the finest in Persia; it is now half ruined. The approach to the Chehel Setoor, or palace of forty pillars, itself, is thus enthusiastically described by Sir R. Porter. "When we turned into the grand avenue, and the palace broke on us, I thought description was put to silence, words can give but a faint idea of the wonderful object in sight. I must attempt some detail of this Persian Versailles; the exhaustless profusion of its splendid materials reflected not merely their own golden or crystal lights on each other, but all the variegated colours of the garden; so the whole surface seemed formed of polished silver or mother-o'-pearl, set with precious stones. The scene appeared an eastern poet's dream, or vision of fairy tale. The entire front of the building is open to the garden, the roof supported on a double row of twenty columns; a large tank in front reflects these twenty, and gives the name of Forty Pillars to the palace. These columns, about fifty feet high, are covered with glass mirrors from top to bottom. Each column shoots up from the united backs of four white marble lions; these shafts, rising from their singular bases, are covered with arabesque patterns and foliage, in gilding and painting, on the glass surface; some twisting spirally, others winding in golden wreaths or running in lozenges, stars, circles, and I know not what strange intricacies of fancy and ingenious workmanship. The ceiling is equally iris-hued with flowers, fruits, birds, butterflies, and even crouching tigers in gold, silver, and painting, amid hundreds of intermingling compartments of glittering mirrors. Within this open chamber are two more pillars of similar taste to the range in front; from their capitals springs a spacious arch forming the entrance to a vast saloon, in which all the caprices and labours and cost of oriental magnificence have been lavished to an incredible extent of prodigality. The pillars, walls, and ceilings might be a study for ages for designers in these gorgeous labyrinthine ornament-

ations. An odd addition has been made to the decoration of the wall near the floor; little recesses spot its lower range, taking the shapes of bottles, goblets, vases, flagons, and other vessels, all equally indispensable in those days to a Persian feast." The floors of both these apartments are laid with carpets some sixty feet long, of a texture never made now, and though bearing a date of five hundred years ago as fresh now (1870) as when they were laid down.[1]

Le Viel thinks the art of glassmaking, still practised in Persia, dates from the remotest times; "at Shiraz they made the best glass of all the East, and they knew how to unite broken bits like porcelain." In 1753 Kerim Khan established glass works at Shiraz, where bottles, goblets, and window panes are still made. Chardin, who went to Persia in 1664, speaks of the very common glass then made in that country, bad in colour and of imperfect manufacture, which he attributes to the feeble fires they used with insufficient fuel, and which were only maintained during three or four days; the best glass, he also says, is that made at Shiraz; the manufacture had only existed for eighty years, and had been introduced by a needy Italian, in his day mirrors and beautiful bottles for tobacco (probably snuff) were brought from Venice. In the British Museum, besides the beautiful lamps described elsewhere, there is a bottle richly diapered with coloured birds, and another square one with a red and a white horse enamelled on it; the Persians (unlike the Arabs) do not object to introducing animals and men into their ornamentations, as may be seen in the Damascus work of to-day. The art of Damascus is still Persian, and in the middle ages that city was looked on as a chief seat of glass manufacture, as we find in many royal inventories, among treasured objects, glass "en façon de Damas" particularly mentioned.

In 1350 Charles V. had "three pots of red glass" and also "a little glass worked outside with figures in façon de Damas" and a glass in Damascus fashion without any ornament. Most of these old glasses have coloured enamel inscriptions, and arabesques oriental in character, though the letters cannot always be read, being intended probably merely as ornament, or possibly copied by some one ignorant of their sense, as has been done in the later Hispano-Moorish pottery, where the letters are so

[1] As a specimen of the luxury displayed in the courts of Persian sovereigns, read the description of the travelling tent of Nadir Shah, in Appendix, Note C.

degraded as to have lost all meaning.[1] An additional proof of the celebrity of Damascus as a centre of manufacture, and a curious instance of the way history repeats itself, may be found in Clavijo's narrative of his embassy to the court of Timour Beg, 1403–6, where he relates how in 1402 that conqueror carried off from Damascus to Samarcand "silk weavers and men who make bows, glass, and earthenware, so that of these articles Samarcand produces the best in the world," also that, at Timour's banquets in camp, meat was served in basins of gold, silver, glass, earthenware and porcelain. His account is confirmed by Cherefeddin, the historian of Timour, who says "these artisans were divided among the emirs, to be immediately conveyed to Samarcand." The manufactories of Damascus probably never recovered from the ravages of Timour's army and the loss of the best workmen; little more is heard of their productions, which were probably thrown out of the European markets by the superiority of the productions of Venice, which soon attracted to herself the trade of the greater part of the world in glass. The extreme fondness displayed by Persians for mirrors has left its mark in their literature: in one of their fables we read of a cat "the mirror of whose imagination had never conceived" the possibility of always having enough to eat; and one of their poets in praising travellers says, "whosoever has travelled shall be approved, his perfections shall be reflected as from a mirror of light."[2] Persian rosewater bottles, of delicate glass and very graceful and original shapes, principally blue in colour, are shown both at South Kensington and the British Museum. Some of these bottles are modern, some older, and probably made in Venice for the Persian market.

[1] It is the case all over the East at the present day. Even the Arabic inscriptions on Constantinople cloths, etc., and on the brass platters, are so corrupt as to be illegible; they are the *mere imitations* of letters.

[2] The same simile is common with us; in old lists of books registered at Stationers' Hall we find such titles as "The Mirror of Man's Miseries," "The Mirror of Princely Deedes," and so on.

ETRURIAN, POMPEIIAN, AND CHRISTIAN.

FULL many a monument is there
Of nations fallen to decay ;
Though every trace they left is fair,
Not less for that they passed away.—*MS.*

ETRURIA.

WHO the Etruscans really were is one of the many disputed questions that may probably never be satisfactorily settled. It would be useless here to re-discuss the point as to whether they were a civilizing band from Asia, or sprung originally from the Pelasgi, or found their early cradle in the Rhætian Alps. They flourished centuries before Rome was thought of. They would seem to have always borrowed or imported their art from neighbouring nations. In early times it is strikingly oriental (though in their funeral paintings the women are never veiled); it then becomes very Grecian, and like Greece the glory of Etruria lies more in the glyptic art than in the making of glass. A commercial people they traded with Phœnicia and Egypt, and nothing indicates a close analogy between Egypt and Etruria so much as the multitudes of scarabei found all round their cities. They seem to have been worn as charms; and the Etruscans probably adopted this relic of foreign superstition without attaching to it a religious signification. At Chiusi these scarabei are found in such numbers on a spot near the city that it is called the "jeweller's field."[1] Glass found in Etruscan tombs is supposed to have been brought both from Phœnicia and Egypt. Various beautiful specimens of coloured and variegated glass bottles for perfumes and cosmetics, taken from Etruscan tombs, may be seen at Vulci,

[1] Scarabei found in the foldings of a mummy are thought to have been placed there to pay the fees on some part of the soul's journey heavenward, "an obolus to Charon." In the Etruscan tombs at Chiusi a five sided crystal, the matrix of the amethyst, was put into the mouth of each corpse, meant as its fee to Charon ; these stones are not found anywhere near Chiusi.

Volterra, Naples, and Rome. They are generally dark blue in colour; some are fluted. The patterns are chiefly zigzag lines in yellow, white, and pale blue; nearly all are now iridescent; their blues are due to cobalt. Elegant amphoræ-shaped bottles of various colours are supported on circlets of gold. These are found alike in tombs in Egypt, Greece, Sicily, and Italy; the estimation in which they were held is proved by their golden settings. In Etruria they come principally from Vulci and Toscanello. Various kinds of glass, porcelain, and alabaster were exported from Egypt and received by Greece, Etruria, and Rome as luxuries which, being remarkable for beauty, were prized as ornaments for the table and preserved as sacred relics in tombs. Together with the bottles are found numerous small ornaments in glass, such as rings, bugles and amulets, which, common objects in Egypt, were valued as articles of great rarity in Etruria. Set in their exquisite golden filagree work,[1] we may imagine them adorning their fair Etruscan owners in life, and we know they were buried with them in death. One remarkable object found at Vulci is a bracelet formed of small fish strung together and secured by a gold clasp. In many museums may be seen cups and vases of opaque and clear glass, in rich colours and varied designs; sometimes encrusted with plaques of gold finely worked and of good taste in the Egyptian style; sometimes square bits of gold foil are found inside the glass. Whether all these things were imported or made in Etruria we cannot tell. King thinks none of them were of native manufacture, and that Etruscans, superior to Egypt in many arts, knew nothing of glass, a fact singularly attested by the two wonderfully fine pastes in the Basle collection, one aventurine with emerald ground, and a breccia agate of beautiful colours, both honoured by the choicest and most valuable performance in the way of ring setting ever achieved by Etruscan goldsmiths in their own peculiar style, a proof that they had mistaken these artificial productions for novel gems of the highest rarity.[2] In the age when the Etruscans burned their dead the ashes were collected in terracotta and alabaster urns, and afterwards in cinerary urns of glass. Romans, who borrowed

[1] In the Gem Room, British Museum, may be seen a very beautiful specimen set as a pendant.

[2] In Etruscan tombs are repeatedly found porcelain and alabaster bottles with all the characteristics of Egyptian workmanship. The stone undoubtedly comes from Egyptian quarries, and the form and style of the articles leave no doubt as to their origin.

so much from the Etruscans, would certainly not have remained indifferent to glass, and it is very possible that they owed their first acquaintance with this product to their neighbours.

POMPEII.

"On the coast of Italy near Cumes is found a quantity of fine white vitrifiable sand, which, fused with three parts of nitre, comes out of the furnace a pure white glass."[1] It is most probably from this sand of Cumes that originally was manufactured the splendid harvest of glass which the buried cities of Pompeii and Herculaneum have yielded to their excavators. The Bourbon Museum at Naples is enriched with the priceless treasures which the ashes of Vesuvius have preserved for her. There are now more than four thousand articles of glass, collected from buried cities, stored in the museum; of these the most important, the Naples vase, has been described with the Portland one. Perhaps the objects that first strike a visitor to the Pompeiian remains are the numbers of square glass bottles in which the ancient housekeepers kept their wine, oil, vinegar, honey, preserved apples, dried figs, prunes, beans, and barley. Some of these bottles are a foot and a half high. There are hundreds of smaller bottles of varied shapes; some enclosed in clay vases to prevent the wine from being spilt; some intended for pouring out liquid drop by drop, called "oxybafo"; some evidently meant for distillation. Quantities of glass bottles for drugs were found in the doctor's house; since the time of Galen glass has been the favourite receptacle for drugs, "because from it cometh no smell or bad qualities." The twisted bottles still used in Italy for oil and vinegar were known in Pompeii. A painting on a wall gives a festive table arranged with glasses and small ladles, which were possibly used to lift perfumed wines out of small decanters on special occasions. In the tragic poet's house ten bottles of ointment were found, and the numerous well known antique bottles for scents and cosmetics abound. Pero has described all the ornaments with which the workers in metal are in the habit of decorating scent bottles. In the Street of Fortune alone were discovered no fewer than two hundred and fifty bottles of common glass, forty of them nine inches high, and four decanters, besides several cluster bottles, made of four bottles attached,

[1] Pliny's recipe, which would not make good glass.

of the same kind precisely as those still made in pottery by Kabyle mountaineers who no doubt learned from Romans the art of making them. With these bottles were thirty cups of green glass and four plates, also six tumblers eight inches high and only two inches across, probably meant for effervescing liquids. In this same street leading to the temple of Fortune was discovered a terracotta jar in which, carefully packed in straw, were a large number of cups of a beautiful blue colour, with drinking glasses, plates, and other objects, all in glass; these may possibly have been packed in this manner for the purpose of removal, and so are fortunately preserved. In the house of Lucretia were twenty-six glass objects; among them two ornamented cups, a drinking glass with its foot in a stand, and some scent bottles; also two bowls, one blue glass the other with a leaf ornamentation, a circular dish with the head of Medusa, a tube with a masque of Silenus, and thirteen paste buttons. Some of the glass plates are fourteen inches across. In the theatre were two paste figures in basrelief, one of Abundance, the other without any emblems. Some of the gladiatorial cups have been already described; the commonest names of these gladiators are found scratched on a wall in Pompeii. An inscription preserved on a wall announces that, a glass urn having been stolen from a certain Varus, tavern keeper, he offers a reward of about eleven shillings if it is brought back to him, and promises to double the reward if the robber is also brought. Among the more refined specimens of glass ware in Pompeii may be mentioned a fragment of a patera with a handle; it is of blue glass splendid as a sapphire, with milk white cameos on it representing a twig of ivy leaves and the head of a ram enclosing the masque of a faun. The exquisite beauty of this design and extraordinary delicacy of the workmanship recall to the mind Pliny's words, "they sculptured glass more delicately than silver." Among these articles of luxury domestic things are not forgotten, as there is a glass drainpipe to be seen. Among the ruins were found two large pieces of ammonitrum and also masses of dark brown and dark greenish glass, formed of flint or shells with some particular kind of sand. Apparently these masses differ little from the obsidian stone used in Egypt, and may have been made for dishes for the service of the table, as Pliny says was the fashion in his day.

Cinerary urns containing ashes were usually glass enclosed in lead, and that again enclosed in clay; these probably contained

the remains of rich people, the commoner ones are only clay. The mosaic of Pompeii, the windows and lamps of her baths, have been treated at length in their respective places. Gell describes a fountain covered with glass mosaic, with a border entirely composed of sea shells, which remain quite perfect after the lapse of so many centuries. Philander mentions this mode of decoration, which still holds its ground in many places. The fountains of Pompeii were furnished wtth leaden pipes and brass cocks for admitting and turning off the water, precisely the same as those of the present day. Notwithstanding the enormous quantity of glass found in the city, the common people seem to have used drinking cups both of horn and wood.

Fosbrooke describes a curious toilette service exhibited at Pompeii which consisted of a modern square looking glass; a candelabrum behind the glass supported a lamp; on the table were pins, jewel boxes, scentbottles, cosmetic and ointment pots, and numerous objects connected with the toilette. Pollux enumerates a long list of the various articles required for the toilette of an ancient belle, but cynically adds that "no one is acquainted with all of them." Niccolini describes a "cestino" formed of glass beads threaded on bronze wire. The catalogue of the museum at Naples gives the complete list of all glass (and other) articles rescued from Pompeii and preserved there. A superb copy, of sixteen vols. illustrated, may be consulted in the South Kensington reading room.

CHRISTIAN GLASS.

Much interest has surrounded the cups and disks found in the catacombs of Rome. They are generally ornamented with gold figures enclosed between two layers of glass, and the whole fused into one mass. Cups so treated are usually known as Christian glass, because the greater number have been found imbedded in the mortar of Christian graves; the middle part being thick has generally resisted the action of time, but the thinner edge has disappeared. This kind of glass has preserved many valuable details of costume, but its invention seems to have been of greater antiquity than the Christian era, as many pieces represent pagan figures and inscriptions. Possibly the germ of this species of decoration may be found in an Etruscan cup which has square bits of gold foil fixed in the body of the glass, and also in the

small pieces of gilt glass with a protecting layer of glass over the gold, found at the temple of Diana. We constantly find on the cûps such sentiments inscribed as Return day of fête; Drink and do not put me down; Drink and live many years; Give drink; I thirst; Rejoice because thou art here. It would seem the early Christians took many of these legends for their cups preserved in the catacombs, as "Drink, live," connecting them probably with the sacrament and life eternal. A glass cup of this description was found in a tomb near Pesth, in 1845, with the inscription "Bibe, Viva"; there were no Christian emblems in this tomb, but all the signs pointed to pagan worship. The peculiar character of this style of glass can be best appreciated by examining some of the specimens preserved in the Vatican, or the British and other museums. Among Christian designs the most usual subjects are Jesus turning water into wine, also desiring the sick man to walk, Jesus present with the three children in Nebuchadnezzar's furnace. The good shepherd with sheep is a very favourite subject; so is Noah in a square box meant for the ark; Adam and Eve; Tobit and the fish. The only known representation of the crucifixion is supposed to be a forgery. Sometimes the Virgin appears alone or with saints; by far the most common figures are St. Peter and St. Paul, the latter always represented with impressions of the sole of a shoe round him, in allusion to his many wanderings. Among ecclesiastical characters we have St. Agnes and St. Laurence. Sometimes two busts of a married couple, with a figure of Christ placing rings or crowns on their heads, and an inscription wishing them all happiness. Besides these, many miniatures with proper names, some figures of children, not all real portraits, only conventional, with scenes from domestic life and inscriptions of a convivial character which preclude the idea that these cups were meant only for chalices. A few are found with invocations to saints, and the monogram of Christ sometimes appears; but there are many pagan memorials, as allusions to Hercules, Cupid and Psyche, and others; a judge with two wrestlers, a palm branch at the feet of one seems to indicate that he is the victor; chariot races with the names of the horses, a player on the double flute, with other instances of the same kind. It is possible Christians may have joined in these games, or people having once gained distinctions in them, and afterwards becoming Christians, may have taken their prized decorations with them to the tomb. In

some of these cups is still to be seen a dark crust, which has been suggested to be the blood of martyrs buried there, indeed cups are found with the word "sanguis" on them, but De Rossi and other antiquarians suspect them to be forgeries. This does not however prove that the sediment found is in no case blood; the analysis of De Broglia has shown that in vessels found in Christian tombs at Milan blood can still be recognised. The word "sanguis" or "sang." might possibly have been used in allusion to the sacrament, but the whole question requires more direct proof than we have at present acquired. Perret gives an engraving of a long shaped drinking glass, round at the bottom, incised with palm branches and a bird in a cage; some red substance still adheres to the bottom of the glass; doubtless it was the favourite drinking glass of the occupant of the tomb. The red sediment left by wine in a glass preserved in the dry air of a tomb would last for many centuries; in the ruined marble wine-vats well known to many visitors, on the Roman Campagna, the red stains, where the grapejuice has trickled down into the lower vats, are distinctly visible now on the white marble, after it has been exposed to the storms and sunshine of many centuries.

Looking at the numerous convivial subjects depicted on these vessels, many of them must have been used at marriages and agapæ, or Christian feasts. St. Augustine mentions that his mother Monica never took more than one cup to commemorations of martyrs, which would imply that some took more, bearing perhaps effigies of the particular martyr to be commemorated. Impressions of entire plates are found in the mortar of the catacombs, where they would seem to have been fixed as were the disks still found there, while the mortar closing the tomb was moist, to mark the spot. The plates were probably used at the same festivities as the cups. When Monica at Milan brought to the commemoration of saints (as was the custom in Africa) pulse, bread, and wine, it is reasonable to suppose these plates were for the purpose of holding the pulse and bread, as the cups were meant for the wine. Besides the gold decoration most commonly used, many cups had varied and beautiful colours, in some the drawing was incised and filled in with colours. Boldetti found in the cemetery of Callisto a head of the Saviour, delicately painted in various colours at the bottom of a cup. Buonarotti (A.D. 1475) gives an engraving and the following careful description of a glass vase discovered in the catacomb of St. Agnes, which must

have been of a most elaborate character. "I congratulate myself that I made the drawing at once, for a few days after the vase burst into atoms, and there remained not the smallest piece. It was of the most beautiful workmanship, ground blue; the arebesque border, the young girl, the children, the tresses that one held, the cornucopia, the urn and roses, all were in gold; the dress of the woman in silver, the hair a light brown; the principal figure, the man, in gold, also the drapery which hung from his shoulder, that which covered his knees in silver with purple stripes; the water falling from the urn seagreen; the fruit which the young girl carried in the folds of her robe red and gold, those which came out of the cornucopia were the natural colours; the garland held by one of the winged cherubs was gold and green and red, the vase of gold carried by one of the genii was marked out in red, except a row of little circles in black, and the word 'Katteo' which was red." Caylus pronounces the drawing as very well done, he also says this kind of glass was successfully imitated in Rome some years before his time (1752), to deceive strangers, but the author died without revealing his secret. To this method of manipulation may possibly be ascribed the beautiful miniature on glass of a slave, inscribed "Sappho Iraccilla," now in the British Museum, which Caylus describes with great enthusiasm and perfect belief in its antiquity, but modern experts pronounce it a forgery. It is at all events an exquisite work of art, and is interesting especially from showing the crescent or half moon on the forehead. Slaves were sometimes marked in this way as a punishment for running away. Plautus calls a slave so marked a lettered or literary slave; Pliny says soldiers were so branded in the Lower Empire, which was one reason why the troops became degraded. This mark on a child's forehead was probably in remembrance of a vow, and it is possible the imitator had examples to copy from. Such a habit was common among the ancients; Prudentius says, "they take fine pointed needles, and mark on different parts of the body, the part so marked is consecrated to the deity." The dress and details of the glass miniature in question are so beautifully worked out it is a great pity we are not allowed to believe in its authenticity; it is a mode of preserving a friend's portrait that might well be revived. There are many portraits of noble dames whose authenticity is uncontested, and Garucci points out the singular fact that on none of them do we find any earrings, though this would seem to be

by their inclination only, seeing the extraordinary richness of the gold ornamentation introduced on their dresses, and remembering that it was an age when it was specially the mode to pierce the ears of Christian girls and hang from them gold and jewels. Laonde Avito, in his poem praising his sister the virgin Fuscina, notices that her beauty increased so much daily in lustre that her parents would not allow her ears to be pierced for the introduction of gold and precious stones, which adornment would only attract glances that wound.

All the authors who have written on the subject of Christian glass agree that these cups with gold designs were used, not only for the sacrament, but also for the mystical supper, the agapæ, for marriage and funeral feasts, and also for the purposes of every day life, favourite cups being no doubt buried with their owners. The greater number of the plates have perished in the attempt to remove them, and of the cups it is principally only the bottom or thicker part which has been preserved. Boldetti found some whole ones which are shaped like an Etruscan cylix, but without a foot and with two handles. Regarding the probable date of this catacomb glass, as usual, the authorities differ widely. Wiseman considered them the work of Christian artists alone, but this is highly improbable and does not accord with the numerous pagan symbols existing on some specimens, which are wholly incapable of any Christian interpretation or adaptation. It is possible, even if artists embraced Christianity, they could not at once forget all the teaching of their former lives, and they may have continued to repeat pagan emblems much as we do, after any real belief in them had passed away. Martigny observes that all the best executed examples have Greek legends, and are probably the work of Greek artists. The art may be Asiatic, as well as European. One cup gives its own date, as it represents gold coins on one of which the head of Caracalla, A.D. 211, appears. Another cup bears the name of Marcellinus, bishop of Rome, martyred A.D. 304. Garucci thinks none of this glass is later than 380. De Rossi limits it to an earlier date. Marriot considers that, as they all belong to a period of degraded art, they must be as late as the fifth or sixth century. But if these glasses were really found in the catacombs, it is hardly possible to place them later than 410, as after that date no inscription appears in the catacombs, though Pope Vigilius (537) and John (560) did their best to restore inscriptions there, after the ravages of the Lom-

bards and others; but they would scarcely have replaced glass vessels which had been stuck into the cement closing the graves.

Besides the coloured designs on these cups already mentioned, may be noticed some with purple in the draperies, green sea waves, pink colour in the faces, and silver is sometimes used for white garments and the white bandages of a corpse, as in pictures of Lazarus. Gold and silver figures are also found, on azure grounds. The little disks or medallions so often found, of about an inch in diameter, were supposed to be the bottoms of wine glasses; but the discovery at Cologne of two flat plates, ten inches wide, formed of clear glass, into which while in fusion have been inserted many medallions of green glass similar to those found in the catacombs, would show that these medallions, being thicker than the rest of the plate, have resisted the action of time which has destroyed the thinner part. One plate, in the possession of Mr. Pepys of Cologne, has twenty medallions fused into it. That in the middle represents the three children of Israel in the fiery furnace, four give scenes from Jonah's life, one has Adam and Eve; other subjects are not so distinct, and eight are only stars. Peligot says that in the church of St. Ursula at Cologne they have recently discovered a series of cups with biblical subjects, made in the same style as this catacomb glass. At Cologne was also found some years ago a very curious example, in which the real cup, about three inches high, is ornamented with winged genii and flowers in gold, and is enclosed in a network of threads of glass, which join handles constructed in a like manner, the whole standing on a foot, the threads of glass in this instance are not cut. Some specimens have been found in which the gold leaf seems to have been applied to the surface of the glass, and not protected by a second layer of glass, either from inadvertence, or perhaps from a desire to make the cups cheaper; such a decoration would be very liable to be injured; there is a specimen in the Slade collection, No. 120. In the Kensington Museum are two specimens of the clever imitations of old glass, probably the work of forgers of the renaissance, of a similar character to the miniature of a slave in the British Museum.

M. Majault gives a careful description of how to make these pictures enclosed in glass. They were often made by cutting figures out of gold or silver leaf, and laying them on the glass, but he advises the use of powdered gold and silver in preference

to the leaf; the figures are sometimes marked out with a black line to heighten their effect. The red, black, and purple colours are iron, and the greatest care must be taken to avoid any inferior kinds of material, as purity is essential to success. The slightest bubble of air, or inequality, will ruin the work, and all dust is hurtful. The design is to be placed on one plate of glass, and the medium used in fixing the gold must be dissipated before applying the second plate of glass, which must not be too thick, or it will burst, the heat must be just sufficient to melt the glass but not the gold. Extreme care and great experience are requisite to ensure success in this kind of work, but the patient artist is rewarded by a lasting and beautiful result. Eraclius, who describes a method of ornamenting cups with gold designs enclosed in the glass, does not speak of it as practised in his time or even as known by tradition, but as having been discovered by himself. Modern photograph portraits are sometimes seen treated very much in this manner, enclosed in a thick piece of glass and set as brooches. Modern science has discovered that by placing two plates of glass in a vessel, and exhausting the air, the glass will collapse together and so avoid all danger of bubbles. In the Museum of Practical Geology may be seen a mass of glass enclosing an inscription similar to the one placed under the foundation stone of the Royal Exchange by the Prince Consort, and which would be practically everlasting. We know however so little of the methods of working in vogue among the ancients, save by conjecture, that it is quite possible they had some mode of exhausting the air and so avoiding bubbles. There is some Christian glass referable to a later period than the catacomb glass. Martigny gives a Nativity in green glass of about the sixth century, Mary adoring the Saviour, an ox and an ass look on; this is a semicircular plaque; there is a similar one in the Vatican. De Rossi describes some fragments of plates, which he refers to the fourth century; they were found at Porta, and were engraved in shallow incavo, on the bottom only of the plate, so that the upper part remained smooth, the figures had the appearance of being in relief. One represents Christ standing between two saints, another Christ giving a tablet inscribed "Lex Domini" to a figure intended perhaps for St. Peter. De Rossi thinks these were simply plates meant for domestic use, but it seems improbable that sacred symbols should so early have been taken for anything but church purposes that Mr. Nesbitt suggests

they were the remains of patens, as Pope Zephyrinus (203) ordered patens of glass to be carried before the celebrating priest. Some vases incised with colours represent the seven-branched candlestick. Little crystal fish, possibly hospitable emblems, are also found in the catacombs. A vase in the form of a fish, now in the museum at Autun, found in a Christian tomb, is supposed to have held holy oil. Christian artists also made use of glass pastes to multiply their emblems; some exhibit varieties of the monogram of Christ, a red jasper paste has "Bonus Pastor" on it, and a blue glass plaque in the Slade collection brought from Constantinople, with a bust of the Saviour, is supposed to date about the ninth century. A white glass urn, of the same shape as the Portland vase, was found in the last century at Pisa, which had chariot races engraved on it in intaglio, with the words "Claudia zezes," which seem to be a Christian allusion and may belong to a later period than the catacomb glass.

BYZANTINE AND ARAB.

"He set before us whatever is sweet in the mouth or fair to the eye. And after this he brought forth a vase, which was as though it had been congealed of air, or condensed of sunbeam motes, or moulded of the light of the open plain, or peeled from the white pearl."—*18th Assembly of Al-Harîri: Chenery's translation.*

AS the hordes of barbarian invaders advanced upon Rome, and succeeded in extinguishing the fading glories of that once all-powerful empire, the glass-making art with many others fell into decadence and was almost lost in the West. Constantine in transplanting the seat of empire to Byzantium in A.D. 330, not contented with taking from Rome, Greece, and Asia, all the objects of art he could collect (after the usual manner of despotic sovereigns), called to his court artists of all kinds of industries and settled them in his new city. From Rome he selected the most skilful of the workmen accustomed to make those world-renowned vases in glass, and gave them studios; they were most likely all placed in one quarter of the town, and M. Labarte points out the fact that one of the gates was called Glass-making; it opened on to the port, so that the productions of the glassworks situated near it might easily be transported on board the vessels waiting to carry them all over Europe. Glassmakers were exempted from all personal tax, and Byzantium in her turn sent presents of royal onyx and glass vases to Italy. Roman artists fled from the troubles in fallen Rome for refuge to Byzantium, and those marvellous cups which for centuries had been the pride and delight of the Roman people were made there no more; if some few factories survived the fate of the empire, they confined themselves to producing common glass only, meant for domestic use. Meanwhile the East furnished Europe with all the gilt and enamelled "verre de luxe" required, until the time when the palm of superiority passed to the Venetians, and they succeeded in creating glass even more beautiful than the older workmen had dreamed of. Ancient furnaces were re-lit in Greece, and glass factories

were established in Macedonia, Thessalonica, Phœnicia, and Alexandria. After the Arab conquest they continued to flourish, and during the middle ages these oriental factories, whether Arab or Byzantine, were alone able to fabricate the finer and more ornamental kinds of glass required by those parts of the world where civilization was again awakening. During the middle ages the seat of manufacture was supposed to be Damascus, and we find Greek productions like those of Syria and Egypt all designated under the generic name of "verre de Damas," the glass made at the time in Europe being rude in manufacture and of a greenish tint. We know very little of the early products of the Byzantine workshops; Mr. Nesbitt is inclined to attribute to them examples containing classical subjects in decline, such as a bacchanalian cup belonging to Baron L. Rothschild which is classical but degenerating into feebleness. Byzantine artists seem to have followed classic models with more or less bad taste, and this would be a very natural result if we remember they probably only copied patterns brought with them, and every copy would fall short of the original by a greater distance. It was not till some centuries later that a real Byzantine school arose, and powerfully influenced European art in the twelfth and thirteenth centuries. The manufacture of glass would doubtless follow the example of the other arts. Window glass and mosaic were no doubt early industries of Byzantine workers, as the church of St. Sophia was built in the first quarter of the sixth century. Mosaic seems to have been a special branch of work in Constantinople; it is especially noticed in its place. Imitation stones, as suiting the eastern taste, appear to have been successfully made there also. The blue cup of Monza (A.D. 600), the famous table of emerald taken at Toledo (A.D. 711), and the celebrated sacro catino of Genoa, all came from Byzantine factories. M. Labarte quotes Constantine Porphyrogenitus as enumerating vases of glass among the objects sent by Emperor Lecapenus to Hugh, king of Italy, 926. Luitprand states that Greek bishops drank from glasses of small dimensions, 968. St. Mark's, Venice, preserves among its many treasures a thin crystal jug on feet, with a handle ornamented by two seated lions, with an inscription in Arabic letters stating it belonged to Aziz Billah, who reigned in Egypt in the second half of the tenth century. He married a Christian, and had a son whom he named patriarch of Alexandria. A probably Byzantine vessel of about the same date is a cup in the church

of St. Adalbert, Cracow, said to be the chalice of that saint, who died 997; it is of variegated glass, very massive, with eagles and lions carved in a very stiff style out of the thickness of the glass. A fragment of a very massive turquoise blue glass vessel, which has been ornamented with enamel painting in red and gold lines, is in the British Museum and is probably Byzantine; Nos. 320 and 321 may also be attributed to the same manufactory or school. The curious cups or bowls preserved in the treasury of St. Mark's, Venice, are always referred to as almost the only certain specimens we are acquainted with of Byzantine make; they formed, with many other objects in the same treasury, part of the plunder of the crusaders, taken from Constantinople in 1204. There are five cups and two bowls, all of greenish glass of inferior quality, and all have been cut with the wheel; they are supposed to date from 800 to 1200; they have been most carefully described by Mr. Nesbitt as follows:[1] "one of a somewhat elegant form has two handles, and is twelve inches wide and six high, it is without ornament; another cup has the surface so cut away that small cones are left standing up; another is cut into circles in a similar manner; another has outlines and spots left in a like fashion, with the addition of the figure of a lion couchant. The basins are shallow, about eleven inches wide; one has a setting of gems in silver gilt, and a long handle; the other has circles and cones in projecting lines on its under side, and a setting in silver gilt with a Greek inscription, 'Saint Panteleon protect thy servant Zacharius, Archbishop of Iberia. Amen.' The most remarkable however among these glass vessels is a small vase, three and a half inches high by four wide, of a very dark brown glass almost opaque, somewhat globular in form, with a wide mouth and two handles. The body is decorated with seven circles enclosing figures, which are painted on the surface in a pale flesh coloured enamel, with ornaments in gold and red. These figures are evidently free copies of antique originals, and are closely allied in style to the ivory boxes of Byzantine origin with mythological subjects, which may be seen in various collections and church treasuries; some of the figures are clothed and some are nude, one seems to represent Jupiter seated on a throne addressed by a figure with wings, probably Mercury, another figure holds a trident. The circles are composed of rosettes of blue, green, and red enamel, each surrounded by lines of gold. Above and below

[1] "Catalogue of Glass Vessels in the South Kensington Museum."

the points of junction of the circles are smaller circles of gold, enclosing busts of men with bands of gold in their hair. On the outer side of the mouth are rosettes in groups of four, with scroll-like flourishes in gold between the groups. An inscription in Kufic characters runs around the inside of the mouth, and another round the lower part of the vase. No reading of these inscriptions has as yet been obtained, and it seems probable they are merely ornamental and without sense. In the character of the figures and the manner in which they are drawn, and the rosettes, there is so close a similarity to the ivory boxes before mentioned that we may assume them all to have had a common origin, and this must have been at some place where works of antique art were familiar objects. The only point of dissimilarity is the presence of Kufic inscriptions, which have never been met with on the boxes in question, and which may perhaps point to Sicily, one of the countries where antique Byzantine and Arab art met. The ivory boxes in question with mythological subjects were made chiefly in the eleventh and twelfth centuries, the best period of Byzantine post iconoclastic art." A very beautiful ivory coffret of Hispano Moresque work was exhibited at the Burlington Club in 1879. It was signed with the artist's name Khaleḥ, and had a Kufic inscription on it stating that it was meant to contain precious spices, and its execution was so admirable that the sight of it inspired the artist with fortitude to support the troubles of his house. St. Mark's possesses also another very remarkable glass vessel which is probably of early date. It is of oriental make, of a turquoise green colour, nearly opaque; on the bottom are four Arabic characters signifying "God the Maker." The bowl is eight and a half inches wide and four inches deep; it is five sided, and has on each side a rude figure of a hare. The inscription and figures are all in low relief, probably cut with the wheel. The setting is of filagree, with stones and ornaments of cloisonné enamel. Tradition says it was a present from a Persian king, in 1470, but the style is not Persian and the character of the setting is earlier. Mr. Winston insists very strongly on the great influence of Byzantine art in Europe during the twelfth and thirteenth centuries, "the wider the experience the more positive the belief," especially is this influence traced in glass painting. The churches round Limoges, where a Venetian colony settled in 979, all resemble St. Mark's (the only real specimen of Byzantine architecture in the western empire); he considers all the glass painting of the time

tinged with Byzantine influence, indeed the glass used was probably prepared from Greek and Byzantine receipts. The ornamental details of early glass painting are very Greek in character, the foliaged decorations closely follow the examples employed by Greeks, and the same feeling may be observed in figures and draperies. Theophilus,[1] writing in the eleventh century, gives many minute details as to the methods followed by Greeks in ornamenting cups and flasks with various coloured glasses ground very fine, and placed again in the furnace; this method is more like enamelling than the gold ornamentation of Christian glass, though the Greeks seem also to have used gold leaf, but many instances are known in which both processes appear used in the same cup; they will be found more detailed in Christian glass. With the exception of the Arabs, Byzantine Greeks, and a few of the clergy, all Europe during the tenth century was plunged in a profound ignorance; one cause of the general prostration of knowledge at this time was the prevailing superstition that at the end of a thousand years from the birth of Christ the last day would arrive. The only rays of light that pierced through this mental darkness are found in Arab[2] and eastern writings. That the Arabs of the twelfth century made and appreciated delicate glass vessels, the lines descriptive of a wedding feast at Sinjar, by Al-Harîri, which are quoted at the head of this chapter, distinctly prove. The travels of Benjamin Tudela (1163) mention the manufacture of glass in Syria. There is little difference of character in the glass made about this time by Greeks, Syrians, or Egyptians; all show they were expert blowers of glass, but the material is bad in colour and full of imperfections; the Byzantine mode of gilding and enamelling glass seemed the favourite style of ornament. Inscriptions in large characters, very often in dark blue, are common; figures of birds, animals, sphinxes, and other monsters abound, the outlines generally put on in red enamel; sometimes the spaces between are gilt, the decoration is in various colours and silver. A cup preserved in the museum of Breslau is of this manufacture; it is a drinking cup without a foot, with ornaments on it in red enamel forming arabesque patterns. It is said to have belonged to St. Elizabeth, Queen of Hungary, who

[1] "Diversarium Artium Schædula."

[2] In the *Asiatic Journal* for 1819 is a curious translation from an Arabian author writing A.D. 850, who gives a careful and elaborate account of the trade carried on between India and China.

died in 1231. In the Cluny museum is an Arab vase of glass, with medallions painted in gold and an inscription in blue enamel. It bears the name of one of the Malek Adel dynasty, who reigned in Egypt between 1279 and 1294, followed by the words, "Honour to our master the Sultan, powerful, wise, and just." To the same age and possibly factory belong the basin and large bottle belonging to Baron L. Rothschild; the latter has an Arabic inscription with the name of El-Melek-el-Ashraf, a name borne by several sultans of Syria and Egypt in the thirteenth century. In the Slade collection, British Museum, may be seen a bottle of elegant shape diapered with birds, and a covered bowl, Nos. 334 and 335, both probably of Egyptian origin. The Arab lamps both in the British and South Kensington museums have been noticed in another chapter, they all date about the fourteenth century. The so-called verre de Charlemagne, in the museum of Chartres, has Arabic inscriptions; and the well known "Luck of Edenhall," still preserved in the Musgrave family, is an oriental cup elegantly enamelled but with no inscription. Another similar specimen is in the museum at Douai, and two good examples have been preserved since the fourteenth century in the cathedral at Vienna. The taking of Constantinople by the Turks, in 1453, drove many artists to emigrate; some went to Venice, where the art of glass-making was rapidly rising into importance.

The enamelled glass vessels once so highly esteemed in western Europe, as well as the rough enamelling on incised brass, are being now imitated with some success in Damascus. Captain Burton in his two books on Midian continually refers to the fragments of glass found, showing that it must have been in common use and made in the country. "On the ground at the ruins of El-Knuraybah are scattered fragments of sea coloured glass, varying in tint, like the Roman, from blue to green according to thickness; these fragments found principally on the coast where the wealthy inhabitants enjoyed sea bathing, never, as far as our researches extended, in inland settlements. Rare sherds of pottery found composed of almost pure kaolin. At Jebel el-Safra traces of ancient buildings, and down the stream the bank is a vast strew of broken pottery; one place covered with glass fragments was named the tavern, or hotel, by our sailors. At El-Haura, south of Yembin, the sailors dug and found shapeless fragments of corroded brass and copper, opaque coloured glass, and broken earthenware. At the mounds and tumuli, sole remains of ancient Elath, once

the port of Petra, we found large heaps strewn with scoriæ. I decided it was the smiths' quarter; between it and the sea the surface is scattered with glass, sherds, and slag. At El-Kantara a strew of scattered fragments and specimens of glass and pottery were gathered, and the same experience at Shaghab." Lady Anne Blunt[1] says near Shargát, Bagdad, "made a discovery of refuse glass, showing that at some period of history there must have been a glass foundry here." Dr. Birch points out that the Arabs soon substituted faience for glass, as may be seen in the Alhambra and many Moorish buildings.

The glass medallions, pressed with a stamp and used as test weights for money, which have attracted a good deal of attention lately in Egypt, were probably first made at Byzantium, as there is one in the British Museum with the monogram of Constantine, and one at Paris with Theodore's name on it. For a long time they were supposed to have been issued as coins, and were alluded to variously as "vitrei nummi," or *monnaies de verre* and *monnaies fictives*, but Mr. E. Rogers has successfully proved they were primarily designed as standard weights for coins, and "never intended to be used as current coins or representative pieces of money." M. de Goeje points out that the use of glass weights throughout the whole large estates of the Fatimite princes (who only re-established an ancient custom) explains at once the frequent occurrence of these objects both in Egypt and Sicily. The kit'a's spoken of were fragments of money that had currency. Ibrahim the Aghlabite prince abolished their use in Africa, which led to a fearful riot in Kairwan, A.D. 888. The Fatimite dynasty ended 1171. Mr. Rogers thinks weights of a similar kind to these so called Kufic[2] coins were in use among the Greeks and even amongst Mahommedans. The striking of purely Mahommedan coins only begun in A.D. 698 by Caliph Abd ul-Malik, who it is possible was induced to copy the Greek custom of making glass weights for the purpose of testing the weight of the current coin. The first Arabic allusion to glass weights is in a work of Demîri written about seven hundred years after, but giving an account of the Byzantine emperor having in 698 threatened to coin "dinârs which should contain insulting allusions to Mahommed. Ul-Malik was advised to circumvent the Greek

[1] "Bedouin Tribes of the Euphrates."

[2] Kufic letters were the ancient letters of the Arabic language, so called from Kufa on the Euphrates.

emperor by striking coins of purely Mahommedan type, "and you shall cast weights of glass, which cannot alter either by increase or decrease." As each caliph altered the weight of his current coinage, these glass weights were stamped with the name and sometimes date of the reigning prince, in order that shopkeepers might not test a coin by an obsolete weight. A large collection may be seen in the coin room of the British Museum; they are of all colours, though the larger number present different shades of green. Some larger disks or blocks of glass were cast by Mahommedans, and possibly used for weighing articles in shops; one such disk has the words "half ounce" on it in very bold Kufic characters, this would be two hundred and twenty-eight grains in English. Another interesting species of stamp is one giving the measure of capacity. These seem to have been broken off from some vessel; one in the Slade collection, British Museum, is the measure of a quarter kist, or rather over half an English pint; this bears date A.D. 733; the earliest coin weight described by Mr. Rogers is dated 712. Many of these weights have rosettes and ornaments on them.[1] Mr. Nesbitt thinks the practice was originated by Byzantines, continued by Egypt, and copied by Venice, where glass weights were made 1279.

Modern Arab families sometimes possess among their household treasures very handsome glass objects of some age; they are principally gilt covered bowls, chiefly used for preserving sweetmeats on public occasions such as marriages. They refer all these articles to Tunis, but no vestige of a local glass manufactory has yet been found there. They are probably due to Venetian and Bohemian enterprise, and Tunis was only a central market for the wares made to suit the Arab taste. The long-necked blue rose-water bottles sometimes brought for sale in Arab towns are most likely Persian in origin. The large quaint glass drums (darbouka), so much in fashion and so highly valued in Tunis during the reigns of former beys, but which are now superseded by a more European style of musical instrument, were chiefly made in the factory at Baccarat, France. They are very strong and richly gilt, in the Arab taste, and in the hands of a real native artist produce soft wailing strains which exercise the most extraordinary effect on their Arab hearers, throwing them with great apparent ease into a state of ecstatic trance incomprehensible to the European mind.

[1] See Mr. Rogers' paper to the Numismatic Society, 1873, and one to the Royal Asiatic Society, 1877, for more details.

CHINESE, JAPANESE, AND INDIAN.

"The king says, O Fung, I have no pleasure in making you this long announcement, but the ancients have said, 'Let not men look only into water; let them look into the glass of other people.'"—*From the Charge against Drunkenness, "Chinese Classics": Dr. Legge's translation.*

CHINA AND JAPAN.

THE extreme antiquity of civilization in China is proved (if proof be wanted) by the fact that parts of the Shoo-King[1] were undoubtedly written more than two thousand years B.C., when the Chinese were already acquainted with writing. In these books are allusions to glass, one of which is quoted at the head of this chapter. Then we find it stated that the Emperor Shun, on receiving the crown from Yaou, who abdicated 2145 B.C., "examined the gem-adorned turning-sphere and the gem transverse tube, that he might regulate the seven directors, or regularly governed bodies." The writer of this must have had some constructed instrument connected with astronomy in his mind's eye. It is acknowledged the "seven bodies" mean sun, moon, and five planets. The existence of instruments is in accordance with the astronomical knowledge we know Yaou possessed. In the introduction of the late J. Williams' work on Chinese Comets it appears that certain astronomical phenomena recorded by the Chinese, even at an earlier date than the Emperor Yaou, have since been tested and found correct. It being supposed that human eyes have always had much the same circumscribed power of vision, could these phenomena have become known to the Chinese sages without the help of astronomical instruments? Yaou reigned 2300 years B.C., and left the kingdom to Shun. Surely the power of making a telescope would argue some knowledge of glass! It is doubtless to the telescope of the Emperor Shun that P. Gaubil alludes in his Chinese chronology, giving the

[1] "Chinese Classics," translated by J. Legge, D.D.

date as 2283 B.C. The Shoo-King is full of evidences of a very high state of civilization in China; thus in one book we are told the wild tribes brought tribute of oyster pearls, and strings of pearls not quite round, to Yu, 2004 B.C. This emperor wore tassels of pearls hanging down before and behind from his crown, and all his chief officers wore pendants of the same kind (in time of mourning they were made of black gems).[1] If the Chinese understood glassmaking they would soon begin to copy these pearls; and we find under Ou-ti, about 140 B.C., a manufactory where false pearls were made of lieou-li, a species of glass made from a herb, probably fern. Our great ignorance of ancient Chinese literature makes it difficult to collect true information on many points. We know they understood the art of glazing pottery at a very early date, and on this account were possibly more careless about glassmaking. Porcelain was invented it is supposed about 185 B.C.; the writing on the bottles found in tombs was used in the century before our era. The martyr god of porcelain was a potter who threw himself into the furnace one day, when for want of fuel the failing fire would have spoiled the contents of the kiln, an unexampled instance of devotion to his art. Another writer says the emperor having ordered some "phantasie," the execution of which was deemed impossible, the potter, Pu, in despair at his non-success, flung himself into the flames, and the ware then in the oven proving to the emperor's liking the hero was deified and became the idol presiding over all porcelain works. The Jesuit missionaries, from whom most of our knowledge of ancient China is derived, describe the process of extracting the oil of stone for glazing pottery. It is made from a powdered stone, white, with spots in it, then mixed with the oil made from ashes of fern and lime, and kept at the consistence of cream for varnishing pottery. Julian Stanislaus says: "Glass has never been seriously studied in China, and the few pieces fabricated ought not to be considered but as specimens isolated and exceptional. Ancient Chinese knew how to produce, with a mixture of lead, sulphur, and potash and powdered 'alumineuses' stones, a transparent substance which they modelled into various shapes by means of the blowpipe, but were never advanced in the art. They do make glass mirrors, applying thin sheets of tin at the back; but they are not so esteemed as those

[1] In sign of mourning for this emperor the eight different kinds of musical instruments throughout the kingdom were hushed.

made of metal, the glass not being completely smooth gives a distorted and unnatural reflection."[1]

The celebrated patra or alms bowl of Buddha is alluded to by a Chinese writer of 1350, quoted by Mr. Nesbitt: "in front of the image of Buddha is a sacred bowl, which is made neither of copper or iron; it is of a purple colour and glossy, and when struck it sounds like glass." This bowl may have been brought from the west to Ceylon, but it proves an acquaintance with glass on the part of the Chinese writer.

A Portuguese traveller in China, G. da Cruz, writing to Sebastian, king of Portugal, about 1560, says at a banquet given by a very rich merchant "the house was built with a loft and very faire, with many faire windows and casements, and all of it was a mirror"; what the mirrors were made of he does not explain, nor if the casements were filled with glass, but this is one of the earliest notices concerning life in China, as the Arab El-Edrisi, 1154, does not seem to have been himself in China; he says "Djan-kou is a celebrated city, the Chinese glass is made there." Djan-kou has not been satisfactorily identified with any existing city, but the passage shows that Chinese glass was supposed to exist. M. Labarte thinks it probable that fine porcelain and not glass is really meant by El-Edrisi, but an Arab of the twelfth century is unlikely to have made any confusion between the two substances, with which he must have been perfectly familiar. Mr. Nesbitt, who has collected together many allusions to glass in the writings of the early Jesuit missionaries, says the words "po-li" were in use for a glass at a very early time. One missionary quotes from the Chinese annals that in the beginning of the third century the king of Ta-tsin sent to Tai-tsou of the Wei dynasty very considerable presents of glasses, of all colours, and some years afterwards a glassmaker, who by means of fire could change pebbles into crystal and who taught the art to disciples. The Wei dynasty reigned in northern China, and the manufacture of glass in Shan-tung, extensively practised to this day, possibly owes its origin to the glassmaker of the third century. Pere Duhalde in his description of China, 1735, says the kind of glass called lieou-li was made at Yen-tching, near Shan-tung, that it was more brittle than that of Europe, and broke when exposed to the inclemencies

[1] "Industries Anciennes et Modernes de l'Empire Chinois."

of the weather (vol. i., p. 213, French ed.). In Purchas' Pilgrimmes another writer gives a curious account of the manufacture of lieou-li in his time; it was so thin as to be elastic, and all sorts of toys were made of it for children, also trumpets and grapes, these last so natural as to deceive the eye; all these objects were extremely cheap. This writer seems to have been perfectly acquainted with the nature of glass, so we must conclude the Chinese had then a knowledge of some process by which the elasticity of glass or its toughness could be much increased, a knowledge which however no modern traveller seems to have noticed. The missionary first mentioned says he could furnish many proofs of the antiquity of glass in China, but he will only mention a vase of glass presented in A.D. 627 to the Emperor Tai-tsou, which was so large that a mule could have been put inside it, and it was brought to the palace in a net suspended between four carriages. The writers who mention glass however speak with contemptuous pity of the false pearls, the mirrors, the celestial globes, the windows, screens, and great vases made under the Han dynasty. The ancient books state that mirrors were made from pebbles and a material obtained from the sea reduced to ashes, evidently soda made from seaweed. Nearly all French writers on glass allude to the tale of a piece of crystal being taken in China for the real material of which heaven is made. The original narrator of this account is Father Ricci, who left Europe 1583 and spent some years in China; he states that he gave a prism of glass to a native convert, one Chuitaso, who put it into a silver case with gold chains, and "adorned it further with a writing that it was a fragment of that matter whereof the heavens consist. One was said to offer him five hundred pieces of gold soon after for it, which till Father Matthew had presented his to the king, he would not sell; after that he set a higher price and sold it." We may suppose from this that colourless brilliant glass was unknown to the Chinese; in another passage Ricci says, "they make glasse but therein are short of the Europeans." He also tells us "the first new and full moon of the year is a great festival, each man having then ingeniously devised lights or lamps made of paper, glasse, or other matter, the house seeming by the diversified lights to be one great fire." The same feast of lanterns we find practised by many ancient nations in honour of fire. The Russian ambassador, E. Ides, who went to China 1693, says he was taken

by command of the emperor to see various sights, among them some "jugglers, who, after many other diverting tricks, played with round balls of glass as large as a man's head at the point of a sharp stick, tossing them several ways without breaking them or letting fall, so it was really surprising." He was also taken through the markets and to various shops, especially a toy shop; the owner had a fine garden, and among other things showed him "a large globe full of fish about a finger long, whose scales appeared as if made of gold, but when the scales fell off they were a beautiful crimson."

One of the French missionaries says in his time there was a glasshouse at Pekin where every year a good number of vases were made, some requiring great labour because nothing was blown, but it was only considered an appanage to the imperial magnificence, and the emperors paid so little attention to the manufacture that they had not thought it worth while to place learners with the European glassmakers sent out or even to bring them up from Canton. One writer, in 1774, advises the importation of glass vessels into China, and says they should be coloured and wrought, and suggests the French workers should copy Chinese forms, such as the little bottles for holding snuff. Some years ago a collection of smelling bottles was exhibited at South Kensington; among them were several Chinese double bottles in various materials, some carved in glass imitations of stone. There are many beautiful specimens of these kinds of modern Chinese glass works, carved beads, bowls, and bottles, imitating agate, chalcedony, and other stones, in very harmonious colours, well worth studying, to be seen in the British and South Kensington museums. Mr. Nesbitt states that two bottles or vases, said to be of a very early date and to have been long preserved in the imperial family, have lately been given by Prince Kung to the Austrian minister in China, Chevalier Von Schäffer. It is evident the Chinese, having such beautiful porcelain at command, only used glass to indulge their taste for rarities, possibly also for colour. The Rev. A. Williamson gives an interesting account of the present activity of the ancient factory in Shan-tung. The glass is made of the pulverized rocks of Po-shan, probably quartz and nitrate of potass; of this they make excellent window glass, bottles of all sizes, cups, lanterns, beads, and ornaments of endless variety. Many of these articles are very finely finished.

Japan has so long been a sealed book to us that it is nearly im-

possible to find any information as to glass made there. Captain John Saris, who sailed 1605 (Purchas' Pilgrimmes), advises that merchants should take to Japan "drinking glasses of all sorts, cans, and cups, beere glasses, gilt beakers, and looking glasses of the largest sorts." This would lead us to infer that those articles were not made in the country. Kaempfer, who published his history of Japan in 1727, does not mention glass beyond that required for glazing the porcelain, which he describes as most prized when nearly transparent. The labour required to achieve this transparence was so great as to give birth to the old saying "that human bones are kneaded into China ware."[1] He gives a singular account of some very curious ancient tea-bottles called "maatsubo" (best of vessels); they are shaped like small barrels with a short neck, are transparent, very thin, and of a white colour tinged with green. The Japanese believe they give a higher flavour to tea kept in them, and assert that old tea recovers its virtue if put into a maatsubo bottle. They are found by divers sticking to the rocks of the submerged island of Mauri, near Formosa. The bottles must be taken off with great care for fear of breaking them; they are much disfigured by shells, coral, and submarine substances growing on them, which are never quite scraped off, as proof of the genuineness of the article. Merchants give high prices for broken ones, which they mend beautifully. No one dares to purchase the whole bottles found; they are reserved for the emperor's treasury, who has inherited from ancestors so many as would amount to a large sum of money if sold. The island of Mauri is supposed to have been submerged by the anger of the gods; some scoffers having painted the faces of the idols red, no one escaped save the Prince Peiruun and his family who reached China, where the day of their arrival is still kept as a festival, the people row about in boats and call on "Peiruun." Much interest was excited a few years ago by an account of the exhibition of many antique articles at Nara, the ancient capital of the mikados of Japan, near Kioto the present capital. Mr. Campbell[2] describes this exhibition. It is supposed that each mikado had put aside some important treasure and dated it, before the removal of the government at the end of the eighth century to Kioto where it has remained ever since. Among these treasures is a glass ewer

[1] It is singular to trace this feeling repeated in the Scotch song of "Caller Herrin'" and Hood's "Song of a Shirt."

[2] "Circular Notes," vol. ii.

about a foot high, which is entered in the original list of the articles deposited in the sort of barn where they have been preserved. As no certain knowledge of glassmaking in Japan exists, it has been suggested that this ewer was imported either from China or by Arabs before the eighth century, and being considered a curiosity was deposited among the treasures. It is possible that before long some Japanese writer may be enabled to throw some light on the whole subject of glass in his native country. A recent traveller[1] describes a very curious vitreous sponge with threads which seem as if composed of spun glass, found on the eastern coast of Japan.

The Rev. J. Edkins in his "Chinese Buddhism" makes the following remarks on the origin of the word "glass," which may interest some.

"I here place some remarks on 'glass' (po-li). In Buddhist glossaries the Chinese 'po-li' is derived from the Sanscrit word 'spatika,' crystal. Many Hindoo Buddhists who came to China spoke dialects of Sanscrit but not Sanscrit itself; the 's' was dropped and the final 'ka'; the 't' in 'ti' became 'l,' as in the Turkish 'belur.' The rock crystal of China comes from Turkestan, and would bring its own name with it from that country. Buddhist makers of glossaries would prefer to derive the word from Sanscrit as the mother of all knowledge. They have passed over without remark the possibility that the Chinese word may come from the Turkish. The word 'po-li' for glass, formerly pronounced 'pa-li,' has been in common use in China since the Tang dynasty. It came in with Buddhism and the international trade with Turkestan. I believe the initial 's' in 'spatika' might be an accretion and not original, as most probably 'smelt' is later than 'melt.' Curiously we find in the Mongol vocabulary 'bolor,' crystal, glass; 'bolor daboso,' rock salt; 'bolo ch'ilagon,' a polishing stone. Compare Turkish 'bileghi,' whetstone. Let it be noticed that glass dust is used by polishers and grinders. Whether the 'bôli,' or 'bali,' is of Turanian origin and has originated the Sanscrit 'spatika,' it would be interesting to know; 'ballur' is Arabic for crystal, 'spashta' is Sanscrit for clear, 'borrak' is Turkish for clear, limpid. Probably here is the root, but who shall decide?"

[1] Capt. St. John: "Wild Coast of Nipon."

INDIA.

We can collect very little information concerning ancient glass in India, it is only by placing together bits of information from various sources that any conclusion is possible. Many authors insist on the close trading communication between India and Egypt, which would lead to the supposition that the manufactures of one country would be familiar to the other. One of the earliest notices of such a commerce is found in Gen. xxxvii. 25, when the Arab caravan which carried Joseph (1729 B.C.) into captivity was at the time engaged in transporting to Egypt balsam, myrrh, and spices, Indian products. In the days of Solomon and Hiram the trade with India flourished to a great extent. The religions of Brahmins and Egyptians are in so many points identical it is difficult to believe they had not a common origin.[1] One singular corroboration of this idea is given by Captain Light in describing the ruins of Dendyrah, Egypt.[2] "It was here that our sepoys, in their march from Keenah to join the army of Lord Hutchinson, imagined they found their own temples and were very angry with the Egyptians for their neglect of their deities; I have understood from English officers who accompanied the Indian army that the sepoys performed their devotions in these temples with all the ceremonies practised in India. This fact affords a strong proof of that connection in remote antiquity which the researches of the Calcutta Society have led the learned there to suppose anciently existed between Egypt and India."

Royle[3] says: "the similarity between the arts practised in Egypt and India is so great that it is hardly an exaggeration to say the pictures painted on the walls of Egyptian tombs might be introduced into a book of modern travels as representations of Hindoo artisans." No glass of positively Egyptian origin has been found in India. That exhibited in the British Museum found in a tope at Braminabad, some found in the tope of Manikyala, Punjaub, by General Cunningham, and fragments found in ruins in Thibet, and vessels and fragments found in other topes which are supposed to date from about the Christian era, are all similar in make to Greek or Roman glass.

[1] For the extraordinary resemblance between the two mythologies read "History of Hindostan," by T. Maurice, also the works of Sir W. Jones.
[2] "Travels in Egypt": 1818.
[3] "Arts of India."

We know that glass is one of the articles of export mentioned in the Periplus[1] as sent by the Red Sea to India. Many writers have pointed out the numerous Sanscrit names which occur in Greek mythology. Mr. Stone[2] mentions a singular fact that in the catacomb of St. Proetextatius, Rome, there is a picture representing the judgment of two Christian women; one of the judges is Jupiter, the other is "Abracura," a Sanscrit word signifying Queen of Heaven, the spouse of the Indian Jupiter. Many of the Indian "vedas," 1500 B.C., are translated word for word into Greek. Eusebius, A.D. 340, mentions a Hindoo visitor at Athens. Mr. Fergusson when describing the Amravati sculptures (river Kistnah, north of Madras) says: "the study of these sculptures has convinced me that there was much more intercommunication between the east and west during the period from Alexander to Justinian than is generally supposed, and that the intercourse was especially frequent and influential in the middle period between Augustus and Constantine." This was just the busiest time for glassmaking in Rome, and her cheap and common wares would doubtless have been exported to India; after this probably for some centuries the export ceased, and as the Indians would seem never to have made much glass themselves we only find the remains of classical glass preserved in topes. Sir G. Birdwood has suggested that when Pliny speaks of Indian glass being beyond compare because it is mixed with crystal he probably meant Chinese; a confusion very likely to be made at that time in Rome, especially as the Chinese still use quartz rock at the present day for making glass, and Royle tells us enamellers in India still use cakes of glass imported from China. Mr. Nesbitt quotes from the Mahawanso (chronicle of the Singhalese kings, 306 B.C.) "that mirrors of glittering glass were carried in procession, and festoons of beads like gems," probably glass; about the same date the chronicle mentions "windows with ornaments which were bright as eyes," which would seem to refer to those windows (still in use among Arabs) in which small pieces of coloured glass are set in perforated marble or stucco. The Hindoos seem to have been long aware that glass is a non-conductor of electricity, and placed lumps of it on the tops of

[1] It would perhaps be unwise to attach too much belief to the works of Scylax, as the writer on India of that name asserts that there dwelt in that country men with feet so large that they were in the habit of using them as parasols, others had ears like a winnowing fan so large that they slept in them!

[2] "Cradle Land of Arts and Creeds."

their temples as a protection against lightning. Admiral Fitzroy states that in Japan, China, Siam, Ceylon, and other eastern countries a system has prevailed from time immemorial of placing lumps of glass on the pinnacles or other high points of buildings to avert lightning. An obscure passage in the Mahawanso, A.D. 241, seems to refer to this practice; it runs thus: "having placed a large gem on the top, he fixed below it for the purpose of averting lightning a 'vajira chumbata' like a ring." Turner has translated 'vajira' glass, but it may mean a loadstone or iron magnet. These passages from the chronicle appear to prove that the making of glass has been earlier in date and more important in practice than has been usually supposed, and the whole matter deserves more consideration than it has yet received. A very curious passage in the life of Hionen-Thsang, a Chinese Buddhist, A.D. 629, who undertook a journey to India, describes his passing through Thibet, and near the Ganges arriving at a convent where was placed a diamond throne of one hundred paces round, on which the disciples of Buddha sat, that is to say it was firm, solid, and indestructible; and he adds naively "if it had not been made of a diamond, how could the disciples of Buddha ever have gone into the ecstasy of the diamond?" What could it have been the Chinese monk saw?

Mr. R. Tyler, in describing the temple of the idol Neel Kauta (blue throat) near the fort of Kallingur, says the principal idol is of black stone, column shape, cut out of solid rock, with a large human head adorned with projecting triangular-shaped silver eyes, each nearly the size of a teacup, decorated with glass eyeballs, in substance and shape resembling a bull'seye lantern, and perforated in the middle of the glass with a hole the size of a pea to represent the pupil of the eye. A female idol in the temple has similar eyes. In 1023 Prince Mahmoud marched against Kallingur; the fortress was a great object of attack among Mahommedans, and this idol is certainly older than their era.

Indian enamellers have always been celebrated, and the art appears to have been very ancient. In the fortress of Gwalior, taken by the British in 1780, are two remarkable pyramidical buildings of red stone, in the most ancient style of Hindoo architecture; they are said to have been built as residences for the mother and sister of a rajah who lived at a very remote period, when this fortress was the capital of a large and extensive empire. Along the east side of these buildings runs a line of blue

enamel, still very fresh and brilliant; a proof that this manufacture attained great perfection in Hindostan at an ancient date. Near the fort is the tomb of a very learned man, Mahommed Ghous, who lived in Akbar's time. The cupola of the tomb is covered with blue enamel. Mr. Royle observes "we have the curious fact of uneducated natives being found in almost every bazaar, who can make alloys, colour glass, and work enamels by methods which are unknown in Europe, with the most simple means and apparently rudest processes." Dr. Tennant is of opinion that before the arrival of Europeans in Hindostan not a house in all India was furnished with glass windows; the Hindoos made trinkets and ornaments of glass, but were unable to build furnaces of sufficient power to make useful things. This cannot have been true of north India, as the emperor Jehangir planted the beautiful gardens of Shalimar, Lahore, and in these gardens he is said to have built a palace of glass for the peerless Nourmahal. Where he got his glass from is not known; the system of canals and the magnificent buildings left by him attest a high degree of civilization. There is a small glass manufactory still carried on in Kashmir, which may have originated in this palace, as the mosaic industry of Agra originated in the Taj. Mr. Prinsep[1] says that at a wedding at Sreenugger, Kashmir, among the couplets sung by various members of the families the mother of the groom asks the bride, "Didst thou suffer any inconvenience in thy glass jampan?" Mr. Prinsep describes the ceiling of the Rajput palace of Jodhpore as an elaborate gold carved pattern over glass, which no doubt lights up well at night, and says the Oodeypore palace had numerous rooms highly decorated with elaborate patterns made of coloured glass all over wall and ceiling; several apartments had pigeonholes of looking glass, in each of which was placed some small glass box, jug, or vase; the effect was savage, but somehow very rich; these palaces are comparatively modern. Buchanan, who was sent in 1800 by the Marquis Wellesley, then Governor-General of India, to collect information through Mysore, describes glassmaking at Chinapatam. They manufactured there principally coloured glass, which they made of powdered quartz and cakes of fossil alkali, adding copper or iron as they required blue, green, or red. They make anklets and armlets, principally for women, of coloured glass. A good workman makes ten of these glass

[1] "Imperial India."

rings a minute; a great many are used, as each woman wears several, and as they must fit close they are rarely got on without drawing blood and are often broken; as Indian habits do not alter, the process described has most likely been going on for ages. Rings of glass also form part of their warping reels, and small greenish bottles are common; but it is probable the diffusion of oxide of iron in Indian soil has prevented the making of both good glass and pottery. The native shapes both for clay and metal are very good, and their enamelling is well known for singular brilliance and beauty of colour. Heeren seems justly to have ascribed the flourishing state of many of the cities of Egypt, Babylon, Palmyra, and Petra to their ancient trade with India. Quantities of glass must have been sent to India by the Venetians, from the notices of it in the travels of Hawkins, Sir J. Roe, and others; and the annals of the East India Company show what numbers of chests of glass a year were imported into India; but the native manufacture, never very large, appears declining, as even in Buchanan's time the natives of Muteodu told him they used to make a great deal of blue glass with a substance called runga, but the manufacturer having died no one else knew how to make it. It has always unfortunately been an eastern habit to keep trade secrets inviolable.

GREAT BRITAIN AND IRELAND.

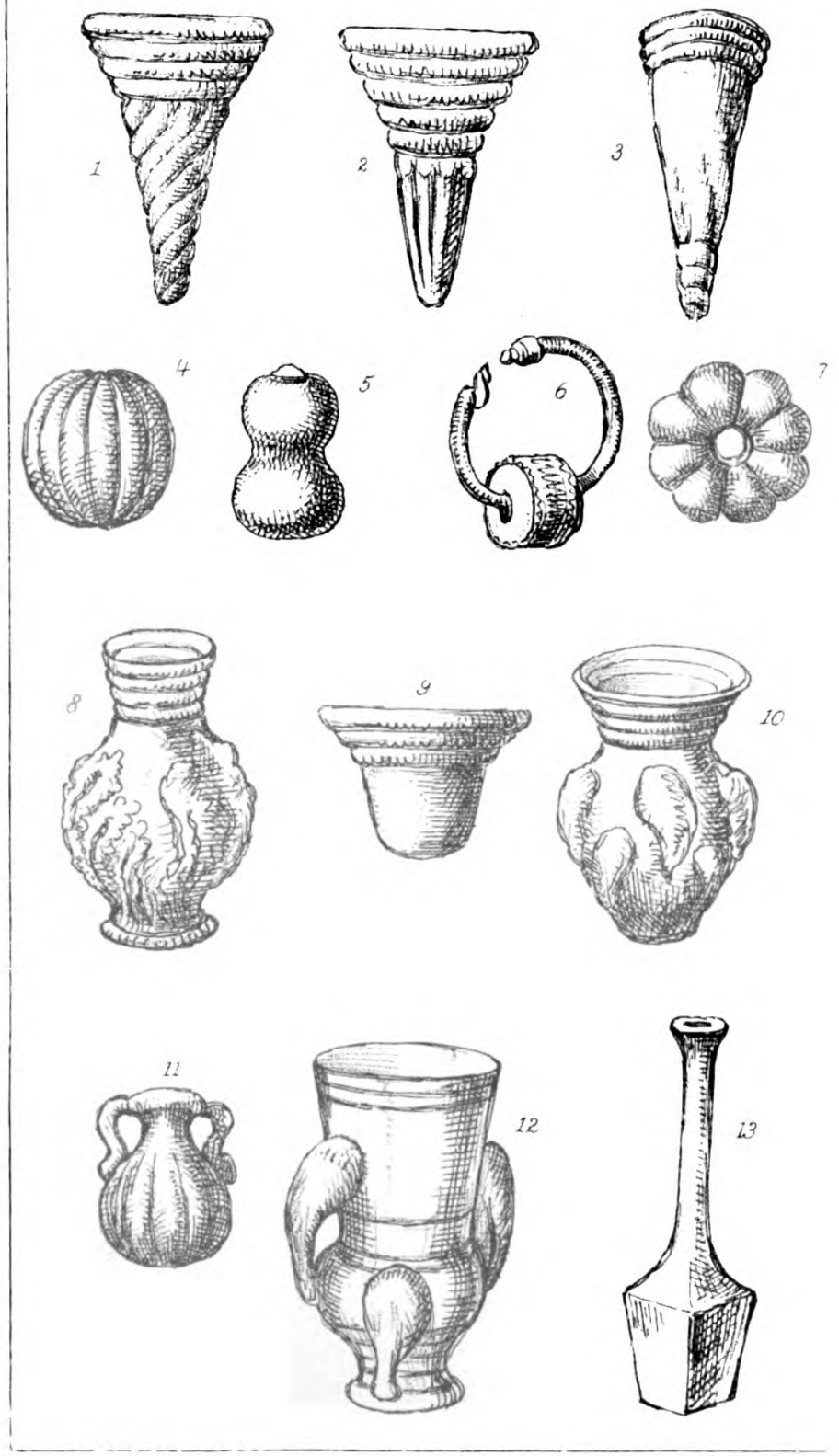
"Who, when he saw the first sand or ashes by a casual intenseness of heat melted into a metallic form, rugged with excrescences and crowded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world? Thus was the first artificer in glass occupied, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature and the beauty to behold herself."—*Johnson's "Rambler."*

ENGLAND.

WE are too much accustomed to look on all civilization in Britain as dating from the Roman invasion, whereas in Cæsar's time, 55 B.C., Britain had a considerable commerce, indeed must have then been a naval power, as the assistance she sent to the Veneti in Gaul was made the pretext for the Roman invasion 42 A.D. Tacitus, nineteen years afterwards, speaks of London as a city of the greatest importance from its commerce and its crowd of merchants, a result which could not have been achieved in so short a time and during a state of warfare. Strabo, who wrote twenty years before the first settlement of the Romans in Britain under Plautius, says the inhabitants exported various metals, cattle, slaves and hounds to the Rhine, Seine, Loire, and Garonne, and imported earthenware, copper vessels, necklaces, glass, and salt. These exports would come down the Thames, so there must have been a commercial port on that river just such as we find London described by Tacitus. Long before that date the Phœnicians had traded with Britain, "Tinland," for tin; Sir Cornewall Lewis admits that this trade was carried on between 1500 and 1200 B.C. Some moulds for casting tin have been discovered, and one pig of tin which, as it differs from any made by Romans or Normans, has been considered Phœnician; it is preserved in the Truro Museum, and a cast can be seen in the Museum of Geology, London. This would indicate a knowledge of smelting which would soon lead to

Plate IV

Plate IV.



BRITISH GLASS.

a more advanced civilization.[1] Lewin says that when the workmen were excavating the foundations of the Royal Exchange they first discovered the usual debris of houses, then a stratum of gravel two feet thick, and below that a pit nineteen feet deep, filled with pottery, broken glass, lamps, old shoes, and coins of Vespasian, Domitian, and others. This spot must have for a length of time been outside a well peopled city. Penmarch is of opinion that glassmaking in Britain dates prior to the Roman invasion. Druids were accustomed to impose upon their more ignorant followers by means of coloured glass, clumsily formed, beads, which they pretended were endowed with the quality of preserving their possessors from all evil. It is not improbable that the long trade with the Phœnicians must have introduced many of the manufactures of the south into Britain; and among an uncivilized population[2] anything like personal ornament, especially if supposed to possess supernatural qualities, would naturally be highly prized. If the manufacture of any glass in Britain can be assigned to pre-Roman times[3] it would probably be confined to those opaque imperfectly vitrified amulets or beads with wide holes, commonly called glain neidyr or holy snake beads, of which a more detailed account is given in the chapter on beads; specimens have been found all over the country, from Cornwall to the Orkneys, there are several examples in the British Museum. Glass however, both Greek and Celtic, has been found among the Druidic menhirs of Carnac, principally ornamented with striped lines straight or bent in chevrons. Similar glass has been found in other parts of

[1] The Carthaginians came to Britain for tin, as the Tyrians had done. The quantity of tin required for bronze in the old world was enormous; bronze was known in Egypt 2000 B.C. Tin is mentioned in the Periplus as one of the exports from Egypt to India, and it must have been brought by commerce to Egypt. The Phœnicians, very anxious to preserve the monopoly of a lucrative trade, jealously guarded the secret of the Tin Islands. Strabo tells a story of a Phœnician captain who, when chased by a Roman ship, steered on to a shoal of rocks and deliberately caused the wreck of his own and his pursuer's ship rather than betray the secret of his destination, for which he was rewarded out of the public treasury. Afterwards the Romans unravelled the mystery and shared in the trade.

[2] Those who have seen in the museum of Scarborough the figure of the ancient Briton (pre-Roman) whose oak-tree coffin was found in the neighbourhood will remember that it is not the semblance of a savage which the peat moss and oak bark have preserved. The remains are those of a man over six feet high, with a well developed forehead and style of face; the figure looks like an ebony statue; some bronze was found in the coffin.

[3] According to Strabo the Britons made glass vessels of a blue green colour, and a piece of ancient glass of such a colour has been found at Stockton Works.

France, and also at Hallstadt in Austria; and if, as authors say, the Druidic religion was the same from India to Thule, the same amount of knowledge was probably common to all.[1] A curious passage in Diodorus Siculus (lib. vi.) says that in an island west of the Celtæ the Druids brought the sun and moon near them, whence some have suggested that telescopes were known to them. The expression in one of the "Triads," of the moon appearing to be near the earth, is also worth attention. These "Triads" existed long prior to the modern discovery of telescopes; one of them gives "cibddar, the speculum of the son of pervading glance or the searcher of mystery," as one of the secrets of the island of Britain. The knowledge, if it ever existed, must have been lost, and probably never was known save to a few of the priests and kept by them with the usual habit of their order all over the world as a profound secret, for the use only of those initiated in the higher mysteries. We know the Chinese were very early acquainted with the use of telescopes, and among the Persians we find traditions of many astronomical facts which could scarcely have been learned without some magnifying aid to the eyes; so, if as some say the Celts came originally from the East, there is nothing impossible in their having brought the learning of the East with them. As soon as the Romans gained a settlement in Britain, they doubtless introduced all the luxuries they were accustomed to use at home, and to their skill must be attributed the quantities of glass found buried in tombs or disinterred in London and other cities. One of the earliest specimens to which a date can be attached is a bowl of ribbed bluish green glass, placed within a vase of red glazed pottery, that was found in a grave near Takeley, Essex (now in the possession of Mr. J. Clarke), together with three coins of Vespasian, A.D. 69, which as they were not defaced by circulation may give an approximate date to the interment and prove that even at that early period choice works in glass were imported into Britain.[2] A similar bowl was found among the extraordinary sepulchral remains excavated by the late Mr. Tastrip, Shefford, Bedfordshire, with other elegant

[1] A melon-shaped bead found in a British tomb is formed of the pressed scented composition common in the East. This bead still retained its scent and must have been imported from the East.

[2] In recent excavations for rebuilding Messrs. Tylors' premises, in Newgate Street, a rich collection of Roman antiquities was found; among them three leaden situlæ, each enclosing a beautiful glass urn of large size. From the presence of coins of Nero and Claudius, these urns may be approximately dated.

and rare glass vessels, among them a blue glass bottle with narrow neck and a handle ornamented with ribs, and an amber coloured vase, with ribbed globular body and wide mouth. Fragments of glass and bottles found in graves at Faversham, when compared with those found in the south of France and Germany, seem to be identical in shape and quality, and it is difficult to believe that the Anglo-Saxon glass was not all imported. Among these are bowls of a dark copper colour, but which, when held up to the light, appear to be deep blue; others are opaque, variegated with lines and shades of various colours light or dark in shade. Pieces of glass found in London are precisely of the same make and pattern as those brought from Rome, Nismes, and other places; there is one especial kind formed of shades of green, similating leaves, a very common pattern in Rome and equally common in London. It is scarcely possible to believe that all this glass was not manufactured at the same place, as even when the same process is used or the same workmen transplanted to another place, some unknown difference in the materials used produces unexpectedly differing results in the making of glass and glazing of pottery. Very marked specimens are the shallow glass cast bowls, with the figures and names of gladiators pourtrayed on them, found in London and Hartlip, evidently from the same mould as those found in Pompeii. The British Museum contains numbers of very beautiful beads from English tombs, with specimens of mosaic and other glass, much of it found in London.[1] Among these are undoubted fragments of window glass, also one piece made for a mirror and several specimens of mosaic; these are all noticed more at length under those heads. The number of vessels interred with the dead were meant to hold blood, milk, wine, pulse of various kinds, and honey cakes, for libations, and water, balms and oils for purification. Virgil in the "Æneid" mentions blood and milk; and Servius, in explaining the custom, says that the soul delighted in milk, being the natural nourishment of the body, and in blood, the union of body and soul; the saucer shaped bowls are those used for the libations. Though we owe so much of our knowledge of ancient life to the explorers of tombs, it is impossible to read of the continual spoliation of sepulchres without remembering the story of Nitocris, queen of Babylon, whose tomb (reported to enclose great riches) was broken open by Darius, 516 B.C., in search

[1] See Plate IV.

of her treasures, but he found nothing save her body and a scroll on which was written, "If thou hadst not been insatiate of pelf, and a sordid and avaricious soul, thou wouldst never have violated the repose of the dead." Mr. Gough[1] thinks that one kind of barrow, of circular form, raised in the middle like a cone, and which is generally found to contain blue glass and amber beads together with metal trinkets, is to be ascribed to the Firbolgs or Belgæ who, long before the Roman invasion, had crossed over to Britain; those barrows which contain lamps, vases, and urns, may be considered Roman. In the shifting sands of Westram, Orkneys, some ancient barrows were laid open containing beads, and in one a metal spoon and a very neatly made opalised glass cup holding about half a pint. In some of the Orkney tombs at the links of Skail beads are found, stone and glass, together with bodies that have been burnt and that in a very fierce fire, so that they are nearly vitrified and look something like the clumps thrown out by forges. The bodies were sometimes only buried in woollen shrouds fastened with bone or wooden pins, which are found with bones, and it is supposed that these pins were made in a few cases of glass, like pins without heads. Mr. Douglas, who opened some tombs at Chatham, found beads of glass, amber, and clay, glass vases, and crystal balls; these latter he thinks were used for magical experiments,[2] and he thinks beads were only found in the graves of women; this is however a mistake, many men's skeletons still wear their necklaces of glass beads. At Ash Richborough in 1762 several wooden coffins were found, the skeletons in each having a sword and a spear beside them, and a necklace of glass and amber beads; from the coins buried with them they are concluded to have been Roman soldiers. The skeletons of men sometimes wear bracelets as well as necklaces. In the island of Ely was discovered with a skeleton a curiously shaped glass vase like a pipe; and at Chesterton in 1754 a stone coffin contained, besides a man's skeleton, three glass lachrymatories; the only perfect one of them contained a fungus-like substance, mixed with water of an aromatic smell and a coin of Faustina and Gordian. On Winstre common, Derbyshire, from a barrow which also contained silver ornaments and red glass beads, were

[1] "Sepulchral Monuments of Great Britain": 1786.

[2] "Such was the glassy globe that Merlin made,
And gave unto King Rymer for his garde."
—*Spenser's "Fairy Queen."*

taken two glass vessels, eight or ten inches high, with wide mouths, each containing a pint of greenish water. Stow relates that in 1576, on the field now called Spitalfields being broken up to make bricks, among numerous Roman remains discovered there were "divers phials and other fashioned glasses, some curiously wrought, some made of crystal; a few had water in them, others oyle." Such instances are not uncommonly found to this day; one bottle half full of liquid is in the Rouen museum and others have been found in Pompeii.[1] In Dr. Mortimer's account of tumuli opened near Canterbury, 1730, he speaks of one of the greenish tumblers or urns often found in tombs, with a spiral cord round it, which when first found had a fragrant smell as if sweet gums had been in it; no bones were found in the urn, but a white powder with shining particles like talc and a thin iridescent skin inside the glass. Bryan Faussett describes opening three graves at Gilton, Kent, and finding in each one green and yellow glass, beads,[2] rings, and at the foot of each an urn of greenish glass; in one of these were coins of Justinian, which, being worn, would fix the date late in the sixth century; in one grave was an urn ten inches high, with a coin of Nero.[3] At Kingston and Sibertswold similar urns were found, always in the graves of women and children, though they have been found but rarely in the graves of men. In these graves were discovered beautiful long drop earrings of dark blue glass, and also some fibulæ of Frankish design, which would give a date of sixth or seventh century to the graves. In Weaver's "Funeral Monuments," published in 1631, is described a lead coffin, containing a woman's skeleton and several great phials of glass, six and eight inches square, having whitish liquid within them, and on either side two sceptres of ivory, and on the breast a white stone figure of Cupid. Many tombs were found at Stepney, which was one of the cemeteries of London. In the Roman tumuli at Bartlow hills, Essex, several large square glass vases were found, some containing ashes and some a dark coloured fluid. Douglas thinks the vases or cups found in Christian graves contained holy water to scare away evil spirits, and in pagan graves an aqua magica was placed for the same

[1] In the tomb of Childeric II., who died 673, was found a glass vessel filled with perfume which still retained its scent.

[2] See Plate VI. 5, a flat shaped bead, green with yellow lines.

[3] See Plate IV.; 11 is probably a Roman vase; 12 an Anglo-Saxon vase; 13 is the long necked bottle found in Greek tombs, and constantly reproduced in Roman and British graves.

purpose. Lucan makes the witch Erichtho bestow on a dead body she had raised to life a charm to secure it against any future incantation; "no words or no herbs shall disturb its sleep." Douglas engraves two very delicate pendants found at Sibertswold, formed of mosaic glass, one with light green chequers, blue and crimson stripes, and the other dark and light green chequers with a border of carnation. Mr. Akerman describes some gold ornaments set with vitrified pastes found in a tomb near Devizes; one round ornament with gold chains had a cruciform decoration from which the tomb was supposed to be that of a Christianized Anglo-Saxon lady. A fibula found near Abingdon, and another in a grave at Wingham Sandwith, are remarkable for the minute delicacy of the patterns formed by small pieces of garnet coloured glass, divided by threads of gold; the colour of the glass is heightened by the insertion of gold leaf at the back; bits of blue paste are mingled with the red glass. The most beautiful fibula of this class ever discovered is one found at Kingston by Bryan Faussett and figured in his work "Inventorum Sepulchrale"; from the same work I have taken the fibula (Plate VI. 3) found at Sibertswold. A very beautiful fibula found at Milton is now in the Ashmolean Museum, Oxford; another is in the collection of Earl Amhurst. There are two imperfect specimens in the gem room, British Museum. In a woman's tomb at Chatham Mr. Douglas discovered a silver spoon with the handle ornamented in the same style as these fibulæ, with square bits of red glass set on hatched gold; it was pierced at the top and worn very smooth, showing it had long been pendent from the dress, the bowl thin and pierced with many holes like a sieve; he suggests it may have been such a sieve as Hudibras alludes to, canto ii.:

> "In magic he was deeply read,
> But far more skilful in the spheres
> Than he was at the sieve and shears."

Personal ornaments with incrustations of coloured glass are frequently found in graves of the Teutonic race in England and the continent. A knife with the handle thus decorated was found at Selzun; the Abbé Cochet gives several examples in his works. The genuine fibulæ so often alluded to during the decline of the Roman empire were very probably these incrusted glasses.

Fragments of bowls with projecting ribs on the outside and sunk inside are now often found among Roman remains, both

in England and elsewhere.[1] Mr. A. Pellatt gives an interesting account of the patent which was taken out in London for pillar moulding glass, which was considered a triumph of modern skill; it was a legitimate and true invention doubtless, and the patent had been worked for some years, when Mr. Pellatt recognised in some of these fragments evidence of the antiquity of the invention, another proof, were one required, of the assertion that there is nothing new under the sun. In renewing the excavations at Silchester, 1861, in the ruins of a Roman room were found among some remains one of these pillar moulded vases and bits of pottery, another example of an ancient habit we have copied; one amphora had been carefully mended, and retained a leaden rivet in drilled hole. The extreme antiquity of this thrifty practice may be imagined from one of the Sybarite fables quoted by Aristophanes. A woman of Sybaris broke an earthenware pot, which began screaming out and calling for witnesses to show how badly it had been treated. "By Proserpine," said the dame, "were you to leave off bawling for witnesses, and make haste to buy a copper ring to rivet yourself with, you would act more wisely."

Fosbrooke describes some peculiar glasses found at Machynlleth, Montgomery, the use of which could not be divined. They were formed like hoops curiously twisted of various colours; some were twenty inches in circumference, others were of smaller dimensions. In some of the broken pieces parcels of sand of the same colours appeared to be enclosed in several cells within the glass. It is difficult to conceive any use for these hoops, unless they were the stock in trade of a magician. Glass urns similar to those described by Bryan Faussett have been found in many other tombs; one was dug up at Castle Eden, Durham, one at Fairford, Oxford, and in other places; these vases, though suitable for drinking cups, are very fragile and seem unfitted for the daily use of a half civilized people; they may perhaps be regarded as objects of an unusual and sacred character, consecrated perhaps on occasions of interment by some rite of which we are ignorant. A very elegant greenish vase with cornucopia ornamentation is in the Canterbury museum, it was found near the Reculvers; a round shaped drinking cup, also found at the Reculvers, is in the British Museum. The use of glass must have been common in Saxon

[1] There is a beautiful specimen among the Assyrian remains in the British Museum, probably from the Roman colony, Claudiopolis.

times, judging from the quantity still preserved. Two beautiful pale blue vases were found in 1847, in front of the bishop's palace at Cuddesden, ornamented with cords or threads of glass fixed on in a molten state, probably for strength as well as ornament. Two drinking cups of peculiar form were found near Sandwich, one rich brown in colour and very light, the other green, with a spiral thread round the lip and ribs down the sides, it holds exactly a pint of liquid; these cups are finished with a knob at the base, and could not be set down until empty, possibly the origin of our name "tumbler." Similar cups are found in Frankish graves in France and Germany. Mr. Roach Smith considers that a greater number and more varieties of these drinking glasses have been found in English graves than in those on the continent, which gives greater reason for supposing that they were home made. Many of these are elongated tumblers, either rounded at the base or terminating in such small feet they cannot be made to stand. Some of them have a hornlike shape, and are made of glass without lead and blown very thin. Sometimes they are ornamented by having lobes or knobs of glass attached to the exterior or by threads of glass wound round them or disposed in wavy lines, which Mr. Nesbitt thinks is the origin of the expression in Beowulf (line 983). At the hero's funeral "the thane observed his office, he that in his hand bore the twisted alecup." (Anglo-Saxon Poem.) In a drawing on an Anglo-Saxon calendar in the British Museum may be seen seated figures drinking out of these same shaped cups.[1] Some drinking cups are found protected by wooden buckets bound with metal. So many of these so called tumblers were found near Wodensborough, Kent, that they were used in a neighbouring farmhouse as beer glasses.

Remnants of Roman civilization in the shape of potters' kilns have been found in numbers in Northamptonshire, near Peterborough, Wandsford, and other places; they are especially to be seen in the marshes below Upchurch, where no doubt the dark blue-black ware called Upchurch was made. These kilns are interesting, as the pottery found in them, being stamped with Latin names, proves that much of the so called Roman pottery discovered, and supposed to be imported into the island, was actually fabricated in Britain. Some was no doubt brought from

[1] See Plate IV.; three Anglo-Saxon imitations of horns.

abroad, as in potters' kilns in Germany and France pottery has been found stamped with the names of makers identical with those found in England. It has often been said that no glass kilns have been found in Britain, but in 1860 a glass furnace was discovered at Buckholt, near the Roman road between Winchester and Salisbury; if these remains are Roman it would prove that both ornamental and coloured glass was made in Britain. The following extract describing the furnace is from the *Queenswood Observer*, and is written by Mr. Roper. "The furnace was brick, nine feet in diameter, with four spurs of brick and flint ten feet long, the bricks were cubic lumps of clay one foot each way. Many pieces of pots were found glazed on both sides, some fluted. Lumps of glass nearly as large as an egg, with scores of drops of glass and many pieces looking like necks of bottles, were discovered, also tops of vases with a peculiar hollow rim of bottle-green glass, handles of various shapes, one of a beautiful form and a fine purple colour, many bits of window glass, a green handle with threads of white glass twisted like a cord, pieces of green glass inlaid with white spots, one flat piece with a scarlet pattern painted on it, some bits of prussian blue, purple, and green, and a few pieces of pure white glass." Mr. Cuming suggests that the furnace was mediæval and the old pieces had been brought to be remelted, which hardly seems a probable solution of the affair. A lapidary in Brighton in 1848 had several lumps of bright coloured glass, found on the sea beach, amethyst, amber, emerald green, and maroon; Dr. Guest found pieces on the shore. Mr. Wright thinks these remains were "massæ," made at some Roman glass factories in the neighbourhood; one piece picked up was as big as a child's head, it was of an amber colour and much encrusted by marine animals; it is suggested a landslip may have carried away the remains of a Romano-British glasswork. When the tomb of Edward I., who died 1307, was opened and examined in the last century it was found to contain some very beautiful glass jewellery, but whether it was imported or of native manufacture is not recorded; the body of the king was found beautifully dressed; over his robe was laid a stole of thick white tissue, ornamented at every six inches with quatrefoils made of filagree work, with five pieces of transparent glass in each, imitating precious stones of various kinds, deep and rich in colour; the ground of the stole was thickly powdered with very small mock pearls, tacked closely together, forming a beautiful embroidery;

many of the gentlemen present thought they were real pearls. The mantle of crimson satin was fastened by a magnificent fibula of gilt metal, set with four pieces of blue and four of red glass, and twenty-two beads of mock pearl and a piece of uncut blue paste, shaped like an acorn. On the back of each hand had been laid a quatrefoil set with deep blue glass. In repairing the road near Walnsford, Northamptonshire, the labourers struck on a glass coffin about two feet long, containing the bones of a child; it was of fine transparent glass of a beautiful aquamarine colour, ornamented with five concentric raised circles; some bones were found near, but no coffins. It is conjectured that the interment might have taken place in Henry VI.'s time, when an idea prevailed that bodies might be preserved in some kind of liquid; Mr. Wells gave the Society of Antiquaries a piece of the glass containing the five circles.

Mr. Nesbitt gives two quotations from Welsh poets of the sixth century: Wine out of the bright glass, "Llywarch Hen," and "Bright wine out of glass vessels," "Aneuren." In the British Museum are some specimens of late Celtic bronze and enamel work, an armlet found at Castle Drummond, Perthshire, and a horse's bit found at Hull, Yorkshire, both ornamented with red and blue enamel. There is also in the same case a bronze mirror of the same date, found at St. Keverne, Cornwall, with two large glass beads which must have been used for suspending the mirror.

It was in A.D. 669 that French workmen were brought over to glaze the windows of St. Peter's, York.[1] Benedict is said to have established foreign glassmakers at Wearmouth, 675. An attempt was made to establish a glass factory at Newcastle-on-Tyne in 670, but it proved a failure and the furnaces remained extinguished for eight hundred years. As showing a more modern view of glassmaking in Newcastle the following extract from the *Daily Chronicle* may be interesting. "On 28th January, 1867, a reform demonstration took place in Newcastle, in which some three or four hundred glass workers took part. The glass workers formed the most peculiar, if not most attractive, part of the procession. As they approached they appeared to be a complete rainbow of colours; glass of the richest and most varied hues had been worked up for the occasion into the most strange and singular forms, and hun-

[1] See chapter on Windows.

dreds of persons followed them as they marched along, to see the curious designs the men had wrought. There were glass hats of all colours and shapes, glass goblets, crowns, swords, and batons, and almost every man carried a tricoloured glass rod." For some centuries glassmaking seems to have languished in Britain, even window glass was only used by a few of the richest people; yet that the art was to some extent practised is proved by a curious passage in a French description of the famous Field of the Cloth of Gold which took place near Calais, 1520. The English king, Henry VIII., had constructed for himself a vast palace of wood and glass, which glittered in the sunlight like a prototype of a Crystal Palace. It was divided into four compartments, and bound with cloth painted to represent freestone. In a spacious court two fountains flowed with wine, water, and hippocras. The entire edifice was brought from England in pieces, and joined together by pegs, no stone or mortar being employed.

Notwithstanding this royal patronage however, glass manufactories were not encouraged by the English public, as in the "Breviary of Philosophy" written by Thomas Charnock, 1557, he seems to lament this dearth of factories:

> "As for glassmakers they be scant in the land,
> Yet one there is, as I do understand;
> And in Sussex is now his habitation,
> At Chiddingsfold he works of his occupation."

Henry III. had but one glass drinking cup, presented to him by Guy de Roussillon. The king sent it to Edward of Westminster, the famous goldsmith, with directions to take off the glass foot and mount it on one of silver-gilt, and to surround it with silver-gilt hoops, showing what value he attached to its preservation. Henry IV. is said to have had a silver-gilt cup with glass of Alexandria. The rarer kinds of glass seem to have been imported into England, but some attempts at native glassmaking[2] must have been attempted from a curious letter written 1589 from George Long to Lord Burgheim, which contains a petition to have a patent for glassmaking in England, stating that various people erected glasshouses in different parts, and having wasted the woods there went elsewhere, paying no customs and defrauding

[1] Bourne states that in the reign of Queen Elizabeth some persecuted Protestants from France came to Newcastle and worked at their trade of glass-making at the Close Gate, and afterwards went to Tyne.

the queen. Should his petition be granted he undertakes to keep only two glasshouses in England (there being now fifteen) and the rest in Ireland, whereby the wood here would be saved and the superfluous wood in Ireland wasted, "than which in tyme of rebellion her majestie has no greater enemy." He also suggests that his houses will give poor people work, and civilize and quiet the country, as each of his houses will be like a garrison of twenty men. It was not till 1677 that the Duke of Buckingham brought Venetian workmen over to Lambeth, "where they made huge vases of metal, as clear, thick, and pondrous as crystal, also looking-glasses far finer and larger than any that come from Venice." (Evelyn.)

SCOTLAND.

Very little trace of ancient glass can be found in Scotland, her bleak shores do not seem to have tempted Roman or other old world settlers; even the paste beads so common in British tombs become few and scanty in more northern graves, and doubtless owe their presence in them at all to the Druid priesthood, whose courage no climate seems to have daunted. The nearest approach to glassmaking which ancient Scotland can show is to be found in her vitrified forts, which are interesting at this point as bearing on the question of whether or not glass can be made in the open air. These so called forts are among the most remarkable antiquities of Scotland.[1] Their walls consist of stones piled rudely one on the other, and firmly cemented with a substance that has been vitrified by means of fire, which forms a kind of artificial rock that resists the action of weather and time perhaps better than any other artificial cement that has been made. It is singular that a rude people should have been capable of discovering such a cement. Throughout the north of Scotland a kind of earthy iron ore, of peculiarly vitrescible nature, abounds. This ore might have been accidentally mixed with stones at some place where a fire was kindled, and the solid mass thus formed would suggest a hint of the use to which it could be applied. This knowledge once attained, it would have been easy to raise a wall of dry stones, and filling in the interstices with iron ore, build a fire round it

[1] They are supposed to be peculiar to Scotland; about fifty have been discovered, none south of the Tweed. The largest is near Dingwall, and the next in size near Inverness.

sufficiently intense to melt this vitrifiable ore and cement the whole into one coherent mass. As the country then abounded with wood it would have been easy to collect any quantity of it. Mr. Higgins[1] gives a description of the fort of Knockferrel, two miles from Dingwall, where a section has been cut through the walls to enable people to judge of the manner in which it was constructed. The outside wall is a crust, two feet thick, of stones immersed in vitrified matter; some stones are half fused, and all have suffered a considerable heat; inside a considerable thickness of loose stones is heaped up. There are several of the same kind in Scotland. Dr. McCulloch thinks there is an oriental cast about them which indicates the remote eastern origin of the early Celtic tribes. It has been suggested that these masses of buildings resembling vitrified forts were formed by the immense heaps of wood burned on the tops of hills by the ancient fire worshippers, piles of such magnitude that they were loftier than the hills and heated the atmosphere to such a degree that the spot could not be approached for several days!!

No record of glassmaking exists in Scotland till 1620, when John Maria dell'Aqua from Venice had the post of Master of the Works in Scotland offered to him. Sir R. Mansel, who had a patent for glassmaking in England, in a statement to the council some years later complains that his workmen were drawn into Scotland, so that most of the glass used here was imported from thence, and he was obliged to buy up the Scotch patent at £250 per annum. The Romans left some traces of the art in Scotland, as Pennant mentions in his "Tour" that at Netherhall, Maryport, at a Roman station, were found fragments of glass vessels and mirrors and two pieces of painted glass cups.

IRELAND.

The old records of Ireland yield more encouragement to the student of ancient glass than those of Scotland. Not only are glass beads, identical in pattern with those found elsewhere, discovered in the graves, but some are of peculiar and curious designs, and are described in Sir W. Wilde's catalogue of the Royal Irish Academy Museum. Then the art of glass working seems to have existed from an early period, and taken chiefly the

[1] "Celtic Druids." 1827.

form of ornament, as small pieces of mosaic glass are found in the cross of Cong and the Lismore crosier, and cameo beads in the Tara brooch, works of Irish origin. The mosaic glass in the Lismore crosier (which belongs to the Duke of Devonshire) displays remarkable skill. It was made for a bishop of that see who died 1112; but the glass industry must have been much older. Some beautiful chalices, now in the museum of the Irish Academy, were found at Ardagh, Limerick, and are supposed to date from the ninth and tenth centuries. Mr. Nesbitt points out that their mode of decoration was probably by impressing a pattern on the glass while soft, and filling the cavity with metal or glass or enamel of another colour. He goes on to suggest that the colours and patterns used in these processes are so peculiar as to render it highly improbable that the objects referred to were made elsewhere than in Ireland. There is no indication of such an art being practised either in Britain, Gaul, or Germany at the time; apparently therefore it must have been derived at a very early date from Rome or possibly even from Egypt. Dr. Keller remarks that the colours and ornaments on the Irish manuscripts at St. Gall have much analogy with Egyptian art, and says there is direct evidence of the sojourn of Egyptian monks in Ireland in the "Leabhar Breac," where mention is made of seven Egyptian monks who were buried at Disert-Ulidh. Mr. Higgins gives another evidence of ancient communication between Ireland and Egypt. "There are in Kerry fourteen inscriptions in the Ogham or tree system of letters. Herr Hammer, of Vienna, found in Egypt a manuscript written in a character absolutely identical with the Ogham of Ireland. It is a very strange fact that Hammer, a man who probably never heard of the Irish letters or their histories, should find an Arab work in Egypt written in one of them."[1] He also says that Aristotle distinctly states there was a settlement of Carthaginians (possibly from Spain) in Ireland, from whom many of their customs and antiquities may have been derived. This may be the Milesian settlement talked of; such a colony would tend to introduce or keep alive Phœnician customs in Ireland which the influx of Romans in Britain would tend to destroy.

Phœnician art being directly derived from Egypt may have tended to give Irish art that peculiar impress observed by Dr.

[1] "Celtic Druids."

Keller. In the History of the Britons, written in the reign of Mervin by Nennius, A.D. 858, he gives another source whence Egyptian art may have reached Ireland. "A Scythian of noble family, who was banished from Egypt when the Israelites crossed the Red Sea, wandered with his family through Mauritania to the Pillars of Hercules into Spain, where, having multiplied greatly, his descendants passed to Ireland, landing in Ulster." Nennius also says there came to Ireland three sons of a Spanish soldier with thirty ships, containing soldiers and their wives. After the space of a year there appeared unto them in the middle of the sea a tower of glass, the summit of which seemed crowned with men, to whom they often spoke but received no answer. At length they determined to besiege the tower and advanced towards it with all their ships, except one that had been wrecked; but when all had disembarked on the shore which surrounded the tower the sea opened and swallowed them up. Ireland however was peopled from the family remaining in the vessel that was wrecked. In the "Tripartite Life of St. Patrick," seventh or eighth century, mention is made of "a certain stone cave of wonderful workmanship, with an altar underground, having on its four corners four chalices of glass," situated at Duma-Graidh, county of Sligo. In the British Museum are some curiously formed beads and amulets found at Loughey, county Down. They are of peculiarly elaborate character and varied shapes; some beads recalling the grotesque pendants of Greek and Roman tombs. A string of smaller beads was also found at the same place, chiefly yellow in colour, and carefully graduated.

FRENCH, SPANISH, GERMAN, AND ITALIAN.

On Gentlemen Glassmakers.

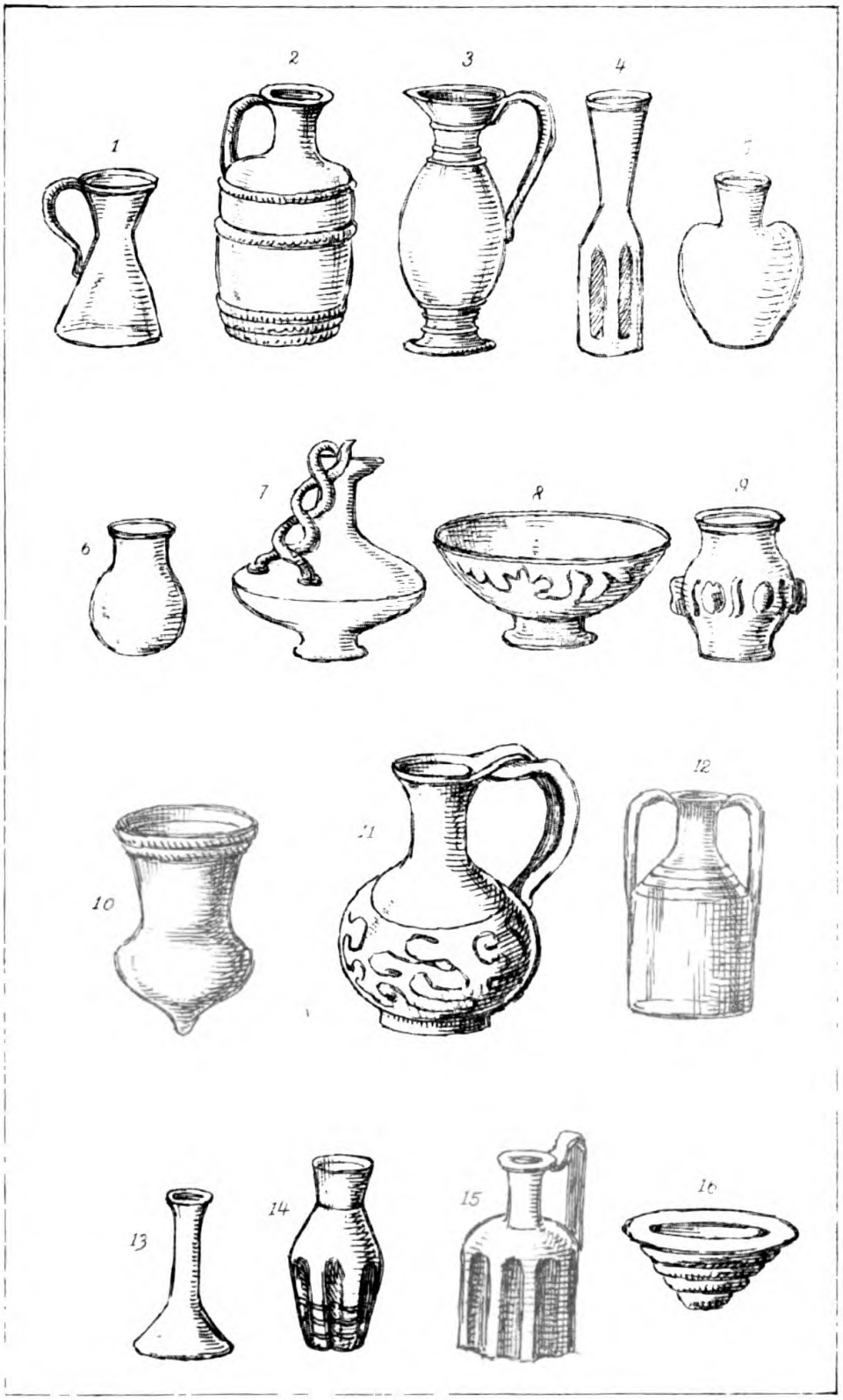
"Votre noblesse est mince,
Et ce n'est pas d'un prince
Daphnis que vous sortez
Gentilhomme de verre;
Si vous tombez par terre,
Adieu la qualité."—*Maynard.*

"Toute votre félicité,
Sujette à l'instabilité,
En moins de rien tombe par terre,
Et comme elle a l'eclat du verre
Elle en a la fragilité."—*Corneille.*

FRANCE.

PLINY asserts that the glassworks of Gaul and Spain were established before those of Rome. Whether this assertion be true or not, there can be little doubt that the ever increasing demand for glass in Rome would induce many busy searchers to ransack the provinces far and near for materials necessary for their art, and wherever those essential articles were found factories were at once established and flourished. The glass made in these differing localities would not show exactly the same qualities, but those artisans who to the possession of proper materials joined the greatest knowledge of chemistry were those who rose most certainly to eminence in their manufactures. The most ancient glass found in Europe was doubtless imported; the tin, glass, amber, and ivory found in tombs at Hallstadt, Austria, which belong to the transition age between bronze and iron, indicate the existence of an extended commerce. M. Fillon considers that the fabrication of glass in France began in Poitiers in the second century; the factories were active in the Roman and Frankish periods, survived the Norman invasion, and were left a legacy to the gentlemen workers of the middle ages. The most ancient piece of glass found in Poitiers is a thick green cup of inferior quality, taken from a tomb

Plate V.



FRENCH GLASS.

at Amuré with a new coin of Vespasian; this probably belongs to the first century and is imported. In the time of the Antonines the tombs furnish great quantities of glass, showing the fabrication had grown quickly. Wherever you discover a cemetery of the Gaulo-Roman period[1] you are certain to find in it glass vases of varied forms and sometimes of delicate and careful workmanship. These discoveries, constantly made, prove that the glass industry was largely practised in the Poitiers territory, which being very woody, and containing all the necessary materials, possessed many factories, the remains of which are known by the presence of vitreous scoriæ, ruins of ovens, and broken melting pots. The names of many places, as Verrerie, Vielle Verreries, Voirie, Verrines, owe their names to glassmaking. Excavations made at Verrines in 1858 disclosed tombs of the second century containing more glass than pottery, proving glass to have been the easiest to obtain on the spot. Much of the glass found at Poitiers and La Vendée has evidently come from the same factory; the usual colours are blue, pale green, and yellow; dark green and red are rare; many pieces are spotted and enamelled in two or three colours. Quantities of little cakes enamelled in various colours, supposed to have been used for some game, are preserved in the Nantes museum, with many beads and glass rings of varied colours strung on stems of bronze for bracelets; also some pieces of cameo glass, and vases in the form of human heads, bunches of grapes, and other shapes. In a gladiator's tomb at Cormier, Vendée, was found a cup of clear yellow glass which had been moulded in two parts, of precisely the same kind as those discovered in other parts of France, England, Austria, Wiesbaden, etc.; it has eight figures of gladiators with the well known names of Spiculus, Columbus, and others. With this cup were some of the twisted glass batons supposed to have been given to gladiators on their retirement. These cups seem all to have belonged to the first and second century. From a tomb of the third century called that of the "female artist," at St. Médard des Prés, eighty pieces of glass of varied kinds were taken. The cemeteries of Poitiers have yielded a rich harvest of glass to the excavator. Abbe Cochet, who has been a most zealous explorer of Gaulo-Roman[2] and Frankish tombs in France, says it is hardly possible to give an idea of the quantity of vases found at every

[1] See Plate V. 1—9.

[2] See Plate V. 10—12.

Roman station; the poor who could scarcely afford a vase for themselves seem to have placed a simple tile in their friends' tombs. To give an idea of the number of vases buried in cemeteries, he states that twenty thousand were found at Terre-Nigre, Bordeaux. Whatever the mode of interment, clay, wood, or lead vases continue to descend by the side of the dead, who seem unable to part with them. Children, who at that time were not burnt, took with them their dolls and playthings of clay or glass, beads, twisted sticks, and tiny glass vases; some of these vases are only half an inch high. In most tombs are numerous glass phials for scent and ointment; many of these are remarkable for being marked with the initials of the maker. From the tombs at Fécamp[1] twenty-five glass vases were recovered, most of them enclosed in clay or wooden urns; only the bronze locks of the latter are found sometimes, the wood having disappeared. Blue coloured vases were the most common for preserving bones. The peasantry in the last century objected very much to the removal of these vases, saying they contained hurtful magic and sorcery. In 1781 a labourer near Entretat, having lost all his cattle near a wood called Haye du Curé, disgusted at having no milk to drink, went to break up the wood, and found there an amphora full of glass bottles and an urn of blue glass containing burnt bones; instantly conceiving that this was the source of the witchcraft that had affected him, he broke the whole in vengeance; how many other precious relics of antiquity may not have been lost in the same manner! Some of the drinking glasses are the shape so common in Greek tombs, as if they had been pinched while soft into a square. Glasses the same shape exactly as that found at the Reculvers are common. The Boulogne museum preserves six curious glass barrel-shaped jars, with two handles each, and six circles at the top and bottom to strengthen them, and bearing the mark of the imperial factory of Frontincennes at Foret Eu; this factory mounts to a great antiquity, it is supposed to have been started in the second century, and was the cradle of all the Norman factories of later times; it is still a great factory, and must surely be about the oldest in the world. All these barrels are cast, and many have a workman's name or initials cast with the stamp of the factory. M. Deville thinks, from the low quality of the glass and its greenish

[1] See Plate V. 13—16.

tone, that it cannot be older than the third century. Among the names of glassworkers collected by M. Deville he also gives that of an oculist, Gaius, who is supposed to have invented an ointment for the eyes; this name placed over a large eye on the body of a square bottle, with the name of the ointment "Diarpodon," has been found in two places; one specimen from Caen is now in the Bibliothèque, Paris. Among the many shaped perfume pots and bottles preserved in women's tombs are small twisted glass sticks, which M. Sanzoy suggests were used for spreading rouge on the cheeks; we know that pots of rouge were found at Herculaneum; another suggestion which appears more likely is that these twisted sticks were used for mixing up the sweet drinks much used in old days; there are several specimens in the British Museum. Two curious sticks, formed of four balls of white cast glass, stuck together, with a letter on each and a point as if meant to be pushed into the ground, were found near the Rhine; no explanation of their use has yet been given. In 1856, at Breauté, Seine Inferieure, a vase was found enclosed in one of clay; on the glass one Orfitus and his wife Constantine have their portraits placed under the protection of Hercules. On another vase is the portrait of a woman in the costume of the lower empire and an inscription: "For thy happiness, drink, live with Donata." In La Vendée in a tomb with other feminine objects was found a large fluted glass basin, and a beautiful dark green cup and saucer with yellow threads, and on the cup in white letters the name "Evtvchia." It is curious to remark how old is the passion for having the owner's name inscribed on personal objects. From Queen Hatasou in ancient Egypt, through pagan, classical, and early Christian times, the custom has been handed down to our days, when it flourishes as freshly as though but recently introduced, with ever renewed interest surrounding each new individuality. On another cup is the name of Demosthenes, with a bust believed to be the god Pan. One cup found in a Norman tomb has graceful serpentine handles twisted with blue from neck to base, others are ornamented with gold. In the faubourg of Rouen an elegant shaped vase with a handle was taken from a third century tomb, and from a woman's tomb in the same place one with engraving of lines and spots rudely cut; but engraving, always confined to very few hands, was at this time declining, the artist tried to place circles, balls, and lines symmetrically; the large spots or tears, so common in Frankish glass, were first raised and then

cut out. During the Roman occupation the art of glass was perpetuated in the farthest and most barbarous provinces, but abandoned to itself it soon began to fade out. The cinerary urns for containing the bones of the dead are common in every Roman settlement; they are sometimes very large, usually square in shape, and have sometimes an inscription denoting simply good wishes for the dead, as Vale, Salve. They were probably procured in haste at the moment of decease, so could not have a special inscription except in the case of royal or important persons. These urns were put into the earth enclosed in a vase of clay or lead, the top covered with a tile. In Normandy Abbe Cochet thinks that gold preserved the bones of rich people, glass those belonging to middle rank, while the poorer classes were content with clay only. Greenish white glass is the most common, and is found in quantities preserved in French museums; there are also several recovered from Algerian soil; coloured and ornamented funeral urns are rarer, one of gilt glass is shown at Nismes. The museums of that town[1] and also of Arles are rich in Roman glass; indeed every winter flood seems to bring to light still undiscovered treasures buried in the earth of these southern provinces. In the Museum of Practical Geology may be seen a flat bowl found at Nismes, of a mosaic pattern, with a ground of pale rose colour which Mr. Franks is inclined to attribute to the use of gold. A green cup also found at Nismes with figures painted on it in coloured pastes is now in the Louvre. A few years ago some remarkable glass vessels were found in a sepulchre near Hellanges, Luxembourg; some were purple and ribbed bowls similar to those found in London, some brown and grey with white veins imitating agate, and one very beautiful bowl composed of at least six colours, blue, rose, yellow, and transparent and opaque white and purple. The entire bowl is divided into four rectangular triangles by two bands of rose colour and milk white crossing each other; at the point of intersection in the centre of the bowl is a purple square with five pellets in white, placed in quinconce. The four divisions are filled with bands of different colours, the most remarkable being of transparent glass with spiral lines of opaque white as seen in Venetian glass. Such work, indicating a most delicate and difficult manipulatory process, would most likely be imported from

[1] See Caylus for more particulars of these localities.

one of the great glass centres, probably Rome. Many writers concur in thinking that the extraordinary beauty, variety, and abundance of glass found all over France prove the greater part of it to have been of native manufacture. With the invasion of the barbarians the art fell into decay, but revived again under the Merovingians. Some of the Frankish tombs contain vases which probably belonged to an earlier period, but being valued by some Frank he would naturally give "them repose with his ashes." Merovingian artists impressed on all their work a seal of bizarre ornamentation which renders it easily recognisable. The large number of vases found in tombs of the first three centuries give the great distinction between them and those of the three following, when Christian emblems begin to mix with pagan. All Merovingian tombs have an empty vase beside the occupant, possibly meant to contain holy water to frighten away demons. Enamel is commonly found about this epoch. Philostratus, writing from Rome in the third century, says: "Barbarians near the ocean have found the art of fixing glass on metal." The Merovingian ornaments are distinguished by having thin gold threads dividing the different coloured incrustations of glass; the art is the same wherever found, and as it only appears to have lasted a short time, would seem to have been imported not indigenous art. This class of ornament is precisely the same in England, France, Spain, or Germany; from this latter country it is believed to have taken its origin, as it is in Frankish tombs it most abounds. At Londiniers in 1847 some fine ornaments of this class were found in a woman's tomb, consisting of little pins presenting the form of a bird, serpent, or other animal in gilt bronze with encrusted glass ornamentation; a round fibula with filagree and glass, some square or crescent shaped decorations, with the ends prolonged to an animal's head, all with glass,[1] which is rarely blue, sometimes green, but generally red; one parrot's head fibula had red glass eyes. In 1855, at Evermeu, an ornament was discovered of red glass cloisonné exactly like those in the tomb of Childeric, A.D. 481. It is now in the Louvre,[2] it was found at the waist of a skeleton, and had been evidently the clasp of a bag or purse; it was formed of two birds' heads joined, and the glass had metal placed behind to enhance its brilliance.

[1] Ornaments of an earlier date are found set with garnets, which are slightly rounded.

[2] See Plate VI. 1.

A fibula found at Caudebec is made of gold with green paste, and eight tears of red glass exactly like those found in Anglo-Saxon tombs. The sword of Childeric is ornamented in precisely the same manner. Some of these fibulæ are encrusted with glass in the form of a cross. It is difficult to prove exactly the religion of their owners; they stood between the fading pagan and the advancing Christian worlds, from the third to about the seventh century.

The most beautiful specimens of this jewellery known are those now in the Museum of Cluny, commonly known as the Tresor de Guarrazar. In 1858 some peasants digging near Toledo, at the Fuente de Guarrazar, unearthed eight votive crowns of gold, ornamented with a profusion of precious stones and glass; the peasants, ignorant of the value of their treasure, commenced dividing it, when fortunately some wiser person purchased the whole, and, starting for Paris, offered them to the government, who promptly secured them at once for the Museum of Cluny. The largest crown is composed of a gold band, four inches wide, ornamented with thirty large uncut sapphires, and as many pearls arranged in groups of five; between them the ornamentation is infinitely more rare, it is composed of a sort of repoussé pattern of seven leaves open à jour, and filled in with clear red glass; two borders of red glass, cloisonné in circles, finish the pattern, in each circle is a square of green glass. But the most original part of this precious diadem is found in the twenty-two letters suspended like pendants from the lower part of the band;[1] these letters are about an inch long, and open à jour, of the same work as the double border, that is to say, filled in with red glass cloisonné with gold; from each hangs by a golden chain a pendant of green glass, and pear shaped sapphires. The letters give the inscription "Reccesvinthus Rex Offeret." This is the name of one of the most distinguished kings of the Goths, who died 678; the date of the crown is therefore fixed by this ingenious inscription, in which each letter forms a jewel in itself. The crown is supported by four gold chains, joining in a rock crystal ornament, forming an exact copy of the capital of a seventh century pillar, with a crystal bead at the top, and a beautiful cross formed of sapphires, with three pendants of glass paste, pierced sapphires and pearls, hanging from it. This is a unique specimen of jewels set à jour at that epoch. None of the other crowns approach this one in beauty. The custom of suspending votive crowns in

[1] See Plate VI. 2.

holy places, or in secular buildings, was much practised when the northern conquerors placed themselves on the ruins of Roman civilization.

Ravenna gives us many examples, a circumstance of some importance, as many monuments of that town were founded by kings of the Goths. The treasures of Guarrazar are supposed to have been hidden during the Moorish invasion of the eighth century. Julian of Toledo describes a crown of a similar character, that was consecrated to St. Felix by King Reccarède, 586. There is a small reliquary at St. Maurice, Valais, of which three sides are covered with red glass cloisonné with pure gold and cameo ornaments, and the fourth side contains an inscription presenting the names of Theuderic and three others, all giving a septentrional origin. A superb evangelaire in the treasury of Monza shows on the binding a pattern in gold and red glass, of precisely the same character as that on the votive crowns; it is supposed to have been the gift of Theodelinde, a princess of German origin. Lasteyrie, who has carefully described these votive crowns, thinks that jewellery in red glass cloisonné with gold was never practised save by people of German race; as in France by the first Merovingians, in England by Anglo-Saxons, among the Swiss by Bourguignons, and in Italy and Spain by Goths and Lombards. This industry was never native. These conquerors, when treading out all traces of Roman occupation, might have called to their courts artisans from the north, and naturalized to a certain extent their ancient arts; but they took no deep roots when transplanted. These ornaments are red glass and not garnets, as they are flat on both sides and all of precisely the same thickness; the green is simply glass. It is necessary here to return to some of the earlier Merovingian tombs, in which no jewellery occurs, though they present other features of interest; thus among seven or eight glass vases found at Evermeu one, of a bottle shape, was filled with the larger wings of coleoptera, "Calandra granaria"; probably the bottle was filled with these insects, of which only the wings remain; why these singular relics were placed there no one can tell, at the depth of four feet beneath the surface of the soil it is impossible to imagine the natural introduction of the insects. Sometimes vases were placed at the foot of the grave filled with food and nuts. M. Baillon found one filled with the bones of water rats, woodpeckers, jays, frogs, and field mice. Many of the graves

contain cone shaped glasses, with the remains of dried red wine; several of these glasses are shaped like the tumblers found in Anglo-Saxon tombs. Abbe Cochet describes a glass ring for a bracelet, of a black colour, with a bronze ring attached to it, as if for suspending an ornament; this kind of bracelet is rare in Merovingian tombs, but is spread over a great space. M. Troyon says, apropos of a glass ring bracelet found at Vallée de l'Haulne in Switzerland: "it is curious to see how the same kind of ornament was worn in many different countries; thus in some localities the glass ring bracelets are found with Celtic money of three or four centuries B.C., then they appear in Roman remains, and are still worn in many Eastern lands." Some large flat objects, with a hole in the centre and only ornamented on one side, are probably buttons, used by Roman men and women to fasten their robes on the shoulder, as seen in busts; they are rarely found in the same tomb with fibulæ, some think they were amulets. Several bracelets were made of a leather band, with hanging or fixed ornaments and square plaques. Our pins and brooches are precisely the same as those worn by the ancients. At St. Sabine a glass vase was found with an inscription in honour of Julian the Apostate, which would fix the date late in the fourth century. M. Baudot, who excavated the cemeteries near Charnay, Dijon, found in different graves thirty-five glass vases; this glass was not at all iridescent, or altered by its long entombment, as glass buried in other localities generally is. The colours found were only light and dark green, thick or thin according to its destination; a half sphere with the lip turned down was the commonest form; possibly these vases, if meant to hold liquids, were fixed in some kind of foot, as they could not stand alone; some were long shaped, like beer or champagne glasses. Some larger vases were ornamented with horizontal or vertical bands of glass, the same as are now used among rich peasants of Auxois for waterpots; each vase had by it a small cup with a little handle by which it might be suspended with a cord to the large one; sometimes these vases are found enclosed in earthen ones, to preserve them. A great variety of beads in coloured glass, amber, or clay, were also preserved in these tombs. They are supposed to date from early in the fifth century, when King Clovis met the Bourguignons near Dijon, and fought and conquered them, pursuing the barbarians under Gondebard, by the Saone and Rhone, as far as Avignon where Gondebard fortified his

camp. The tombs are conjectured to have belonged to the warriors then killed; the women's tombs among them are accounted for by the fact that the women of these tribes often accompanied the men to battle, sometimes indeed the whole tribe assisted. The graves are Christian as the cross frequently occurs, the art is not Roman. It is possible these tombs may have belonged to the conquerors of Gaul after the expulsion of the Romans from England and Gaul, which is a period more wrapped in shadow than any other. The museum of Rouen is very rich in glass found chiefly in France, the whole is minutely described in M. Deville's beautiful work.[1] Near Avignon many Roman remains have yielded to their explorers a large number of glass vases, of varied though not uncommon shapes; some of these, from three to seven inches high, are of extraordinary lightness, and some are undoubtedly meant for surgical purposes.

As Christianity advanced glass became necessary for the service of the church, and we find many references to it especially with regard to chalices.[2] Thus Pope Zephyrinus, 197, had ordered that wine should not be consecrated as heretofore in a wooden but in a glass vessel; St. Jerome writes of the Bishop of Toulouse as bearing the Lord's blood in a vessel of glass. As the earlier converts to Christianity were by no means all of humble station, there were soon very few churches which could not afford a silver chalice, and in the fourth century we find many churches already rich in gold and silver vessels. St. Exupêre, of Toulouse, fifth century, used glass chalices not by caprice as Romans did, but because he had sold his gold and silver ones to assist the poor. St. Ambrose sold his precious chalices to redeem captives, and used glass until they could be replaced. Some bishops preferred metal, looking down on glass or wood. Pewter was then used and considered a superior material to glass, as St. Benedict of Aniane, 821, says the vessels of his church were first wood, then glass, and at last he ascended to pewter. In the British Museum are preserved two glass chalices of the sixth and seventh century. Church authorities again found it necessary to prohibit the use of inferior materials for chalices, as Pope Leo IV., 850, lays down the rule that no one should celebrate mass in a chalice of horn, wood, lead, or glass; yet glass continued to be used, as St. Winoens says the monks of a monastery founded by him in Flanders still

[1] "L'Art de la Verrerie dans l'antiquité."

[2] Window glass has been treated in a separate chapter.

made use of chalices of glass, and Pugin says monks at Venice up to the tenth century used glass, although a council held at Rheims before that period forbade all chalices made of wood, glass, tin, or copper. Among the most ancient relics preserved in France may be named the fragments of the "Ste. ampoule," a glass phial containing holy oil, which was said to have been brought by a snow-white dove to St. Remi, when he was baptizing King Clovis, who embraced Christianity in 495. This sacred phial was preserved in the tomb of the saint, and used in the coronation of nearly all the kings who reigned in France from Clovis to Charles X. The new king was ushered with great pomp into the cathedral of Rheims, the barons then went to the church and tomb of St. Remi to fetch the "Ste. ampoule," which was brought with great state to the cathedral, and when the ceremony of coronation was over was restored to the tomb, where it was preserved in safety for thirteen centuries, but in 1793 a band of ruffians entered the church and broke the phial at the foot of the statue of Louis XV. Pious hands preserved the broken fragments, to which some dried balm still adhered, and in 1819 these were restored to the clergy and authenticated with great pomp, and dried oil from the fragments was used in the coronation of Charles X., 1825. Glass would seem to have become more commonly used very soon, as Fortunatus, bishop of Poitiers, sixth century, writing to Queen Radegonde, wife of Clotaire I., describes a repast at which he had been present, in which each kind of food was served on a different material, "meat on silver, vegetables on marble, fowls on glass, fruit on painted baskets, and milk in black earthenware pots." Ruricius, bishop of Limoges, 506, writes of a "vitrarius"; and M. Fillon quotes a diploma of Louis le Debonnaire, 825, in which "portus vitriarii" is named as a boundmark in the "pays d'herbauges."

About this time it appears that foreign artists were called in to assist native talent, as Filiasi says in 677 many Greek workmen went to France to make glass. M. Fillon says that written documents connected with glassworks begin in the ninth century. Lasteyrie asserts that Normandy was the first country where privileges were given to glass workers, they were conceded by the first dukes of Normandy in the tenth and eleventh centuries to four families attached to their persons; these families, constantly devoted to the same pursuit, enjoyed their privileges confirmed by English and French kings till last century. To this day

descendants of one of these families, Brossard, are to be found; the rest are extinct. When factories were to be established in other parts of France "gentlemen" from Normandy were sent to start them. These privileges must have given a great impetus to the art in France. Other countries must have been nearly contemporaneous with Normandy in glassmaking; M. Fillon gives the name of Robertus, vitriarius, as witness to two deeds in the abbey of Maillezais, 1088; as his name is placed first in the list of witnesses, he would seem to have held superior rank to the other gentlemen of the country (Poitiers). He also gives the name of a window glass maker in the eleventh century. In 1290 there existed in the department of Aisne, near La Capelle, a factory of glass bottles, which preserves in its archives patents given to it by Charles of Burgundy, Francis I., and others. In the time of St. Louis it was the custom to serve glass on the table; "Le comte d'Eu dressait sa Bible du long de nostre table, et nous brisait nos pos, et nos vouerres" (Joinville). The tube in which the thorn given by St. Louis as one from the crown of thorns of our Saviour is preserved in the treasury of St. Maurice in the Valais, and the piece of glass which encloses it,[1] may probably be the work of the mediæval houses founded after the crusades, whose workers preserved their nobility, notwithstanding their being obliged to exercise a profession. Palissy says, "L'art de la verrerie est noble, et ceux qui y besongnent sont nobles." It does not appear that nobility was conferred on those who worked in glass, but only that exercising that art did not degrade one already noble. M. Chaptal thinks these factories have changed neither their furnaces or their manipulation since the days of Louis, 1226, when they were founded, and thinks the gentlemen workers brought back from the crusades only a power of making very common glass, such as their fathers had seen made in the East. "Ces gentilhommes comme on sait, ne daignaient pas alors apprendre à lire, et ils declaraient ne savoir pas signer, attendu leur qualité de gentilhomme." Charles V. by letters patent gave all glass painters exemption from all "tailles, aides, et subsides, garde de porte, guet, arriere guet, et autres subventions quelconques." Charles VII., 1431, confirms these privileges, and Charles IX. again confirms them, and adds that

[1] In Notre Dame, Paris, is preserved a piece of the true cross (with a pope's attestation of its genuineness) enclosed hermetically in glass blown over it, possibly of the same date as this relic.

all noblemen may work at glass without losing caste. Possibly the gentlemen workers gave themselves airs on the strength of their privileges, as the quotations at the head of this chapter seem to imply. There are records of glasshouses in Provence as early as the thirteenth century. In 1338 Humbert, dauphin of Viennois, granted to a glassworker named Guionet a portion of the forest of Chamboraut, to establish glassworks there, on condition that he should furnish the dauphin with three thousand pieces of glass annually. M. Fillon thinks the custom of placing coats of arms in the bottom of cups is as ancient as 1420, when Guillaume Bouchet describes a widow whose excessive grief made her take to drinking; to cure this bad habit her friends filled for her a cup, containing the arms of her husband, the sight of which always renewing her grief, she was obliged to leave enough wine in the cup to conceal them.

SPAIN.

Pliny states of Spain, as he does of Gaul, that glass factories were established before his time, and the numerous remains of furnaces found there confirm his assertion. It is also not impossible that the Carthaginians who traded with Spain for tin should have introduced some of their glass, in the manufacture of which ancient authors have told us they excelled. Prof. Rawlinson considers that the trade of the Carthaginians with the west coast of Africa has been fully proved, and suggests that the glass objects found there (outside the Straits of Gibraltar) were brought to the coast by them; there is therefore no improbability in supposing that traders from Carthage might have carried their commerce to the nations on both sides of the Pillars of Hercules, though the records left us of that once flourishing city are very scanty. Mr. Nesbitt, who has given a good deal of information regarding Spanish glass, quotes Sinobas as his authority that "in the Ibero-Roman period glass was made chiefly in the valleys which run from the Pyrenees to the coast of Catalonia, near the Ebro, also in Valencia and Murcia. The ruins of furnaces still met with in those parts are small in diameter; he considers they produced the objects found still in Spanish tombs, such as small jars with handles, cups, phials with wide necks but without a foot, pateras with gold, dishes, thick moulded saltcellars, small amphoras, lachrymatories, rings red, yellow, and gilded, counters, and bracelets. He believes the manufacture continued to exist

under the Gothic kings, and he quotes a translation made in the twelfth century of the Lapidario of Abolais, who is supposed to have written in Hebrew in the seventh century, and who says of it that it is of several colours, white which is the noblest, red, green, "xade," which he explains as the dark hue of obsidian, and purple; mention is made also of its use in windows, and as a burning lens. M. Labarte is of opinion that the art did not survive the invasion of the barbarians, and quotes Isidore of Seville, who however only says that "pure white glass was not made in Italy, Gaul, or Spain," but does not deny that glass was made at all. We have seen in the Tresor de Guarrazar, that the Goths of the seventh century brought their own glass manufactures with them into Spain. El-Makkari states that Murcia was renowned for the fabrication of glass and pottery, of both which materials large vases of the most exquisite shapes were made by the Moors. It is to the artistic skill of the Moors that we owe the iridescent Hispano-Moorish pottery so prized by artists. Mr. De Morgan has succeeded in reproducing the brilliant iridescence so highly esteemed on the old faience, but modern art has not yet brought it within the reach of our poorer classes, it remains a luxury of the rich; whereas in Spain, from the enormous quantity found, it must have once been commonly used, as footbaths and large vessels still remain proofs of the skill in glazing of the old Moors. Ash-Shakandu, an Arab author of the thirteenth century, says: "Almeria also was famous for the fabrication of all sorts of vases and utensils, whether of iron, copper, or glass." The manufacture of glass in Barcelona was of equal or probably greater antiquity, as a municipal edict of 1324 banishes all glass ovens from inside the city. After this date large quantities of glass seem to have been manufactured in Spain, both for home use and exportation, much of which bears great resemblance to old Venetian. Many beautiful specimens of Spanish glass, collected by Señor Juan Riano, may be seen in the South Kensington Museum, but their dates are later than the limits examined in this work. Spain not being a country so rich in forests as France, it is probable glassmaking would always have been a more costly manufacture, and her factories consequently not so continuously worked as those of her neighbour. Numerous modern Spanish examples are engraved in Mr. Nesbitt's art handbooks, but they are all later in date than the limits assigned to these notes.

GERMANY.

So much ancient glass has been found in Germany, especially in the neighbourhood of the Rhine, that it seems probable that local manufactories were established in the country during the Roman occupation. It is most likely the art fell into disuse when the Roman influence was withdrawn. In graves belonging to the next period in Germany drinking glasses have been discovered, very similar in form to those preserved in French and British tombs; but whether they were made contemporaneously by tribes of a kindred stock or introduced from one country to the others has never yet been clearly ascertained, though the weight of evidence seems in favour of native factories. The Frankish jewels appear to have all originated from a Teutonic source. Mr. Wright[1] has engraved some German drinking glasses, which present nearly the same forms as those of Anglo-Saxons. Le Viel thinks the Germans of the ninth century taught glassmaking with other arts to more northern nations. "The holy bishops Villebrod, Ouinfrid, and Villehade, in endeavouring to chase away the shadows of paganism by the light of Christianity, strove also to introduce useful arts with a view of uprooting that pernicious idleness, source of brigandage and cruelty, and the people gradually replaced by useful works those scenes of blood and carnage to which their natural ferocity had led them." He is inclined to believe that the English, having learnt the art of glassmaking from the French, taught the Germans in the eighth century; but this view is contradicted by a letter quoted by Mr. Nesbitt, addressed about the middle of the eighth century to Lullo, bishop of Mainz, by Cuthbert, abbot of Wearmouth: "If there be any man in your diocese who can make vessels of glass well, pray send him to me; or if by chance he is beyond your bounds, in the power of some other person outside your diocese, I beg your fraternity that you will persuade him to come to us, for we are ignorant and helpless in that art; and if it should happen that any one of the glassmakers through your diligence is permitted (D.V.) to come to us, I will, while my life lasts, entertain him with benign kindness."

The practice of using glass drinking cups is spoken of in the metrical life of Eigilis, 822, abbot of Fulda, written by his

[1] "The Celt, Roman and Saxon."

disciple Candidus. If these were of home manufacture some more precious specimens were brought from the East, as we hear of "precious glass of Alexandria" at the emperor Henry's court, 1039. St. Odilo, 1049, another abbot of Fulda, is represented in his life as pouring wine into a little glass; some "sculptured glass vessels which were buried in the snow," mentioned in his biography, probably came from Alexandria, as did also most likely the vase which, being accidentally broken by a fall, was mended by the prayers of this saint. St. Donatus of Arezzo, we are told by St. Gregory, was equally fortunate in restoring by prayer a chalice of glass that had been broken by the heathen.

Among the objects found when the island of Bjorkö in Sweden was explored, were some disks of glass, three inches in diameter by an inch and a half thick, convex, and well rounded at the sides, such as are still used in Sweden for smoothing linen after it has been washed. The site is believed to be that of the city of Birka, destroyed about the end of the eleventh century. Mr. Nesbitt surmises that these objects of glass may have been brought from Germany. Window glass seems to have been made in Germany at a very early period, and is more especially treated in its place.

In 1335 the name of "Henricus factor vitrorum" occurs in one of the registers of the city of Cologne. Specimens of German glass in the middle ages are rare; none in the South Kensington Museum is earlier than the sixteenth century.

ITALY.

Though very little is known of glass manufacture in Italy immediately after the fall of the Roman empire, it would be unreasonable to suppose that all traces of an art so highly valued and widely practised should disappear at once from the country, especially when we remember that in other parts of Europe it survived, though in a minor degree, the removal of Roman influence. Christian glass in the catacombs would bring the manufacture there down to at least the fifth century, if not later; and though the window glass and the mosaic, used in the large churches built both at Rome and Ravenna in the fifth and sixth centuries, may have been chiefly Byzantine, it is most probable that some glass should have been made or at least coloured on the spot, in both cities. Thirty glass vases were found in the tomb of Maria, wife of Honorius of Rome, A.D. 423.

The Roman glass which Eraclius directs should be used for glazing earthen vessels and making artificial gems is clearly ancient Roman, as he constantly directs that glass shall be sought for and collected from the pagan edifices for his various recipes, a source of supply which was doubtless much richer in his day than it would be found at present. Eraclius seems to have been an Italian, and wrote his treatise certainly after the sixth century, because he quotes Isidore of Seville, and possibly before the tenth, because he makes no allusion in his work to Arab science which was then becoming well known. But the contents of his book argue a very extended knowledge of glassmaking, probably inherited from previous workers, as it could hardly have been all collected during the life of one man.

The exact origin of the extensive and world renowned manufactories of Venice can scarcely be clearly ascertained. Native writers are inclined to believe that glassmaking was practised in the lagunes of Venice by refugees from the troubles of Italy as early as the fifth century, and it would be impossible to disprove such an assertion, as among the many exiles from large cities like Padua or Aquileia there were most probably some capable of carrying on in small houses, such as were then used, an art so commonly known in Rome and other cities. If any skilled workmen were among such refugees they would hardly fail at once to recognise in such a place as the lagunes the presence of marine plants yielding alkali, and the abundance of sand which would make the manufacture of glass easy and inexpensive. It was doubtless the existence of these rich gifts of nature which afterwards gave Venice such superiority in her art. In the days of her after renown, not contented with her own native productions, she sent her boats to Belus to collect the sand celebrated of old, wherewith to provide the factories of Murano. Signor Cecchetti declares that the first documentary evidence of glassmaking in Venice is contained in the municipal archives of 1090, where mention is made of a certain Petrus Flavianus, phiolarius. Several churches in Murano and Venice had before that date been decorated with mosaic. St. Cyprian was finished in 882, but there is no record of the place at which the mosaic was manufactured. The building of St. Mark's, 1159, would naturally give a great impetus to glassmaking on the spot; and the taking of Constantinople, 1204, would probably drive many Greek workers to seek employment and an asylum in Venice, and they

doubtless brought with them the knowledge of many Byzantine recipes that would tend to enrich the new factories. In 1224 twenty-nine "phiolarii" are mentioned as having infringed the official regulations laid down by the town for the management of the works, thus showing a great increase in the members of the trade. At the election of the doge in 1268 the glass workers exhibited decanters, scent bottles and similar pretty objects, and in 1279, by a decree of the great council, they made measures and weights of glass somewhat like those issued by the Fatimite princes, showing at this time their traditions were rather derived from Byzantine than Roman influence. In 1275 a law was enacted prohibiting the exportation of the sand and other substances used in making glass, and also fragments of broken glass. After this time the republic strove, by various similar decrees, jealously to guard from the outer world the secrets of a manufacture that brought great riches to the citizens. Marco Polo, 1295, gave them useful hints as to extending their trade in beads by the same routes followed by Phœnician merchants centuries before. The fear of fire made the council abolish all glass furnaces from the city of Venice, 1291, though the makers of small glass wares were afterwards allowed to remain within the city, provided a space of fifteen paces was left between the workshops and the houses. It is supposed the banished establishments were reconstructed at Murano, where they seem to have remained in full activity almost ever since.[1] In 1295 the council increased the fines to be levied on glassmakers who should return to Venice after a sojourn abroad; and from a petition presented on this occasion it appears that furnaces had been established in Treviso, Vicenza, Padua, Mantua, Ferrara, Ravenna, and Bologna. Many travellers of this age bear testimony to the marvels produced in the renowned workshops of Murano. Foreign towns strove to attract Venetian workmen to teach their artisans this lucrative trade, and the council of ten redoubled their precautions to preserve their precious secret. In 1459 they took entire charge of Murano, to prevent the art being taught to any strangers, and an article of the

[1] At the beginning of the seventeenth century there were three hundred glass-houses in Murano; at the commencement of the present century all were gone except a mosaic factory, which closed in 1825, but the necessity for renewing some of the mosaic of St. Mark's induced the government to persuade the owner, Tradi, to reopen his works. He afterwards made some valuable discoveries, and ultimately a great revival of glassmaking took place, which appears to be daily increasing.

state says: "if any workman carries this art to a foreign country he will have first an order to return; if he obeys not, all his nearest relatives will be put in prison; if in spite of this he obstinately remains abroad, some emissary will be charged to slay him." Two workmen whom the emperor Leopold had tempted into Germany were actually killed. But if the republic thus sternly punished offenders, it covered with favours those who remained faithful. The Venetian police had no power in Murano, they had their own magistrates and code of laws. Nobles gave their daughters in marriage to glass workers, and their children retained their nobility.

F. Faber, of Ulm, writing in 1484, says such precious and beautiful glass wares were manufactured nowhere else in the world save Murano, and relates that the doge and senate considered a vase of glass a fit and worthy present to the emperor Frederick IV. when he visited Venice. Such vases had in ancient days been esteemed fitting presents for royalty; this emperor however, to show his mean opinion of the gift, let it fall, and remarked that in one respect, fragility, glass was inferior to gold and silver; the doge taking the hint replaced the glass by a vase of precious metal. Leandro Alberti, who visited Murano early in the sixteenth century, says there were then twenty-four glass-houses at work, and describes among the remarkable objects of glass he saw there a galley with all its tackle, a braccio in length, and an organ which produced melodious sounds. The large extent of the trade in glass carried on by Venetians may be imagined from a note in the journal of Sir Thomas Roe, ambassador from James I. to the court of the Great Mogul, Jehangir, 1615. He had brought a number of presents from the English king, but while he was still negotiating with the Mogul an ambassador from Persia arrived, who presented on the part of his sovereign, among other costly offerings, "seven mirrors of Venice so fair and beautiful that my heart sank within me on seeing them." Capt. Hawkins a little before this date reported that the Great Mogul had in his treasury two hundred glasses and rich cups. These were most probably also of Venetian manufacture, as the length of the journey did not prevent the Persians from sending large mirrors, which would be more difficult to transport than glasses. Vincenzo Cervio writes that at the marriage of the Prince of Mantua, 1581, "there was there, besides most rich sideboards and ordinary glass ware, a display of various beakers,

decanters, jars, and other most beautiful vessels of Venetian crystal, so that I think all the shops of Murano had met there, and of that there was need, for all the signori invited, after they had drunk, broke the beakers, which they held as a sign of great joyfulness." This idea, that no meaner toast shall ever be drunk from any glass once used for such an important occasions, has, fortunately perhaps for the cause of art, been altered of late years. The shops of Murano which furnished these signori with the power of showing their joy are described by C. Sabellico as forming a magnificent street, extending a mile in length, and illustrious on account of its glasshouses, where in 1495 every conceivable object that could be fashioned in glass was produced. In Curzon's "Libraries in Italy" a curious use of glass is described. "In the beginning of the fifteenth century a man named Panfilo Castaldi was employed by the government of the republic of Venice to engross deeds and public edicts of various kinds, the initial letters at the commencement of the writing being usually ornamented with red ink or illuminated in gold and colours. According to Sansovino certain stamps or types had been invented some time previously by Pietro di Natale, bishop of Aquileia. These were made of Murano glass, and were used to stamp or print the outline of the large initial letters of public documents, which were afterwards filled up by hand. Panfilo Castaldi improved on these glass types by having others made of wood or metal, and having seen several Chinese books which the celebrated traveller Marco Polo had brought from China, and of which the entire text was printed with wooden blocks, he caused movable wooden types to be made, each type containing a single letter, and with these he printed several broadsides and single leaves at Venice in 1426. Some of these single sheets are said to be preserved among the archives of Feltre. The tradition continues that John Faust of Mayence became acquainted with Castaldi, and passed some time with him in his scriptorium at Feltre." Mr. Nesbitt, who has collected an immense variety of facts connected with the glass manufactures of mediæval Venice, gives a curious list of articles of glass from the inventory of effects belonging to Henry VIII. in 1542, which were under the custody of Sir Ant. Denny at Westminster. Nearly 450 glass objects are enumerated, and probably the greater number of these were of Venetian manufacture. Among them are many pieces of blue, or blue partly gilt, some of many colours, and several garnished

with silver. Four "bell candlesticks" of glass are especially named, and the expression is interesting, as brass candlesticks of this form are well known not only from Venice, but also of Damascus and Persian work; glass in this form are rare, though some specimens of faience are known; the shape was a favourite one in the East, where it is still much in use. Venetians made numerous vessels in the form of animals or fish or monsters. René François, chaplain to Louis XIII., gives an amusing sketch of Murano filling Europe with a thousand fantasies in glass and crystal, which compel people to drink in spite of themselves; one swallows a ship or a gondola of wine, a pyramid or a steeple, a whale or a lion, all sorts of potable or non-potable beasts. The astonished wine takes all kinds of shapes and turns all manners of colours, thus claret becomes golden and white wine is dyed scarlet. From this we see these extraordinary vessels were meant for use as well as for objects of ornament. The activity of Venetians in searching far and near for means of improving their important factories is shown by Sandy, who travelling in 1610 says: "in the desert between Alexandria and Cairo is a wood called kali by the Arabs, which they use for fuel and sell the ashes crushed together like a stone, in great quantities, to the Venetians, who, equally mixing the same with the stones brought from Pavia by the Ticino, make thereof their crystalline glass." These are the same "tarso" stones which Neri directs should be used for making pure glass. As the factories of Venice rose in renown, new born genius was added to the experience of the past, and the art the Byzantine Greeks had transmitted to western Europe approached an extraordinary degree of perfection. Specimens of ancient glass were carefully sought out and earnestly studied by the most skilful workmen of Murano, and the result of their close observation of the antique enabled them to produce those countless marvels in colour and form which still give pleasure to the uncultivated as to the most fastidious taste; the extraordinary lightness of old Venetian glass rivals that of ancient Greece or Rome. They succeeded in copying all the old colours, and blended two sheets of colour in one glass; they imitated all kinds of marbled stones; they made mille fiori or mosaic glass; they invented aventurine; and they far surpassed their masters in reticulated or lace glass. The most remarkable of this filagree glass is that called à reticelli. M. Labarte gives the clearest account of how this beautiful appearance is produced. Canes are

prepared containing a coloured or milkwhite thread, twisted in a transparent rod of glass; these rods laid side by side are heated in the usual manner to make two sheets of glass (the enamel must be very dry). These two are laid slanting across each other, so that between each rounded point of the approaching canes a bubble of air is left; with the iron pinchers these sheets are put into the furnace and formed into a vase with a stand and cover; the extraordinary manner in which the bubbles of air inside the mass of glass increase and decrease with mathematical precision, according to the shape of the vase, makes its manufacture appear totally incomprehensible to the uninitiated. The amount of dexterity and skill in manipulation required to produce works so minute and delicate in their details must always place specimens of this glass among the most valuable artistic treasures a nation can possess. This reticulated glass has been perfectly reproduced at the modern Murano works, and Englishmen may feel some pride in remembering that their countrymen have had some hand in fostering the revival of this beautiful art. It is no secret that English culture and capital materially aided Salviati in his early difficulties, and the exquisite works produced by the Royal Society of Murano and exhibited at Paris 1878 were deservedly rewarded by the Cross of the Legion of Honour bestowed by the French government on M. Castellani, the director of the society, which is chiefly supported by Englishmen. It is the extreme delicacy of touch and artistic taste inherited by the artisans of Murano from numerous generations of glass-working ancestors, that has enabled these modern societies to rival and reproduce all the envied treasures of mediæval times, whose hidden secrets have all been unravelled in the last few years by the patient determination of modern skill. The fame of Murano so entirely eclipsed that of all other glassmaking cities in Italy that we find very little mention of their productions, with the exception of mosaic and painted glass. No doubt, glass of other sorts was made in the middle ages which could not all have come from Venice. Thus it is possible the glass found in the tomb of Maria, wife of Honorius, at Rome, may have been of local manufacture; in her tomb was a beautiful lamp and a silver box, about a foot and a half long, containing vases and other pieces of glass to the number of thirty; among them two cups with beautiful figures in half concave, and a flat bottle for oil, wonderfully thin, also one shaped like one of the skimmers with handles used to take holy water out of bénitiers

at Rome. The tombs of Roger I. and Constantine in Sicily, both of the twelfth century, have pillars ornamented with glass mosaics, and several of the Sicilian monarchs were buried with embroidery of imitation pearls on their shoes and dresses, but there is nothing to prove that all these were not made in Venice. In 1623 Antoine Miotti addressed a petition to Philip IV. of Spain, in which he says that Rome had two establishments for glassmaking, Florence one, and that Milan and Verona had tried to set others on foot; and Sir R. Mansel in the same year procured a "company of glass workers from Mantua." Therefore it is possible that some of the articles classed as Venetian are really the production of other Italian cities.

IMITATION GEMS.

"Should you wish to make an emerald, take two ounces of fine crystal glass and half an ounce of calcined copper, grind in a mortar, add some alum, melt at an equal fire for three days and nights."—*From an MS. on the sacred art of Alchemy, by Olympiodorus of Alexandria, third century.*

THERE is little doubt that the most profitable and probably also the most scientific trade carried on in Egypt was that of imitating all manner of precious stones, of which an enormous number seem to have been produced; therefore the process of making transparent glass must have been understood, though we have no means of fixing the precise date of its discovery. Not only would the manufacture be guarded with all the jealousy of trade secrets, but it would be veiled in the additional mysteries of an all-powerful priesthood as well. Indeed we are told that the earth around Egypt was supposed to produce various coloured gems by the aid of divine fire. No doubt that branch of chemistry was held in high honour, as historians have thought worthy a place in their annals the name of that king who succeeded in imitating the stone called a "cyanus."[1] In the Harris papyrus (British Museum) Rameses III., twentieth dynasty, is supposed to recount after his death the benefits he has conferred on the country and temples, and mentions adorning the statue of the god of Thebes with "real" stones; he also among the list of rings enumerates those of good gold, with real precious stones, and mentions three qualities of gold and beaten silver, together with glass scarabei, and crystal signets, and beads, and pieces of vases, also real stones, and other stones, real lapis, and turquoise statues of the Nile,[2] and carefully distinguishes between the number of white and coloured jars, and earthenware jugs and amphoræ for holding

[1] Cyanus is an inferior sort of lapis used for making ultramarine. Theophrastus, 384 B.C., says it was produced by art, and an Egyptian king first made a fusible cyanus.

[2] There is apparently an allusion to embroidery in this list, "plants worked as flowers in screens."

incense, spirits, beer and wine, and paint and cosmetics. A sandstone tablet in the Bibliothèque Nationale, Paris, of the date of Rameses XII., twenty-first dynasty, contains a curious distinction between xesbit *ma*, real lapis, and xesbit, only, supposed to be the paste imitation of it, sometimes sent as tribute. It also specifies "real" malachite (see a papyrus tale called "The Possessed Princess"). Real lapis, or "pure," is often mentioned among the most precious of stones.[1] In the pectorals and other jewellery found in Egyptian tombs many of the stones are real, and others glass imitations. Saumaise declares the Egyptians sent such numbers of glass gems to India that they far outnumbered the real ones; he accuses Indians of trafficking them with other nations who came to buy the precious stones and knew no difference between real and false. No wonder Pliny says "it was the most lucrative trade ever invented by the mind of man." The priests of Memphis were famed for making a preparation called "l'œsustum," which produced emerald glass. From their laboratories proceeded probably the marvellous columns which Herodotus saw in the temple of Hercules at Tyre, and which he describes as formed of a single emerald, which at night threw out an extraordinary light. Doubtless they were made of hollow green glass, lighted up by the care of the priests with lamps inside. Even in our time such a luminous column would have a grand effect. Most likely these would be the same columns which St. Clement describes in the isle of Aradus, (where stood the Tyre of Herodotus,) which the inhabitants invited St. Peter to come and see, and which "astonished the prince of apostles by their size and grandeur." Of a similar character must have been the obelisk in the temple of Jupiter, Egypt, which was sixty feet high, and four and a half wide, formed of four large emeralds. It must have required great skill to cast these large pieces of glass. Sesostris had sculptured in emerald glass a statue still seen in Constantinople in the reign of Theodosius, he also used a sceptre made of emerald glass. There existed in the time of Apion Plistonique, in the labyrinth of Egypt, a colossal emerald statue of Serapis, thirteen and a half feet high. This god's name also appears on a black

[1] That there must have been quantities of real stones in Egypt is shown by an inscription at the temple of Karnak, where Amenophis III. engraves a list of his donations to the temple of Ammon, and enumerates among quantities of rare stones 4820 uten of turquoise, part of the booty gained from a campaign against the Asiatics.

glass amulet before described; the little ornament remains intact, but of the great statue not a vestige can be found. When we read of an emerald six feet long sent as a present from Babylon to a Pharaoh, of a piece of jasper out of which was carved an effigy of Nero, A.D. 54, in armour, or of that beautiful chrysolite, six feet long, which Ptolemy Philadelphus,[1] 285 B.C., had sculptured into a statue in honour of Queen Arsinoe, may we not imagine them all to have been glass? Also when we hear that Pompey, about 80 B.C., found among the treasures captured from Mithridates two thousand drinking vessels all made from precious stones, may we not think it probable that some among them were glass imitations? Though it is said that emeralds,[2] being the most easy gem to imitate, were fabricated in the greatest numbers, yet many other stones were made in Egypt. A Theban jeweller could provide a set of ornaments imitating any fashionable novelty of the day at a price that placed them within the reach of all classes. It is only when a nation has reached a high state of civilization and luxury that artificial wants are cultivated, and poorer classes feel the desire of copying all the caprices and tastes of the wealthy. Democritus, 460 B.C., was said to have invented emerald glass, but it is much more probable that during his five years' residence in Memphis he mastered the secret of making it. The Egyptian priests also succeeded in making from the scoria of their factories a black glass resembling jet,[3] which they used in their jewellery and also for statues, to replace not only jet but the obsidian of Ethiopia, a substance which pleased the emperor Augustus so much that he had his statue made of it, and also four elephants which were placed in the temple of Concord. These obsidian statues were no doubt sculptured by hand, as a block of that substance from Hecla has in recent times been made into a bust of a king of Denmark, in Copenhagen, where, as of old in Egypt and Rome, they still make earrings and necklaces of it. This substance seems to have appealed to the taste of widely separated nations, as the old inhabitants of Peru made mirrors and ornaments of a vitrified lava like obsidian. Of the false

[1] Founder of the museum and library of Alexandria.

[2] Ancients probably classed as emeralds fluor spar, green vitrified lava, green jasper, and also green glass. The piece of green glass, seven inches long, preserved in the monastery of Reichenau, and the sacred cup of Genoa, long considered the veritable "San Graal," which is full of flaws, are both given out to be emeralds to the present day.

[3] A statue of Menelaus in jet was brought from the temple of Heliopolis in Egypt to Rome, and afterwards sent back to its original place by Tiberius.

obsidian statues from Egypt, having no knowledge as to whether they were wrought by hand or cast, we can only quote Pliny, "eastern marble liquefied by fire and used as glass." We have many proofs that signet rings of glass paste were highly valued, and thought worthy of presentation at the shrine of divinities. Chandler publishes, from a marble inscription, a list of articles contained in the treasury of the Acropolis, between the fourth and fifth centuries B.C.; among them are two "glass signets" of different colours, set in gold and having gold chains to them. In one of Boeckh's inscriptions, dating from the Peloponnesian war, he enumerates " seven signets of coloured glass"; and in the treasury of Curium, Cyprus, numerous pastes, some set as ring signets, and of various colours, were found, though most of them were too much corroded to enable the original design to be distinguished. Some among them were imitations of lapis lazuli, that "royal gem" as Epiphanius calls it. Mr. King thus describes one of great beauty. "Among these was an unexampled paste pendant, belonging to a royal lady, with bands of gold inserted to imitate the real stone. It is probable, from the care bestowed on the setting, that the Sidonian merchant had passed it off on the Cypriote queen as a precious and rare stone." It is curious to see such similar votive offerings treasured up in shrines so far apart; it is possible that the donors may have believed their gifts to be real stones, or the glass imitations may have been equally valued.

Signet rings of engraved gems must have been used before 600 B.C. in Greece, as soon after that date Solon passed a law prohibiting the gem engravers (who were already numerous enough to constitute a distinct trade) from keeping by them the impression of any signet ever sold, in order to prevent the chance of forgery from a replica of the original design falling into the hands of dishonest persons. It would be a great convenience now if forgery could be prevented by a simple enactment. Cicero, in speaking of Verres that fanatical collector, describes as a heinous crime on his part that being greatly pleased with a seal on a letter, he sent for the signet itself under pretence of looking at it, and then refused to return it. The fashion of wearing signet rings was introduced from Greece into Rome, and soon became universal.

It is to the skill of the ancients in making false stones that we owe the numerous imitations of gem camei and intagli,

technically known as "pastes," which fill our public and private cabinets. Hundreds of them are probably forgeries, but many are really antique and very valuable, not only for their own beauty, but because they are often impressions from ancient gem camei, and have in some cases preserved to us rare designs of which the originals are lost. Winckelmann mentions as an example a paste representation of the combat between Pittacus, one of the seven wise men of Greece, and Phryno on the promontory of Sigëum; the former has entangled his opponent's head in a net, and so mastered him.

Mr. King describes two beautiful pastes from the Basle collection, one aventurine with an emerald ground, the other a breccia agate of wonderfully beautiful colours, both honoured with the choicest performance in the way of a gold setting ever achieved by an Etruscan artist. In the Bibliothèque at Paris is a dark glass intaglio, bearing the head of Augustus, with the name of the engraver, Dioscoride, a repetition of the signet he used during the later years of his life. Suetonius, A.D. 70, says he first used a sphinx, then Alexander the Great's head, then his own head engraved by Dioscoride. While the rich Romans wore jewels and gem camei set in gold for signet rings, the trade of making pastes, meant to meet the requirements of the poorer classes (always eager to copy the habits of the rich when possible), throve immensely,[1] and has left us numbers of most valuable and skilful specimens. When gem engraving declined in the third century the art of making pastes seems to have ceased also.[2] The paste gems made for the people in Rome are sometimes found set in a twisted shank of glass, differing in colour from the pretended stone, but perfect specimens are naturally very rare, they are more generally found set in massive bronze. It is so extremely difficult to remove this setting from the paste without breaking it that Mr. King thinks any pastes found without any remains of setting may be set down as forgeries[3]; this is perhaps true in many cases, but there are

[1] Ancient pastes are much harder than our common window glass, while modern coloured glass is softer than white.

[2] We believe that etching on glass now so common was unknown in old times, because it depends on the properties of fluoric acid, a chemical discovery of the last century.

[3] In the last century paste making was rediscovered and brought to great perfection by Regent Orleans, 1700; he got the chemist Homberg to reproduce all the gems in the royal cabinet.

numerous unset paste gems of undoubted antiquity preserved in museums. Imitation gems were seldom set in gold, unless to deceive the unwary; Romans put a backing of stone to a paste sometimes, so that when the edges were concealed by the setting the fraud was very difficult of detection, as the back of the ring when tested gave back a true reply. Of such a kind may have been "the well dissembled emerald" on the finger of a dandy mentioned by Martial, who, after asking the price of all the most expensive articles, is glad to sell his ring for two shillings to get himself a dinner.

Pliny says the glass gems from rings of the people were ground up with pipeclay, to make a paint called annulaire. Among the Duke of Devonshire's gems are to be noted an Achilles of Pamphilus, and portraits of Nero and Poppæa, both on pastes that are more lustrous and beautiful in colour than even the ruby and emerald they were meant to imitate. Busts and figures in full relief made in glass are sometimes cut, as if out of a hard stone; there is a fine example in the British Museum, in hœmatinum, opaque red glass, a bust two and a half inches high, in very good style; while many of the cameo pastes preserved in the gem room are more brilliant than jewels. Seneca says in his time they had discovered the art of converting pebbles, by means of fire, into stones resembling emeralds, and they made all sorts of colours by means of stones, which in fusion took those tints. Pliny says no substance lends itself better to colour than glass, and they manufactured at Rome not only "obsidian which is made in stained fashion for vessels of repast," but also red, white, murrhine or hyacinth, sapphire, and all other coloured stones; so that it was impossible to tell real from false gems, save by proof of stone, glass being softer. He tells us he had in his possession manuscripts in which were written all the secrets for imitating precious stones, but the fear of propagating this fraud determined him never to reveal these secrets. He gives the best means of detecting impositions, "Lunâ, tactu, pondere." In describing white glass however he is obliged to speak of manganese, which contributes so much to its purity, and in his article on metallic colours for painting he cannot help enumerating those oxides which give them. The result is that without wishing to do so he has pointed out to us the road we must follow to make glass gems. Pliny also remarks that in his day pearls were worn by the wives of inferior public officers, who

wished to vie in the splendour of their dress with ladies of the highest rank, so it is certain some means of imitating pearls had then been discovered, though Pliny does not describe it. Trebellius Pollio says it was a false pearl which deceived Salonina, wife of the emperor Gallienus, A.D. 260, who took a whimsical revenge on the perpetrator of the fraud. The unfortunate merchant was condemned to be thrown to the wild beasts in the arena; but when, half dead with fright, he was waiting his last moments, the door of one of the dens was thrown open and a cock (some say a turkey) entered and trotted peacefully round the enclosure, the peccant victim being released after his false alarm, the emperor saying, "He deceived others, he has himself been deceived." Yet some authorities have asserted that the art of making false pearls was unknown to the ancients, and only invented in Venice, where the manufacture was forbidden by the government early in the sixteenth century, as too fraudulent, or perhaps, as they were made of quicksilver, too dangerous to the health.[1] M. Baudet describes finding in a tomb in Burgundy, dating about the fourth century, a necklace of blown beads of small size, into each one of which had been introduced a leaf of silver or some such metal, which gave to the outside of the beads that "chatoyant" aspect which exactly imitates the lustre of a pearl. Such tricks as the one practised on the emperor must have been often repeated, as Tertullian complains that in Rome they sold "a bit of glass as dear as a fine pearl." M. de Goguet, quoting from Pliny (i. 37, sec. 17), says "that on the tomb of Hermias, a prince of the island of Cyprus, was a lion in marble, with emerald eyes, which shone so brightly their lustre penetrated to the bottom of the sea, and frightened away the tunnyfish from the adjacent fisheries. The fishermen, suspecting this might be occasioned by the eyes, took them away, when the fish returned in great plenty as before." The marble lion discovered by Newton near the peninsula of Cnidus, now in the British Museum, has deep sockets in place of eyes, which, like those of the Cypriote lion, were probably filled with coloured glass.

The vivid imagination of Lucian makes him describe the city, in his Isles of the Blessed, as having walls of emerald, while the temples were made of beryl and the altars were formed of a single

[1] M. Jaquin in 1656 first invented lining glass beads with the scales of the bleak fish. It requires about 20,000 fish to manufacture one pound of essence of pearl.

amethyst.[1] Some ancient authors have said that mirrors were made of rubies, but we do not find rubies in our day large enough for such a purpose, though Marco Polo says the king of the isle of Zeilan "is said to have the best ruby in the world, one palm long, and as big as a man's arm, without spot, shining like the sea. Cublai Khan sent and offered the value of a city for it in vain; it was not to be bought with money." Captain Hawkins tells us the Great Mogul had in his treasury "fifty cups made of ballace rubies in one piece, emeralds, and other sorts of stones." These stones were evidently believed to be real by their possessors. When we read in the Chinese classics that an emperor built for his favourite "a palace with walls of carnation gem, and inner walls of ivory," we suppose the word translated gem must have some other meaning in Chinese from that attached to it by us. Also when we read that at the abdication of the emperor Yaou, 2145 B.C., a mysterious dragon brought in its mouth a casket of red gem, in which was enclosed a white gem with an inscription giving the empire to Shun, and when some centuries later Leu Chang opportunely fished up from a lake a gem on which was inscribed that "Chang emperor was to receive it," and was therefore proclaimed emperor at once, we feel these inscriptions were too quickly discovered to have been really engraved on a hard substance such as we call gems, and were probably glass or some such imitation.

The "fabri ocularii" of antiquity were at one time supposed to be those artisans who made imitation eyes of glass for men, they are now known to have been workmen who furnished glass eyes for statues. Many stories are told of jewel or glass eyes for Hindoo and other pagan idols. The exact manipulation of glass for making false gems has always been a trade (or rogue's) secret; so we know little of the ancient method of working, until Eraclius published his book about the seventh century. The emerald seems to have been the easiest jewel to imitate, therefore it is the most common.

In many museums are to be seen pieces of coloured glass which were evidently once worn as jewels, from which they cannot

[1] A block of amethyst was discovered in Brazil in 1819, four feet in circumference, and weighing ninety-eight pounds in its rough state; it was formed of fifty irregular columns shooting up from one source, and was pronounced to be a real amethyst by professional men in Calcutta, where it was sent for sale. This is supposed to be the largest amethyst known.

be distinguished by the eye. Batissier especially cites among others a chrysolite and an emerald, so well executed and perfectly coloured throughout, and without the slightest blemish internally or externally, that it is extremely difficult not to be deceived by them. A head of Tiberius in the Florentine gem cabinet, as large as a hen's egg, was supposed to be cut out of an unusually large turquoise, but it has now been proved to be glass. It required great skill and care in old times to guard against such skilful forgeries as these. I have been assured by a jeweller that even among many valuable and celebrated family jewels there are some false stones still carefully hoarded up, and their owners do not care to have them too carefully assayed.

Among the early treasures of Christian churches the same delusion has frequently been exposed; perhaps the donors of the jewels have themselves been deceived, or possibly the imitation gems may have been substituted for real ones during times of great trouble or want. Sometimes we know the monks, guardians of the church stores, have hidden away in safety the valuable jewels, only exhibiting worthless ones to the gaze of a hostile or avaricious public. Among these so called church jewels may be noted the cup at Monza, said to be made out of a single sapphire, and to have belonged to Queen Theodolinde, A.D. 600. It is about three inches in diameter, and of a very beautiful blue colour. Mr. Nesbitt thinks it is probably made of glass, though it is cold to the touch, and he failed to find any bubbles in it. The celebrated piece of emerald glass still preserved in the abbey of Reichenau, Lake Constance, is two feet long by thirteen inches wide and three inches thick. It is said to have been sent by Irene, mother of Constantine VII., to Charlemagne, A.D. 800. It was always given out to be a real emerald, and Keysler, who saw it in 1730, believed in its value himself, and gives an amusing account of the precautions taken by the prior for its safe keeping.

The well known sacro catino of Genoa, a shallow shaped dish with a foot and handle, has always been supposed to be formed out of a single emerald. It was pronounced to be green glass by President de Goguet, 1761. It does not appear even to be of antique workmanship, being rather clumsily made and finished with a tool; but it has long been considered one of the most sacred relics in Christendom, being the veritable "sangraal," whatever that mystical vessel (the object of so much devotion in

the age of chivalry) may have really been.[1] It was part of the booty obtained at the taking of Cæsarea in 1101. The colour is very fine, but it is full of bubbles. Arab writers give such varied accounts of the famous table of emerald taken by Tarib son of Zeyad at the siege of Toledo in the fourteenth century, that it seems probable there must have been more than one table or altar front taken at Toledo. The first is described as formed of a solid emerald possessed of talismanic properties, and made by genii for King Suleyman the Wise; it formed part of the spoils taken from Rome by Alaric king of the Goths, A.D. 402. El-Makkari says the table was of pure gold set with precious stones, and it was found on the altar of the principal church of Toledo, where it was made. Some writers say it had three hundred and sixty-five feet, some three, some none. A manuscript of 1174 states it was inlaid with precious stones of various kinds and hues, as well as with aromatic woods, that it was ornamented with several inscriptions in the Greek tongue, and was made of a single emerald. It was probably the frontal of an altar, and, if the inscriptions were in Greek, of Byzantine workmanship. At all events one table was presented by Musa to the caliph at Walid, and valued at 100,000 dinars. Musa found at Seville among other sacred spoils a cup made out of a single pearl, said to have been brought by an early king of Spain from Jerusalem. Pliny has described the effect produced by a kind of crystal called iris. In modern times triangular pieces of glass are made like crystal, which decompose light like a prism; one of these prisms was passed off in China for a "fragment of that substance whereof the heavens consist." Father Ricci, a Jesuit missionary, 1570, narrates his giving a prism to a native convert who, putting it into a silver case with golden chains, sold it for a high price as a veritable piece of heaven. No. 274 in the Paris cabinet is a cylinder in glass paste, an inch and a quarter long, representing in relief twelve scenes from the life of Christ. Chabouillet considers it as anterior to the eighth century, and made in Mesopotamia, the original country for that form of gem. King points out that the fact of this specimen being a paste shows that there must have existed a regular manufactory of the kind, otherwise the mould for casting

[1] The holy chalice of Valencia, supposed to have been the actual cup used by our Lord at the last supper, is formed of a splendid brown sardonyx, of Roman workmanship. Its origin is lost in obscurity; the setting is of about the ninth century.

them would have been unnecessary; the figures being in relief show this cylinder was merely an ornament, probably for stringing on to a necklace. The Arab women use all the ancient cylinders they find for their necklaces.[1] The extreme hardness of ancient glass is such that it will scratch modern productions like a stone. This hardness is noticed by Theophilus (about thirteenth century), who says cubes of ancient mosaic glass are scarcely affected by a heat which reduces our glass to a fluid. This property may account for some of the wonderful varieties of mille fiori and other Roman vases. There is no doubt that much ancient glass was melted down by the earlier workmen in their manufactures; it was obviously much easier for them to pound and melt the fragments of an old sapphire coloured cup or vase than to prepare and grind down the necessary oxides for a new one; and much of this skilfully made glass was no doubt fashioned into false stones. Theophilus says: "in the ancient pagan edifices different kinds of glass are found, of divers colours, in mosaic work, not transparent but opaque like marble, made like square stones, from which coloured gems are made for gold, silver, and brass work." No doubt ancient materials were more plentiful and more easily procured than they are now. The same author tells us if we wish to polish glass, gems, or enamel, "to procure some of the potter's ware found among ancient vases, rub it down on a stone with saliva until it becomes thick and red; this you anoint on a flat leaden tablet, upon which you lightly rub the glass stone till the colours appear clear and transparent; again rub down the clay ware with saliva, and anoint with it a goat's skin, upon which you polish the stone till it shines perfectly, so that if one half were wet and the other dry no one could distinguish which was the wet part." The following curious if not useful recipe for sculpturing glass is given in a very old treatise by Eraclius[2]: "artists who wish to engrave glass in a beautiful manner, I can now teach you as I have myself made trial. I have sought the gross worms which the plough turns up in the ground, and the art necessary in these things also bid me to procure vinegar and the warm blood of a lusty goat, which I was careful to place under the roof for a short time bound with a strong ivy plant. After this I infused the

[1] Sir R. Ker Porter says these cylinders are supposed to be animated by a portion of the divinity to whom they are dedicated; this is effected by means of magical ceremonies. This sort of bosom god is usually suspended round the neck of the person happy enough to possess it.

[2] Eraclius must have written between the seventh and tenth centuries.

worms and vinegar with the warm blood, and I anointed the whole clearly shining vessel, which being done I essayed to sculp the glass with the hard stone called pyrites." He also gives many recipes for making precious stones, which sound simple but rather vague, for instance: "take crystal, soak it in alum for eleven days, then melt it with orpiment, and it will be a chrysolite." Similar recipes are given for making other gems. Paul de Canotanto early in the fifteenth century says: "should you wish an emerald, use green copper; if a sapphire, lapis lazuli; if a hyacinth, violet coloured, use less or more of the same stone; if a garnet hyacinth, powder of malachite, if a chrysolite arsenic, if a topaz moderately arsenic." We are also told to use gold free from salt to make a carbuncle.

Neri, who published his interesting work on glass at Florence, 1611, gives most careful directions as to how chalcedony is imitated; he directs you to make nine different coloured glasses; "these nine bodies well closed are to be kept in the furnace fifteen days and every day well stirred, then put all the materials together closed for six days and stir well every day; then put in ashes for twenty-four hours, then very gentle heat that the powders may work strange in the glass, then in twenty-four hours again work it with diligence and according to art, and set it to the fire again. This I performed at Antwerp, 1609. It came forth a chalcedony so fair and so beautiful that it surpassed the oriental agate. Many Portuguese gentlemen admired it, saying nature could do no more. Of this two cups were given to the Prince of Orange which pleased him well."

Old chronicles are generally quite ignorant and probably indifferent as to whether the gems they describe are real or imitation. In the Anglo-Saxon poem of Beowulf,[1] when the funeral pile is raised to the hero, "the people cast into the mound rings and bright gems and all such ornaments." Beowulf having killed a dragon which guarded a hoard of treasure, he had taken possession of the whole and it was this hoard which was thrown on to his tomb. At that date it would have been impossible for the people to detect false from real stones. Some of the jewels shown at the shrine of Thomas à Becket, at Canterbury, who died 1170, were of dimensions larger than a goose's egg. When the body was burned, 1538, two chests full of jewels were taken for

[1] Translated by Mr. Thorpe, 1855.

the king's use. Stones such as onyx, cornelian, and others can be stained by the aid of heat and various acids many colours, and their original colours may be improved and darkened. Mr. Billings gives a curious account of how stones may be stained with an inscription which can only be seen when held up to the light; these were first brought from the East for purposes of mystification.

WINDOWS.

"But since the practice of this kind of embellishment cannot be of quick apprehension, like a diligent inquirer I have greatly laboured to inform myself by all methods what invention of art and variety of colour may beautify a structure and not repel the light of day and the rays of the sun. Applying myself to this exercise I comprise the nature of glass, and I consider that this can be effected by the use of it alone. This art as seen and reported I have learned, I have laboured, for your observance to fathom."—*Theophilus, eleventh century.*

"You shall have sometimes fair houses so full of glass (windows) that one cannot tell where to become to be out of the sun or cold."—*Bacon's Essay on Buildings.*

ANCIENT EGYPTIANS never seem to have used windows, their climate not requiring such a defence against the cold, though as they made plaques for ornamental purposes they could doubtless have made window glass had it been required. It was probably introduced by the Romans, whose more rigorous climate demanded some kind of protection from the weather. It was not known apparently to Seneca, as he speaks of the use of talc as a new thing: "we know of some inventions within our own recollection, as that of the application of thin sheets of talc which transmit the clear light, the plate being transparent." When Varro, 116 B.C., in his Rural Economy directs that the windows of the fruit room should be to the north to give free entrance to the wind, and adds, "but forget not to place shutters for fear too much wind should dry up the fruit," he does not seem to allude at all to glass or talc; but when he goes on to describe the aviary which Lucullus constructed at Tusculum he must have some transparent medium in his mind. "In the interior he made a dining room, in which he could enjoy the delights of the table and see at the same time thrushes cooked and arranged on dishes and others leaping and flying about outside the windows. This example found few imitators, as however pleasant it might be to see the birds fluttering outside the windows, the pleasure

did not make you forget the disagreeable odours of the aviary." These aviaries were sometimes so large that the owners could sell five thousand birds a year. He describes some aviaries which were only made by columns with nets stretched above and around, and goes on to give directions that in building an aviary "you must carefully place the windows so that the birds should not see trees or other birds, as this prevents their fattening. The circumference of the doors and windows should be covered with well polished putty, to prevent rain from entering or any noxious animal." This advice seems to establish the fact that he knew of some transparent substance for windows, as in describing a dovecote he especially insists on the necessity of having "very narrow windows which should be covered with lattice work inside and out, to prevent serpents or other vermin from entering." A curious passage in Philo Judæus, A.D. 30, tells us he heard Nero give orders to have a hall or gallery of his palace (possibly a loggia) filled in with stones transparent as white glass. Martial frequently alludes to windows. Winckelmann describes a so called ancient picture belonging to Cardinal Albani, representing buildings with windows filled in with glass; but supposing the picture really antique what looks like glass might have been thin sheets of phengite-alabaster or some such stone used to admit light and keep out the cold, as we use frosted glass. It is certain that rich Romans had squares of real glass for greenhouses or frames, in which they kept the plants they wished to preserve from cold. These glass squares, though probably not so large as those made in modern factories, undoubtedly led the way for ours. Glass must very soon have been substituted for talc, and the first real evidence of its use comes from Pompeii and Herculaneum;[1] the Naples museum contains various specimens, and it shows the extraordinary ignorance of such subjects which prevailed in the last century, during which so many people disputed the existence of any proof that glass was anciently used for windows, when Dutens, 1778, states that the baths in Pompeii were glazed with as fine glass as in the present day; his book was evidently never read or not considered a veracious history. The pane of glass in a bronze frame found in the house of the faun seems to have been cast on a stone and is full of defects, it could transmit light but would hardly permit external objects to be seen. The public

[1] See also the beautifully iridescent specimens of window glass from Pozzuoli in the British Museum.

baths of Pompeii had windows made of good plate glass slightly ground on one side to prevent people in the street from looking in. One bath was lighted by a skylight, closed by a single pane of cast glass, 2 ft. 8 in. high, 3 ft. 8 in. broad; this pane was fixed into the wall and slightly ground on one side. A window containing four panes of glass, described by Gell, was divided by cruciform bars of copper, fastened with nuts and screws ingeniously contrived to remove the glass at pleasure. In a Roman two-storeyed villa on the Herculaneum road was a large glazed bow window, the glass very thick and greenish, and set in lead like a modern casement; some panes of glass found in the same town measure 16½ in. by 7½ in. Bontemps says he proved that the panes of glass in Pompeii were cast in a metal mould, all the window glass found seemed to have been cast. A window in the house called Diomede's presented a copper frame similar to that described by Gell. Many private collectors possess specimens of window glass from these buried cities, and a very little more knowledge would have disposed of the whole question of window glass, so much disputed by the learned in the early part of this century. Though glass was used in Rome for windows, many other substances,[1] linen, shells, alabaster, and mica, were more commonly employed. Flat pieces are found in houses both in Italy and Britain. From China, Japan, and Java we still hear that windows are filled in with mother o' pearl, tortoise or crocodile shell, and a large kind of oyster shell found in the canal of Chauto. These temper the heat of the sun, and give beautiful colours. Ancient Romans also filled in windows and the litters of women with pieces of transparent "stone speculaire," possibly mica in sheets, or that verre de Muscovie which even now replaces, in some vessels of war, glass, which might be broken by the roar of artillery. They certainly made of glass or some transparent substance greenhouses for plants, and hives through which they could watch the bees at work, and also filled in lanterns which were more brilliant than those covered with bladder. Lucian insists much on the importance of well arranged windows. In describing the baths of Hippias he notices that "the whole building was well proportioned and the windows of a proper size and distance. In building especially, as Pindar says, regard should be paid to the

[1] "Movable windows, closed in either with linen curtains or transparent glass."

windows and a fine external appearance gained. Each room should have double doors, a water dial, and a sun dial." Again when praising a house he particularly delights in "the windows large and disposed according to the various seasons of the year, and all admirably contrived both for pleasure and convenience." We may certainly conclude that Lucian alludes to glass windows, as they had been known and used at least a century before his time in Pompeii. Not only in Pompeii but in Britain, fragments of glass are found which could only have been used for glazing windows. The knowledge of such windows (a great luxury in Rome) would be taken to Britain by the nobles, as there, from the greater cold of the climate, they would require such a defence. Many fragments of flat, semi-transparent, greenish-hued glass, have been found in the ruins of Roman London. Similar fragments which are undoubtedly window panes come from the sites of old Roman villas, and some of an especially marked character are reported by Mr. Wright from Wroxeter, the ancient Roman Uriconium. If this glass was made in Britain, as many think it must have been, the art seems afterwards to have been forgotten, as the first notice we have of church window glazing in Britain is in the seventh century, when Benedict of Wearmouth had to send to France for workmen to glaze the church he had built. Windows in Latin houses being small could more easily be filled in with sheets of stone or talc, or closed with lattice work. Sometimes when the window was filled with a translucent substance it would be preserved by an awning or curtain from the heat of the sun, and it is probable that these curtains would in time be decorated with coloured designs, and thus give the first idea of painted or stained windows. In large windows the pieces of glass were fixed in pierced slabs of marble or wood. "Specularii" were probably the glaziers of the time; they are mentioned in an ordinance of Constantine II., A.D. 337,[1] but they worked in various substances besides glass. The old Roman basilicas were open at the top, that the priests might take auguries from the sky; the Christian basilicas were closed with windows formed of pieces of glass or talc, fixed in slabs of marble or wood. As it always seemed more easy for old workmen to make coloured glass than white, it has been supposed that most likely the earlier churches were decorated with coloured windows, which would

[1] In an engraving by Bellori from a painting said to be of the time of Constantine there is a representation of a house with windows.

have the effect of mosaic.[1] All ancient windows were in fact mosaic, painted windows are a much later invention. Lactantius, A.D. 290, is the first author who distinctly speaks of glass and talc for windows. "But as we see at the same moment of time everything whatsoever placed before us, more truly is it the case that it is the mind which by means of the eyes looks through as it were windows of transparent glass, or talc, at the things placed before it." St. Jerome, 331, speaks of windows closed with pieces of glass. Prudentius, 337, says of St. Paul's beyond the walls of Rome: "the magnificence of this temple is royal, the pious prince Constantine has painted the roof at great expense, he has reclothed the gilded wainscoting, so that the light of day repeats the fires of dawn. In the windows are displayed glass of varied colours, as brilliant as the fields of flowers in spring." An inscription on St. Agnes', Rome, says: "this temple, rebuilt by Honorius, was decorated with windows which produced a magnificent effect." Chrysostom, 398, praises the "high glass windows of different colours." Mr. Franks in his "Churches in Rome" says that Canon Wilmowsley, of the cathedral of Treves, showed him quantities of pieces of glass twisted and bent by heat, which had been found close under the walls of that church, accompanied and overlaid by such other remains as to make it tolerably certain that they resulted from the burning of the church, when the city was pillaged by the Franks in 420. Everywhere Christian art was spreading its roots, numerous churches were being built in France. Gregory of Tours, 525, rebuilt the church of St. Martin (which had been burnt down) and placed in the new edifice seventy-two windows. Gregory also recounts how a man, having conceived the sacrilegious idea of robbing a very rich church in the neighbourhood of the town, was unable to elude the vigilance of the guardians of the church, so for want of any better plunder was obliged to content himself by detaching the windows from their frames, and carrying them away to make money of the glass taken from them. He succeeded in getting off with his prize, but after subjecting the glass to a violent fire for three days could only make some shapeless masses of glass which he sold to stranger merchants. This story seems to prove that the windows must have been coloured, as their brilliance no doubt attracted the thief, and made the merchant give him money for

[1] The early churches may have had coloured windows, but all the fragments found in Pompeii and Britain are greenish white.

the lumps of glass; as dingy white glass would not have tempted the man to steal, and white lumps melted by an unpractised hand would not have brought any price from the merchants. Fortunatus of Poitiers, sixth century, is very much struck with the lighting of churches by means of glass windows, and says the light of day once admitted in these holy temples is imprisoned there and can never escape, "by means of the hand of the artificer imprisons daylight." Fortunatus also lauds highly those bishops who ornamented their churches with large windows of glass, and especially notices the grand effect which they produced when illumined by the rays of the setting sun. Sidonius Apollinaris particularly eulogizes the coloured glass windows placed in the church erected by Patiens at Lyons. The employment of coloured glass mosaic in the fashion of the "fenestra simplex" of Theophilus would soon give place to painted windows. The extraordinary admiration excited by the coloured windows would stimulate Christian artists to new exertions, everywhere we find fresh examples arising. It was in the beginning of the sixth century that the emperor Justinian determined to rebuild with great magnificence the church of St. Sophia at Constantinople, and embellished it with all the art of the day, among the rest with coloured windows; consequently when finished St. Sophia exceeded in splendour anything that had before been seen, and the admiration it excited may be imagined from the words that escaped Justinian at the dedication in 627: "Glory to God, who has permitted me to achieve this great work; I have surpassed thee, O Solomon." Procopius says of the coloured windows, "it appeared that day took its birth under the roof of the temple."

Windows of glass for large buildings seem to have come into use in France in the third century, and become more general in the sixth. But other transparent substances were still employed, as the French have a proverb: "L'abbaye est pauvre, les vitres ne sont que de papier." Britain at this time was ignorant of the art of glazing windows, as Benedict, bishop of Wearmouth, had to send for French workmen to glaze the windows of his church; they executed the special work for which they came over, and instructed the Saxons in the art. St. Wilfrid is said to have glazed the windows of St. Peter's, York, in 669; but if Benedict could find no glazier in England it is most probable the York windows were also glazed by French art. In 709 St. Wilfrid repaired the

church of St. Paulin, and not only glazed the windows, a new thing in the country, but also "whitewashed the walls." This barbarous habit of whitewashing buildings therefore seems as old as the buildings themselves. St. Wilfrid speaks of "artifices lapidarum," which some think must mean that he had windows filled in with transparent stone before the glassworkers came, but he may also have alluded to the workmen who pierced and cut into patterns the stone frames[1] which were to be filled in with little bits of glass, as in the infancy of the art was the usual custom. When Wilfrid first introduced glass windows in place of wooden shutters great astonishment was excited among the simple country folk, and supernatural agency was suspected when the moon and stars were seen through a substance which excluded the inclemency of the weather. Probably owing to the demand arising from these church restorations an attempt was made to establish a window glass manufactory at Newcastle-upon-Tyne, but it proved a failure and the furnaces remained extinct for eight hundred years. It is supposed the first windows used in England were imported. There is a curious passage in Bede, about this date, when writing of the church on Mount Olivet he says: "in the west front of it were eight windows, which on some occasions used to be illuminated with lamps which shone so brightly through the glass that the mount seemed to be in a blaze." Of the great French basilicas but little remains; mostly built of wood they became a prey to fire or fell into ruins, but possibly the coloured glass, always commanding a certain price at that time, would be preserved with a view to re-use when the temples were rebuilt towards the eleventh century, and it is possible that the little round-shaped panes called "chives" (literally small onions), which may still be seen at the top of high windows in French churches, may be the remains of ancient ones. Though the Italians so early knew and practised the art of mosaic, they do not seem to have adorned their churches with coloured glass till the eighth century, when Leo III. decorated the churches of St. Peter and St. John Lateran with coloured windows, the first decided mention of their use in Rome; but the knowledge of making them may have been earlier. Coloured windows soon gave birth to painting on glass; first, the variously shaped compartments in the stone frame were filled in with stained glass of different colours,

[1] In the fifteenth century the name of a builder of churches is commemorated, who is "a maker of windows, both the stone work and glass."

then the glass was adorned with sacred and historical subjects; both had their source in mosaic, an art which the Italians followed with great ardour, while the French applied themselves more to painting on glass, which is not heard of in Italy till 1503 when Pope Julius II. employed it. Stained glass was first fastened with mortar to the pierced stone windows, later iron and lead were used; the way this was done can be seen in the church of St. Prassede, Rome, which was finished in 824, where the openings in the marble windows are rabbeted and filled with pieces of talc fixed against the rabbet by cement; portions of this talc still adhere to the apertures where they were fastened. Many pagan and Christian buildings had these pierced marble windows which might have been closed by transparent stone, talc or glass. Specimens are still found in eastern (especially Arab) buildings where the lace-like elaborately pierced marble windows are filled in with tiny pieces of delicately coloured glass. Though many of these slabs still exist in Roman churches, no glass remains which can be attributed with any certainty to a very early date. At St. Sophia, where the ancient method of fixing the glass has been preserved, may still be seen plates of glass measuring ten inches by eight, which seem to have been cast, not blown, and which may, Mr. Nesbitt thinks, date from Justinian.

The art of painting is probably three centuries younger than the art of staining glass windows.[1] Charlemagne pushed all arts to their greatest possible height during his reign, and especially made France celebrated for its sumptuous buildings, repairing those destroyed by Saracens, and building others. The Abbe Texier holds glass painting to have been invented by the school of Limoges. Winston considers that, wherever its birthplace may have been, its earlier remains show more or less developed strong features of Byzantine art. It is unlikely that glass painting should be exempt from the great influence the Byzantine school exercised over western art. The glass used in the oldest glass paintings was probably made after Greek or Byzantine recipes, from its similarity in texture and colour to ancient Greek glass. As early as 979 a Venetian colony settled at Limoges for the purpose of trading with the spices and other eastern products conveyed through Egypt by Marseilles. To what extent the Venetians had imbibed Byzantine influence is seen by reference to St. Mark's

[1] Most historians, especially Benedictines, are agreed that painted glass windows date from about the time of Charlemagne, 800.

(the only real specimen of Byzantine architecture in the western empire). The church of Front Perigueux, 978, ascribed to Doge Orseolo I., and other churches at no great distance from Limoges, attest in general resemblance to St. Mark's how thoroughly the colony carried with it the spirit of the arts of its parent state. The effects of the artistic impulse thus early given to Limoges may be traced to the present day. The earliest recorded instance of coloured glass windows in Germany is that of some presented to the abbey of Tegernsee, Bavaria, by a Count Arnold in 999. The inhabitants have lately held a festival in honour of the invention of glass painting, which they claim for their town. In the "Handbook of Trades," published at Amsterdam in 1717, is the following interesting extract which bears testimony to the fact that glass windows were used in the Low Countries in the ninth century: "in the dukedom of Cœrnthen, four miles from Villach, there is a very old church celebrated for pilgrimages, dedicated to the mother of God, called Saalfelden, which was built in the ninth century by the Duke Chitomarus. In the year 1482 it was besieged by Hungarius, and also by the barbarian Saracens who destroyed the greater part of the dukedom of Cœrnthen; for three days they shot with arrows at the church but could not destroy it, because they saw that all their arrows could not break a single pane of glass, so they gave it up." No doubt as soon as painted glass was invented it was received with delight by all classes, and it was for a long time the only library of the people;[1] the council of Arras in 1025 declared that "the books of the illiterate were the paintings in the temples." As church windows grew larger, leaving less space for frescoes and monuments, the desire to utilize them must have grown stronger, besides coloured glass produced the softened mysterious light thought most suitable to the services of religion. Perhaps the oldest painted glass mentioned is that described by the historian of the chronicles of St. Beguine's monastery at Dijon, in 1058, who states that in his time there yet existed a very ancient glass window in the church of the monastery, representing the martyrdom of St. Paschasius, and that this painting had been taken from the old church restored by Charles the Bald, 850. Monk Bicher, of St. Remi, states in his chronicle, which ends in 995, that Adalberon, archbishop of Rheims, in 968, after having restored the basilica, lighted it by windows, on which were

[1] Combined with frescoes.

displayed various histories. These, had they been still in existence, would have been contemporaneous with the Tegernsee windows. Peligot gives an account of the coloured windows in the abbey of Leroux, which dated from 1121; the church being in a ruinous state it was suggested that the windows should be removed for safety to Angers, but while those in authority were still contemplating the possibility of such a change the necessity for any action was avoided by the fall of the wall in question which crushed the windows. Leon d'Ostic, abbe of Monte Cassino, 1058, says that his predecessor Desiderius (doubtless the same abbe who sent to Constantinople for mosaics) had entirely rebuilt from the foundation the chapterhouse and adorned it with glass windows, which he had painted in various colours. This is one of the first notices clearly distinguishing between stained (mosaic) and painted windows. Labarte says it is acknowledged by all archæologists that no painted glass windows in France can with any certainty be attributed to anything earlier than late eleventh or twelfth centuries, though that does not prove that some may not exist of an older date. The windows of the abbey of St. Denis are considered to be the oldest painted windows in France.[1] When Louis le Gros, 1108, was rebuilding (for the sixth time) and embellishing this abbey, Jagur who was employed to direct the works tells us no expense was spared to make these windows beautiful. The workmen pounded down in abundance sapphires (lapis lazuli) and burnt quantities of them with the glass to give it that rich azure colour still so much admired, and notwithstanding the great expense the devotion of the time was equal to it, for in the church boxes was each week found enough money to pay the workmen. One window in the abbey is a grand mosaic of colour acting on light almost as a prism; nature is not servilely copied, as many fanciful colours are introduced, thus human hair is represented both as green and purple, the artist thinking only of the harmony of his tones and not of truth. The abbot Suger, who lived in the twelfth century, is represented in the glass of St. Denis. Theophilus tells us how the Greek mosaic cubes of sapphire are melted with white glass to make windows. "They work also from purple and green in the same manner. Divers small vases are also formed of the same

[1] There is a painted window of the eleventh century in a church at Neuwillen, Alsace, representing St. Timothy; the figure is crude, but the border rich and fine in colour.

colours, which the French, most intelligent in this work, collect; and some melt the sapphire in their furnaces, adding to it a clear white glass, and make costly plates of sapphire very useful for windows."

Peligot quotes from the "Art de la Salle," 1455: "then my lady was brought to her chamber which was very well warmed and arranged," *tapissée et verrée*; and in "Cents Nouvelles," published 1459, we find, "he replied that he was happier even than those who had their beautiful chambers all *verrées, nattées, et pavées.*" Bourges was celebrated for its clear glass, 1444; and Boulogne must have made glass windows whose fame extended even to Italy, as in the "Dream of Polyphile,"[1] when describing a collection of natural and artistic marvels, the author says: "between two columns was a window glazed with the 'larmes' of Boulogne in France." Buffon says that "in Greenland they made transparent panes out of the insides of fish, a sort of isinglass probably." It is thought that the oldest specimens of painted windows in England are probably those in the choir of Canterbury cathedral, which was rebuilt in 1174. They contain subjects from holy writ on a ground of deep blue or ruby colour; the spaces between the panels are filled in with mosaic patterns, all surrounded by a brilliant and elaborate border of leaves and scrollwork. There are windows of the same character at Angers and St. Denis. Some of the heads at Canterbury might have been portraits of old Romans. The ornamental details of all early glass painting are very Greek in character, and bear witness to the great influence Byzantine art exercised over Europe. In Granton's History of Peterborough "it is recorded with gratitude that Robert de Lindsay, abbot of Peterborough, had beautified thirty monastic windows with glass, which previously had been stuffed with straw to keep out the cold and rain." Painting on glass is first mentioned in the Claus Roll, 20, of Henry III.; Sir W. Dugdale says it was practised in the reign of John. In 1240 there is a record of the orders given by Henry III. for the stained glass windows in the Tower of London, and we find that Edward the king's glazier at Windsor is in receipt of a pension from the same monarch. Though it is supposed that all the "verre de luxe" in England was imported from the continent, yet window glass must have been a

[1] Written in 1467 by Friar J. Colonna. The British Museum possesses a copy with original woodcuts and bound by Maioli. This copy is perhaps as valuable among books as the Koh-i-Noor is among diamonds.

local manufacture and a glazier seems to have been attached to the royal household. John Prudde under Henry VI. was permitted to have the "shedde called Glazier's logge, in our paleys of Westminster." In the fourteenth century it became fashionable to furnish noblemen's houses with coloured windows, and each lord pleased himself by reproducing in this way his arms, and the portraits of his family. In the college chapel, Winchester, are still to be found portraits of the carpenter, mason, clerk of the works, and the glazier, all English faces; the manufactory which supplied this glass was English in every sense of the word. The author of "Piers Ploughman," fourteenth century, speaks of "wyde wyndows shynen with shapen sheldes, and merkes of merchauntes betweene." Henry VII. in his will, among other directions relating to his chapel at Westminster, enjoins that the windows of the said chapel are to be glazed with stories, images, armes, badges, and cognoissaunts, "as is by us redily divised and in picture delivered to the Priour of Saunt Bartilmews besid Smythfield, maistre of the workes of our said chapell."

Gough in his "Sepulchral Monuments of Great Britain," published 1786, describes a series of windows still existing in his time at South Mimms which chronicled the names and portraits of those who had presented them to the church. Thus Richard Walter, 1525, is a man in a red gown, with six sons in blue behind him; a woman in red, with a blue purse and rosary, has three daughters behind her with golden locks, wide girdles and furred cuffs; another man has twelve sons; and a woman dressed in a red mantle has five daughters. The portraits on glass of Anne and Richard Nevil, Earl of Warwick, were long extant in the church at Warwick.

The whole subject of painting glass windows has been so magnificently illustrated and so exhaustively treated by so many authors, both in France and England, that it is needless to trace their history any farther here. The best age of painted glass is also later than the limit belonging to this work. Window glazing in private houses however has not been so well described, and it may be interesting to note a few data on that subject. Though used for churches and important buildings, it was by no means common either in England or France. In 1386 Richard II. gave a writ to Nicholas Hoppenwell to take as much glass as he could find or as was needful in the counties of Norfolk, Northampton, Leicester, and Lincoln, "saving the fee of the church," for the

repair of the windows founded at Stamford in honour of the king's mother Joan, Princess of Wales; he had also authority to impress as many glaziers as should be requisite for the work. If it was needful to search four counties for glass to repair a few windows, there could not have been much in the country. In 1413 Jean Avin, receiver general of Auvergne, writes in his accounts: "in preparation of Mad. la Duchesse de Berri going to Montpensier to have certain frames made for the windows of said castle and to have them filled in with oiled linen in default of glass." For the palace of the Duke of Burgundy's brilliant and luxurious court in 1467 there were commanded twenty pieces of wood, to make frames for paper, serving as chamber windows. In 1447 John Prudde, of Westminster, in covenanting to execute the windows of the Beauchamp chapel at Warwick, engages to use "no glasse of England," showing though it was made it was not so much esteemed as foreign glass. In 1505 it was held (21 Henry VII.) that though the windows belonged to the heir the *glass* was the property of the executors and might therefore of course be removed by them, "for the house is perfect without the glasse." In less than a century however, 1599, it was resolved that glass annexed to the windows by nails or in any other manner could not be removed, "for without glass it is no perfect house," and the heir should have it and not the executors. Glass was still so costly it was only used at Alnwick Castle when the Duke of Northumberland was at home; in 1567 an entry made in the minutes of a survey of the castle informs us that the glass casements were taken down during the absence of the family, to preserve them from accident.[1] A century later the use of window glass was so uncommon in Scotland that only the upper rooms in the royal palaces were furnished with it, the lower part having wooden shutters to admit or exclude the air. In the memoirs of Queen Marguerite, 1658, we read that during her journey to Flanders her litter was closed with glass, the windows all made "a devises," that she had as much silk for the lining as painting for the windows, which contained forty different devices, each with appropriate words in Spanish or Italian on the sun and its effects; when will so much thought and fancy be bestowed on a carriage for the first lady of our land? The second Duke of Buckingham introduced coach windows into England, and made a great deal of glass at his factory

[1] These movable casements may be seen in the hall of the archbishop's palace at Mayfield, Sussex.

at Lambeth. Evelyn in 1677 went to see this factory, which was first managed by workmen from Murano. Even in 1688 window glass was rare on the continent, as Sir R. Worsley writes in his travels: "a pretty big town called Murano, where they make ye fine Venetian glasse; in all ye great towns of Italy except Genoa and in this city they have paper in their sashes instead of glass." At the close of the eighteenth century, not a hundred years ago, there existed in provincial towns in France, and even in Paris, a corporation of window sash makers whose trade was to fill windows not with glass, but merely with oiled paper. In the present day a recent traveller[1] tells us: "the cost of glass in Odessa is so great that many frames are filled in with greased paper instead of glass. A watchglass costs a rouble, a foot square window-pane about six shillings. In the inland towns the prices are still higher; so that a Russian boy who puts his fist through a pane of glass commits one of the heaviest crimes in the domestic decalogue."

Capt. Burnaby, in "Asia Minor," describes Dudusa near Sivas, a straggling Armenian village, where "some of the better farmers boast glass windows. In other houses the panes were replaced by paper, or pieces of some transparent alabaster, which is found in quantities in the neighbourhood." So the classical mode of lighting houses may be studied there in perfection.

The only notice of coloured windows in Persia seems to be that in Chardin's travels, when he remarks that the windows of the tomb of Shah Abbas who died 1666 at Korn were made of crystal, painted gold and azure.

Dr. Tennant says before the arrival in Hindostan of Europeans there was not a house in all India furnished with glass windows, as the Hindoos were unable to make furnaces of sufficient power to manufacture useful things. But the emperor Shahjehan built a palace said to be entirely of glass for the peerless Nourmahal; this palace was in the gardens of Shalimar, Lahore. It must have had some kind of windows. Mr. Nesbitt quotes from chronicles of the Singhalese kings about 386 B.C., "windows with ornaments like jewels which were as bright as eyes," indicating that the author must have seen windows made of bits of coloured glass.

A great modern instrument maker says he is obliged to search in old chateaux for glass made long ago; it is faulty, and green in colour, but being dryer is much better for isolation. The hardest

[1] See "Russians of To-day."

glass isolates best for electricity, that which has been longest in fusion and contains the greatest quantity of lime; modern glass is too quickly made. Plate glass is very difficult to make, and requires great care in every respect. It is said that, in order to ensure perfect regularity in the supply of wood at the glassworks of St. Gobain, two workmen are made to run at a speed of rather more than a league an hour incessantly round and round the furnaces, each having ten billets of wood cut the same size; these they deposit as they run, one in each alternate opening of the furnace, which by this means is fed at regularly recurring intervals of time. These men succeed each other in relays for forty hours.

MOSAICS AND WALL DECORATION.

"Nous ne saurions aller plus avant que les anciens, ils ne nous ont laissé pour notre part, que la gloire de les bien suivre."—*La Fontaine.*

NO method of glass working has probably excited more attention than the wonderfully minute mosaics found scattered over the world both in beads and amulets. Old writers have exhausted their ingenuity in conjecturing the secret of their manufacture. Many of them are far too minute for human fingers or eyes to have executed, but like many other marvels the explanation is simple when once discovered. They were made (and are now successfully imitated in Murano) by arranging long slender glass rods of various colours so as to form a pattern, a picture, or the letters of a name, and then fusing them together, and while still warm the rod or cane so formed could be drawn out to almost any length, the pattern becoming perhaps microscopically small, but always retaining its distinctness. A tube of glass treated in the same manner never loses a minute hole in the middle. Thin slices cut off such a rod would present on each side the exact picture[1] or pattern originally arranged. When this idea had been once suggested, thousands of patterns could have been invented, and slices from these rods placed in liquid blue or other coloured glass, and cast in a mould and ground into shape, gave rise to the endless combinations of Greek or Roman workers.

The numberless mosaic beads or balls found almost wherever the foot of man has passed are probably made of larger pieces of

[1] Any one may easily try this experiment for themselves by slicing up a cucumber or, which is perhaps more interesting, the stalk of a common bracken fern, beginning close to the root. A well grown stalk of this fern, when sliced straight across, will give numerous little pictures of what country children still call King Charles's oak; but if the stalk be sliced in a slanting direction it presents a very good double headed eagle, for which reason Highland families will tell you that their armorial bearings are to be found on every hillside.

such rods, rounded by being exposed to heat and friction much as beads are made in Murano to this day. The mille fiori glass of the Venetian republic was simply a revival of this old industry. Very early specimens of the mosaic art may be seen in the inlaid bricks of Rameses III. in the British Museum. Many marble and pottery figures of Egyptian deities and sacred emblems are inlaid with glass mosaic. Much of the very oldest Egyptian jewellery is mosaic in character. An exceedingly beautiful example of the work is to be seen in the Turin museum, where part of a mummy case dating from the Ptolemies is ornamented with astonishing fidelity in glass mosaics representing the feathers of birds, executed with the most perfect truth and exactness. Mr. Nesbitt considers that mosaic, first practised in Egypt, is never seen in such perfection as in objects of a decidedly Egyptian character.[1] One of the first allusions to mosaic pavement is found in Esther i. 6, where the king's palace had a pavement of red, blue, black, and white marble. As this palace is supposed to have been in Persepolis, sixth century B.C., we may imagine the Persians to have been early workers in mosaic. Bonucci suggests they invented it for pavements, and quotes Ælian: "beds of gold and silver were placed on a pavement made of emerald and marble of Pharos, and decorated with a surprising and varied painting." Minutoli found remains of glass mosaic among the ruins of Persepolis.

That the Assyrians understood the art of inlaying, the first step to mosaic, is easily ascertained by examining the delicate work on the fragments of an ivory object brought from Nimroud, dating about 880 B.C.; the wings of the bulls and the dresses of the men are all inlaid with gold and lapis. It is in the British Museum, and was found by Mr. Layard.

Greeks and Phœnicians are supposed from a very early date to have ornamented the walls and pavements of their temples and palaces with mosaic pictures after nature, and introduced coloured glass into them, because in it they could produce all manners of shades which it was impossible to get in marble. The Romans copied them and introduced mosaic which remains to this day one of the industries of that city. After the fall of Carthage, 146 B.C., the Romans might have seen the advantages of mosaic pavements,

[1] Under the Ptolemies the Egyptians acquired a rare perfection in mosaic, formed by laying slender filaments of glass in patterns and fusing them together.

as that city was full of these beautiful works, many of which were disinterred from the ruins and sent home by Mr. Davis in 1861.

Though mosaic was known in Rome before Augustus, none is extant of an earlier date. Perhaps Varro, 116 B.C., is one of the first authors who speak of mosaic. In his Rural Economy, third book, he says, "you possessor of a farm distinguished by the elegance of its internal decorations and the beauty of mosaics"; and again, "is not this small farm built by our ancestors preferable to your brilliant one at Reatina? there you see blazing vermillion and azure mosaics, here all is plain and simple."

The first mosaic artist's name we find mentioned is Proclus, who flourished in the Augustan age in the city of Perinthus, where he must have attained some celebrity, as the Alexandria merchants erected a statue in his honour. His name appears on two inscriptions, from one of which we learn that he adorned the temple of Fortune in Perinthus, the second is an epitaph on a mosaic artist who left a son his equal in art. Vitruvius, first century A.D., gives the name of another mosaic artist, Dioscorides of Samos. Seneca alludes to "Numidian mosaic" in the decoration of baths, and we are told that Cleopatra in the ornamentation of her rooms replaced glass cubes by real stones. A common variety of mosaic was formed by combining square pieces of various coloured glass in patterns producing an effect like tesselated pavement.[1] Thick pieces of glass like tiles were much used in Rome, both plain in colour and some imitating porphyry, granite, and other stones, and mixed in patterns with bright coloured marbles for pavement. Mr. Nesbitt mentions the slabs of black, white, and orange opaque glass like tiles, forming a pattern, which were found on the site of the palace of the Cæsars at Rome. The Duc de Blacas found such a pavement in 1820 near the Colosseum. It formed part of the pavement of a private house older than the temple of Venus, which was built by Hadrian, and was formed of slabs of blue, green, and white glass in different patterns, enclosed between rows of tiles placed on a layer of cement laid over the ground. When found it lay seven feet lower than the Via Sacra. The walls of the chamber where this flooring was found were, according to Vescovali, divided into compartments to a height of six feet from

[1] There is a mass of this tesselated pavement in the Louvre.

the ground and laid out with giallo antico, African marble, and other costly stones, upon which was still to be found incrusted fragments of coloured glass. The pavement is given in Part I. of Minutoli's work. Of course remains of pavements in which the numerous pieces forming patterns of this sort have been preserved are rarely met with; but in the South Kensington Museum are pieces from such a pavement taken from a villa near Rome which belonged to Lucius, the son in law of Marcus Aurelius, A.D. 169. At Isola Farnese, nine miles from Rome, a pavement of slabs of mosaic glass was found; it is described by Winckelmann. Passeri says, having examined the ruins of an ancient villa at Porte St. Sebastian, he saw with surprise that the pavement was formed of a compact mass of glass, the same size as the room, and thinks it was seeing such a massive pavement that gave the idea of the sea of glass which the author of the Apocalypse has placed before the Divine throne. Pavements were of different kinds; that now called "opus vermiculatum" was the pavement formed of little bits of coloured glass which were more varied in colour and made of much smaller pieces than "opus tessellatum" or mosaic made of bits of marble; to the first kind belonged a pavement found at Tivoli, so finely worked that a square inch contained 180 pieces.

At first glass was only used for those brighter colours which could not easily be found either in clay or marble; but as the desire for splendour increased, glass gradually took the largest place in decoration. Thinner bits of glass, imitating porphyry and marble, were backed with stone to strengthen them and much used for walls; such pieces are still met with in quantities in the hands of dealers, with their stone backing still adhering to them.[1] Many such pieces of glass are found with a layer of white enamel behind them to throw up the colour, blue especially, which would have little effect without a white ground. Opaque yellow is found sometimes under green.

In Pompeii and Herculaneum slabs for pavements and wall decorations are found in singular shapes like the petals of flowers, stars, or rosettes, each placed in the middle of a piece of lavender

[1] Mr. Nesbitt describes part of a female figure in his possession as formed by placing suitable fragments into proper positions, and then pouring a mass of heated glass on to the back; by this means the pieces were blended together with less of the hardness of a mosaic and more of the effect of a painting. Such figures might have been used in the "opus sectile" or marquetry with which walls were ornamented.

opaque glass, one of the stars is cut from a rod formed of eight pieces of glass; many of these can be seen in the museum of Naples. As these pieces must all have been ground to fit, enormous sums must have been spent on this kind of decoration. Minutoli describes the flooring of the house of the faun in Pompeii[1] as laid with mosaic of glass paste mixed with many costly stones, all in small pieces, of the kind now called "alla Veneziana," set in firm cement; to give himself an idea of what this pavement looked like when new and polished, he had the floor wetted, when there stood out pieces of beautiful red and purple mixed with enamel pastes and many-shaded marbles. Two fountains in Pompeii are covered with vitrified coloured pastes, in patterns in which blue predominates, and bordered with real sea shells which are still perfect. These fountains have leaden pipes and brass cocks for admitting and turning off the water precisely the same as modern ones. The mode of using mosaics for wall decorations instead of pavements seems to have arisen in Pliny's time, as he says, "mosaics banished from the floor began to be used for vaulted ceilings, and those made from glass became a new fashion." Roman habitations were full of works in glass, whether sculptured in colour, painted, or enamelled. When pictures were spoken of it was long thought mosaic ones were meant, but it has now been proved they were real plaques of glass fastened to the wall. One example is in the Vatican; it is a slab one palm long, with four figures on it, Bacchus and Ariadne, with two satyrs, the figures are white on a dark brown ground. One wall decoration is known with coloured palmettes in relief. Passeri describes one in his possession three feet long, with a taurobolium and an inscription on it, and another with Apollo standing between Thalia and Melpomene, and columns surmounted by scenic masks, a composition well suited to a theatre, and just such as Scaurus may have used in his celebrated one; this piece is four inches high, the figures white on a blue ground.

Sometimes these glass pictures had blue grounds with figures painted on them in enamel by means of colours fixed à l'encaustique in lines engraved for them, others painted with colours by the brush on the flat. In these elaborate wall decorations the figures of men and animals are introduced both in marble and

[1] One mosaic in this house represented a small Bacchus holding in his hand a large glass cup full of wine.

glass, they are the result of a high style of art. They were sometimes fixed to the wall and framed in marble. Horace had his room ornamented with paintings on round pieces of glass, and in many museums are preserved small round mosaics in basrelief meant to be fixed on walls. A roof in Hadrian's villa was found covered with basrelief in paste and enamel. In the theatre of Pompeii were found two glass figures in basrelief, six inches high, one representing Abundance, the other a female figure without emblems.

Minutoli minutely describes a very beautiful paste in his possession, of an oval form, which was found in the Baths of Titus where, from marks on the wall corresponding with it, it seems to have been fixed as a decoration. It is a dark green paste with layer of blueish grey on it to imitate an onyx or a flint; some parts have been set in, of a lighter shade, to imitate more perfectly the stone. Doubtless the original of this paste was a cameo of great beauty; the subject is the favourite one of Cupid the lion tamer; the god playing his lyre is riding on a conventionalized lion, the whole composition belonging to the best age of art. The beautiful figure of Bonus Eventus, a naked youth holding a cornucopia, in the British Museum, which if whole would be a foot high, is considered the finest known paste cameo in the world; it is imitation lapis lazuli, and was no doubt a wall decoration. There is a smaller tablet of the same kind at South Kensington. Some of these slabs have architectural ornaments or foliage in brightly contrasting colours; some heads in blue or white glass, flat at the back, have been doubtless used to ornament a cornice. Such decorations would be hardly more expensive than plaster, and far more durable and beautiful; and we have hundreds of examples to copy from; the extreme cleanliness of such a style of mural ornament would be most valuable in a city like London.[1] In those cases where expense was no objection, higher artistic qualities might be employed in reproducing such a wall decoration as that which Minutoli gives in Part IV. of his work. It is a fragment which formed part of the decorations in the hall of Junius Bassus, consul; his house was afterwards made the church of St. Andrew in

[1] Another suggestion which comes to us from America is worth careful consideration, the substitution of slabs of glass for those of wood in Venetian blinds. Such blinds might easily be made of any shade to suit the colouring of the room, and might be highly decorated and ornamental; no weather could spoil them, and they would be a strong defence against thieves.

Catabarbara, in Rome, now destroyed; Ciampini has painted the building as it existed in his time. The only piece now existing is supposed to be that preserved in the Albani palace at Rome. It measures about four feet square; in the upper part is represented the story of Hylas seized by the water nymphs; on the lower part a piece of green drapery appears attached to the wall. In the upper part only the blue and green colours are in glass, the remainder is marble mosaic; the drapery is almost entirely formed of glass; it has a broad border on which are depicted small figures of Egyptian deities and priests, this border is all in glass mosaic, and the subject would appear to denote that Egyptian artificers had been employed on the work.[1] Many smaller pieces of ancient mosaic can be cited, either meant to ornament small pieces of furniture or for personal adornment, representing human faces, masks, or birds. There is one specimen from the Townley collection, now in the British Museum, which depicts a human headed hawk in mosaic, on a piece of lilac glass not an inch across, the feathers and details of which require the aid of a magnifying glass to enable you to distinguish them. A piece of blue glass one inch long, also in the British Museum, shows the kneeling winged figure of the goddess "Sati," like a delicate miniature; this specimen belonged to the Duchess of Devonshire. No. 95 in the Slade collection is a mosaic of decidedly Egyptian character, and No. 93 in the same collection is worth examining carefully from the extreme minuteness of the details; it is a human bust; on the forehead is a lock of hair which appears about the thickness of an ordinary horse hair, but when seen through a lens is found (Mr. Nesbitt tells us) to consist of nine threads of alternately opaque and transparent glass. Specimens of fish are found in which the teeth, divisions of the fins, eyeballs, and eyes are executed with the greatest delicacy and truth.[2] It has been suggested that the ancients, who were quite alive to the value of rarity, only permitted a small number of these specimens to be finished. In some cases the pattern does not penetrate the entire thickness of glass; a cavity seems to have been hollowed out and fitted either to receive a slice from a prepared rod, or the colours as in some

[1] Glass continued in use as a wall decoration for some centuries, as Boethius, A.D. 470, a man famous for his learning, speaks of the walls of his library decorated with glass and ivory; he was afterwards executed for practising magic.

[2] It is possible these fish may have been worn as charms; they are still regarded with reverence by Arab women in North Africa.

Egyptian specimens may have been placed in the form of stiff paste each in its proper place in the cavity prepared for it, and then blended by heat and afterwards rubbed down and polished; but this process could never have rivalled the delicacy of the first described. Many larger and coarser pieces are met with in slabs of four or six inches long, with flowers represented on them. Although the finest mosaics may have been made in Egypt, many pieces were also manufactured in Rome, and fragments of rods prepared for slicing are met with. Mr. Nesbitt describes one in his possession, three quarters of an inch square, which shows a four-leaved turquoise blue flower with a yellow centre on an opaque red ground. One rod, about two inches long but scarcely a quarter of an inch across, now in a private collection, was taken out of the catacombs in Rome; it had a coating of dark blue with a human mask showing at each end. Slices from similar prepared mosaic rods were used to form the thousand varied cups manufactured for Roman use, and they also no doubt assisted in making the flowered slabs still met with. Quantities of pieces of mosaic glass washed up from buried palaces are to be found on every Mediterranean shore; perhaps they are now more numerous on the African side, where fewer people care to search for them. Many beautiful mosaic pavements have been discovered among Roman ruins in Algeria; but as the French have not yet awakened to the fact that they ought to preserve to the world the treasures they have conquered, any such old relics found are left to the careless ignorance of the colonists and generally destroyed. The Romans carried their love of mosaic pavements into all their own cities, and many of those they conquered. Dr. Birch describes a pavement at Verona as made by many hands: Eusebia and her companions made twenty feet; Hiernisa and her friends made twenty feet; Marinus ten feet. Perhaps they only subscribed to the work; but in this age we know that women make mosaic pavements at South Kensington. In the museum at Rouen are preserved some thick slabs of blue and green glass, evidently from a Roman pavement; and in the same museum is placed a mosaic pavement found in the forest of Brotonne, Normandy, which represents Orpheus playing the lyre, in which the brighter parts are in glass. Another pavement found at Avenches has an inscription stating it was made in the time of consuls Avitus and Pompeianus, A.D. 209. Many pavements have been discovered in London; one found in Fenchurch St. in 1858 contained a coloured peacock on a white ground, in which

the blue feathers were all in glass. Another pavement discovered in 1803 in Lombard St. was unfortunately placed in the old East India House and spoiled by exposure to the weather; the design in it was Bacchus reclining on a panther; all the blue, purple, and green colours in it were made in glass.[1] Some pieces of flat glass probably used for wall decorations were obtained from the ruins of a Roman house near Great Tower St.; they show a more elaborate style of manufacture; they are sections cut from a slab in which coloured flowers have been arranged in filaments and fused into a dark ground. The originals may be seen in Roach Smith's collection in the British Museum.

Glass mosaics were much used in imperial Rome up to the fourth century, when we begin to find them in Christian art. The earliest known example is in the catacomb of St. Helen, a glass mosaic pavement remarkable for good style and variety. Constantine, A.D. 306, enriched many Roman churches with mosaics; but the only known ones still existing are those in the circular galleries of St. Constance, near St. Agnes. Their subjects are the vintage, harvest, and Christian symbols. The beautiful mosaics of St. Prudentius, founded A.D. 142, have been many times restored, especially by St. Sirice in the fourth century. Among mosaics of the fifth century are particularly to be noted those world-renowned specimens in the chapel of Galla Placidia, built at Ravenna, A.D. 440. These mosaics were superior to those made in Rome at the time, and were doubtless executed by Byzantine artists brought there by Placidia, mother of Valentinian III. Mosaics were made in Rome till the sixth century. The church of the Nativity at Bethlehem, built A.D. 327, by Helen, mother of Constantine, is one of the oldest Christian churches known; it was adorned by her with mosaics, of which fragments only remain, representing Scripture scenes, portraits of angels, Greek inscriptions, and arabesques. It has been suggested that these mosaics were executed by order of Manuel Comenos in the middle of the twelfth century, but it is more probable that he only repaired them. Helen would have been sure to have adorned so sacred a spot with all the splendour of her age; and mosaic was then too well known to have been omitted. The only other specimen of mosaic extant, of this date, is that of the church of St. George at Salonica (ancient Thessalonica), 323, built by

[1] For information respecting Roman mosaic pavements discovered in England see a work published by Fowler and Lysons.

Constantine. The dome, more than two hundred feet in circumference, is entirely lined with mosaic of a magnificent character which covers 9,700 feet of space.[1] The designs, light, fanciful, and architectural, recall the baths of Titus and Pompeii; the ground gold, the colouring rich and harmonious, presenting colossal figures, holy persons of the Greek Church, birds, purple curtains, and other objects. This splendid work is probably the largest mosaic that has come down to us, one of the few that have escaped the fury of Mahommedan fanatics, and gives point to the saying of Ghirlandajo that "mosaic is the only painting for eternity." Mosaic decoration certainly received a very great impetus from Christian art. From the chronicles of Eutychius it appears when the Mussulmen invaded Palestine for the first time they found the church of Bethlehem ornamented with fsefosis, an arrangement of small stones is called by Arabs *fsefysa*. The word "fsefysa" is found in the Athos MS. to designate mosaic. Theophilus suggests that the term "mosaic" is possibly derived from "mosque," for the adornment of which the Byzantine Greeks were much famed and employed in producing the cubes of glass required in the work.[2] According to Ebn-Sayd one of the conditions of peace concluded at the beginning of the eighth century between caliph Walid and the Greek emperor Justinian II. was that the latter should furnish a certain quantity of fsefysa for the decoration of the mosque of Damascus which the emperor was then constructing. Is it not of these same mosaics that Benjamin Tudela writes later, when he tells us that one wall of the great mosque of Damascus was formed of glass by enchantment? Capt. Conder writes now "the whole of this mosque is whitewashed, but patches of the old glass mosaics which once covered it are still visible, and the effect must formerly have been highly magnificent." In the sixth century[3] the emperor Justinian erected a basilica to the Virgin, the remains of which are to be seen in

[1] "Eglises Byzantines": Texier and Pullans.

[2] M. Dedron writes: "but these are mosaics in glass, transparent with golden grounds; these are the mosaics which cover the vaults, cupolas, and part of the walls of St. Sophia at Constantinople and Salonica, of St. Laura of Mount Athos, of Daphne near Athens, of St. Luke, Livadia, of the round temples of Salonica and Ravenna. Mosaic is Byzantine and Christian, and the Arabs who have borrowed our architecture have even borrowed a great portion of their embellishment."

[3] A semicircular plaque in green glass representing the nativity, Mary adoring the Saviour, Joseph meditating, and an ox and ass looking on, of the sixth century, was found at Martigny.

the mosque of Jamia el Aksa in Jerusalem; it has since passed through many hands, among others those of the crusaders, who called it Solomon's temple; it is probably to their care that the glass mosaics still visible on the south side are owing.[1] This same Justinian determined to build at Constantinople the finest basilica ever seen, and constructed the present St. Sophia on the site of the temple built by Constantine. Among the other embellishments of this building were glass mosaics of the kind called "musivum." Muratori corrects the error of certain archæologists who "seem ignorant that musiva is formed not of stone but of glass." The apse of the church of the Transfiguration, of the monastery of Sinai, is adorned with mosaics of great value, attributed to Byzantine artists of the seventh and eighth centuries; they represent Scripture subjects, and one of the transfiguration (from which the church takes its name) is especially remarkable. Capt. Burton describes finding along the coast of Midian, round the ruins of tenements he thinks probably built for the wealthy inhabitants who wished to enjoy sea bathing, "many scattered fragments of sea coloured glass, varying in tint like the Roman from blue to green." No fragments were found inland.[2] Capt. Conder explored many mounds at the hillocks of Gilgal, and found them "full of pottery, glass, and tesseræ," indicating the existence probably of one of the numerous religious establishments that once covered the plain. Of the mosques and buildings in Jerusalem itself a very curious account is given by Nasir ibn Khusri, a native of Merv, who visited the Holy Land about 1060. His work, called Safarnámah,[3] was translated by Major A. Fuller; after describing various remarkable things he says: "there is a fine large 'dargáh' with two wings; the faces of the wings and hall of the dargáh are ornamented all over with pieces of parti-coloured glass, which they have set in cement in any pattern they pleased, insomuch that the eye becomes dazzled in looking at it. In like manner an inscription in variegated glass has been made on the dargáh, on which is written the title of the sultan of Egypt, and when the sunshine lights upon it the effect of its rays is so enchanting as to bewilder the intellect." The "maksúrah" stands on the southern wall, and comprises sixteen pillars, as

[1] At the ruins of Anni, near Kars, beautiful mosaic work, brilliant in colour, is spread all over the city.

[2] He also found rare sherds of pottery composed almost entirely of kaolin.

[3] "Journal of Asiatic Society," 1873.

well as a huge dome embellished with coloured glass as already described."

The great manufacture of mosaics continued in Rome from the time of Augustus till the ninth century; during the fourth and fifth centuries walls and roofs were entirely covered with glass decoration. A series of mosaics exists from Constantine to Charlemagne. After the ninth century the work seems to have been discontinued in Rome, but still flourished in Constantinople and Venice. In the middle of the tenth century the emperor Romanus II. sent to the caliph Abderrahman III. the materials for the mosaics of the kibla in the mosque of Cordova.[1] In the eleventh century Desiderius (afterwards Pope Victor III.) sent to Constantinople for workers in mosaic, which appears to indicate that the manufacture in Rome had ceased, and that in Venice had not become celebrated. Yet the art was known then in Venice, as the church of St. Cyprian, Murano, decorated with glass mosaics, was finished in 882; probably they were the work of foreign artists. The mosaics in St. Mark's were commenced by Doge Domenico Silvio in 1071; they were made of Greek glass by Greek artists, but doubtless the decorations of St. Mark's would have given a very great impulse to native art. The first mosaic artist's name known as employed on the works of St. Mark's is one Pietro, 1159.[2] In the twelfth and thirteenth centuries mosaic was much used in Italy for decorating monuments, rooms, and furniture, where it was often inlaid in white marble. This art acquired great importance at Florence, where it is still practised. A similar industry exists at Agra, Bengal, where it was introduced by Italian artists employed in decorating the Taj Mahal. In Rome Mr. Nesbitt observes it is not uncommon to find decorations of this class formed partly of antique glass and partly of that manufactured at the time, and this is especially noticed in the works of the Cosmati family, skilful artists in mosaic.[3] Eraclius says, "in ancient pagan edifices are found different kinds of glass in mosaic work, viz. white, green, yellow, sapphire, red, purple, opaque, resembling marble, made like

[1] Arab artists seem early to have substituted faience for mosaic, as in the Alhambra.

[2] George Sand's exquisite tale of "Les Maitres Mosaistes" refers to the time of Tintoretto.

[3] For mosaic pavements in Italy see Sir Digby Wyatt's beautiful work; also Sir A. Layard's paper on mosaic, read to the Institute of British Architects.

square stones, from which gems are made for gold, silver, and brass work." He also tells us to imitate the Grecian gold backgrounds by making white glass tablets the thickness of a finger, dividing them with a hot iron into squares, and covering one side with gold leaf then paint over it with very clear glass, this being placed among coloured mosaic work adorns it exceedingly. Such are the mosaics which cover the interior of St. Mark's, and which have made that building the glory and wonder of the world. "A vast illuminated missal written within and without in letters of enamel and gold. Never had a city a more glorious Bible." (Ruskin.)

Specimens of mosaic glass were eagerly sought for and carefully examined by intelligent workmen of Murano, who succeeded in reinventing mille fiori and trina glass, in some things they even surpassed their masters. The return of the crusaders to Europe had a great effect in stimulating the manufacture of glass; a new proof of this influence was discovered during the restorations of the Ste. Chapelle, Paris. It had long been known that in Persia the ancient usage of decorating walls with plaques of glass was still practised, but no account of such an ornamentation in mediæval Europe had been preserved. The walls of the Ste. Chapelle were however found to have been decorated in many places with tablets of glass stuck on with mastic. Some plaques were white with delicate arabesques at the back; some painted in distemper and flat tints, and lined with silver leaf to heighten the effect and give metallic reflections; others were blue glass backed by silver, and with arabesques of gold in front. This disposition of glass replacing Byzantine mosaics is a curious fact, and shows a decorative element in the middle age churches hitherto ignored. M. Batissier gives this account in his History of Glass.[1] English mediæval mosaic work may be seen on the tomb of Henry II., the shrine of Edward the Confessor, and in Becket's crown at Canterbury, which presents some curious patterns. A singular wall decoration was attempted in the time of Charles II.; when Hawsted House was altered it was plastered over and thickly spangled with fragments of glass, which, according to Sir J. Cullum, made a brilliant appearance when the sun shone and even by moonlight.

There is a sort of coarse mosaic wall decoration used in India,

[1] It may be remarked here that the guardians of the Ste. Chapelle absolutely deny the existence of these plaques, but that proves nothing.

and especially round Lahore, which has a very good general effect. In the fort of that city, built by Jehangir, 1600, are some panels containing elephants fighting, the elephants bright blue on pale yellow, white, or green grounds. The mosque of Wasir Khan is richly decorated in this manner. Some Indian wall decoration is made with arabesque patterns in plaster or chunam, and the hollow parts filled in with small tiles of various colours cut into the requisite shapes. Many Hindoo idols are decorated with a kind of mosaic made of triangular pieces of coloured glass, talc, and other substances. In the Christy collection, Victoria St., is a good example.

CUPS.

"The Sun embarks and is borne across the sea to his setting, in a golden cup made by Vulcan. Hercules threatening to shoot, the Sun bade him desist, and in return for his forbearance gave him the cup in which he used to travel with his horses, when he had set going all night across the ocean to the east whence he rises again; and Hercules went in this cup to Erythea, and when the oxen of Geryon swam over the sea Hercules also passed over in the cup of the Sun to find them; and when he was at sea, Oceanus, to tempt him, appeared in visible form, tossing his cup about in the waves, and he was then on the point of shooting, but Oceanus being afraid desired him to forbear." —*Athenæus*, book ii.

THERE can be but few objects of common use which have more deeply exercised man's ingenuity since the earliest dawn of history, than the effort to give variety of form and colour to the numerous cups or vases which he has during all these ages devised, whether for drinking or merely ornamental purposes. No doubt the first instinct of primæval man was to stoop to the running brook, and quench his thirst as the animals around him did theirs. It was a step in advance when he learned to scoop up the limpid draught in the palm of his hand, and drink from that cup of Nature's own providing; how many years elapsed before Vivian made of her "own lady palm a cup"? We find Diogenes, 419 B.C., already overburdened with civilization, flinging away his bowl, probably made of wood or earthenware, thinking it more convenient to return to a state of nature and only drink from his hand. Leaves of plants and shells were possibly utilised before man made any vessels of clay. Barbarians we know gloried in drinking from the skulls of their defeated enemies. The magic kernos, used in mystical ceremonies to hold small quantities of various viands, was formed of many small vases united in a double row round one central stand.[1] Athenæus describes the kernos as a vessel having many little cups like figures fastened to it, in which are wine, white poppies, wheatears, barley, peas, vetch, pulse, and lentils. And he who carries the kernos,

[1] See British Museum.

like the man who has borne the mystic fan, eats of all these things, as relates Ammonius, A.D. 190. This kernos must have resembled the flat vessel or platter, divided into many compartments, each containing some piquant tasting viands, which used to be carried round before eastern banquets, in order that each guest might partake of hot, sweet, or salted condiments, whichever he considered most likely to provoke an appetite.

It is to Egypt we naturally look for the earliest practical evidence of the use of glass drinking cups, and on the walls of her tombs we find paintings which show at once the transparence of glass and the presence of wine. The rude cup of pottery gradually gave place to the more refined glass-porcelain, of which the ruins of Thebes have yielded many varied specimens. In the Chinese classics, which claim a higher antiquity even than the tombs of Egypt, we find allusions to cups, though no pictorial record of them is left; thus the emperor Shun, 2000 B.C., who to us is so very ancient, speaks with regret of the beautiful figures embroidered on the dresses of "the ancients" emblematic of various attributes, and among them describes one as a "temple cup with figures on it"; what the material it was originally made of might be we know not. Another emperor nearly a thousand years later, who chose to introduce the use of ivory chopsticks, is sorrowfully remonstrated with by one of his court officers: "ivory chopsticks will be followed by cups of gem and other extravagances, which may cost you your empire."

Cups in early times were made only of wood or clay, then of horn, and rich people tipped them with gold and silver; then cups began to be made of the most varied forms and costly materials, and inlaid with jewels. Aristotle says "the cups which are called Rhodiacan are brought into drinking parties, and when warmed deprive wine of its intoxicating qualities." In a play of Euripides, 480 B.C., one of the characters on hearing an ominous word threw his cup on the ground and called for another, desiring all present "to pour like him the untasted liquor down." Cups were dressed with garlands and filled to the brim, when libations were offered to the gods, for Athenæus[1] quotes Aristotle thus: "we offer nothing imperfect to the gods, but only things whole and entire, and that which is full is entire." "The cups are crowned with drink, that is they are filled above the brim, so as the wine riseth

[1] Lib. xv., cap. 5.

in the manner of a crown for good luck's sake." A wreath of ivy is also placed around the cup, and this is not attached but engraved. Cups were presented to guests at the end of a feast; thus Alexander at his wedding feast at Susa is said to have given a cup of gold to each of his nine thousand guests. In Greek feasts a king was chosen by lot to direct the revels, whom all obeyed. Arrian, A.D. 100, reports, "the king commands in this manner, Do you drink, do you fill the glass, do you go, do you come." Theocritus says: "at last we voted each should crown a glass, what health he pleased, but name whose health it was." Lucian reports that in the islands of the blessed "there were large trees made of glass, the fruit of which are cups of various shapes and sizes, whoever comes gathers one or more of these cups, which becomes immediately full of wine." Full cups were presented to guests of high quality at Greek feasts. The first cups were emptied to the gods, then to absent friends, and to the mistress of each guest. Sometimes three cups were drunk to the graces, sometimes three times three to the muses; four was an unlawful number. Sometimes prizes were given to those who drank the most, then again laws were enacted against the large use of wine. Some Grecian sages only allowed three cups, one for health, one for cheerfulness, and a third for sleep. Parryasis only permitted two, the first to the graces, the second to Venus, and the third was dedicated to strife. It was often the custom to propound riddles and give prizes for the best solution; the prize was sometimes a cake, sometimes a cup of wine; the loser was obliged to swallow a cup of wine mixed with salt. The word cup seems to be applied equally to a drinking vessel, to a vase for holding liquid, or merely for ornament, also to prizes given in games, a signification which we preserve to this day. The most celebrated examples of vases known are undoubtedly the two cameo urns generally called the Portland and Naples vases. Perhaps this is as good an opportunity as can be found for placing together some almost forgotten points of interest connected with the first named vase. The greatest glass treasure of our Museum is enshrined in the gem room, jealously guarded as such a gem should be. This vase was originally discovered in the sixteenth century in the tomb of the emperor Severus, near Rome. It was supposed on rather insufficient evidence to have contained the ashes of Mammea the mother of Severus. This emperor was killed A.D. 222, but the vase is probably of earlier date. When first discovered it was

supposed to be a splendid sardonyx, but closer inspection proved it to be made of a deep pellucid blue glass, adorned with beautifully carved cameo figures in semi-opaque white glass. Learned authors have exhausted themselves in trying to interpret exactly the meaning of the scenes depicted on this vase, but have arrived at no positive conclusion except that they are a triumph of antique art, and undoubtedly belong to the very best Greek or Roman period. Winckelmann asserts the figures are designed to pourtray the nuptials of Thetis and Peleus, a sort of mystic marriage which was a very favourite subject with ancient artists,[1] and the explanation is not an unlikely one; his opinion of the merits of the work is thus expressed. "Such glass work must ever be regarded as infinitely more beautiful by all true connoisseurs than the porcelain vases so much admired, whose beautiful material has not been ennobled by any pure work of art nor impressed with any worthy or instructive devices. Most porcelain has been formed into ridiculous shapes, from whence has sprung a childish taste that has diffused itself everywhere." For two centuries after its discovery the vase remained in possession of the Barberini family; from them it became the property of Sir W. Hamilton, and then passed into the hands of the Duchess of Portland; the contents of her museum were sold by auction in 1786, and then Wedgwood the English potter conceived the idea of copying the vase, and bid up to a thousand guineas for it but ceased bidding on receiving a promise from the duke her son that it should be lent him to copy. In 1810 the Duke of Portland gave the vase to the British Museum, where it has since remained regarded as a national treasure. On one unfortunate day a foolish madman entered the museum, and smashed the precious vase, one of the wonders of the world, into a hundred pieces. Very wisely the name of this feeble imitator of Eratostratus (who set fire to the temple of Diana of Ephesus in hopes of gaining notoriety) has never been known more definitely than as a madman. The ruins of the vase have with wonderful skill and patience been reconstructed into a resurrection of its former beauty, and it is kept in an inner room, out of danger it is to be hoped of any future catastrophe of this kind. The famous imitations made by Wedgwood with infinite labour and trouble are worthy of his fame. Though the fifty original copies were sold for fifty guineas each

[1] See the Aldobrandini marriage at Rome.

(they are now much more valuable), they did not repay the great outlay they had cost him, the model made alone having cost £500. The original vase remained more than a year in his hands, "without which it would have been impossible to do justice to this rare work of art. I now flatter myself with the hope of producing in a short time a copy which will not be unworthy the public notice." The copies were finally finished 1790. The black Wedgwood ware copy of the Portland vase exhibited at Paris in 1878 is one made of jasper clay, but rendered more valuable as a work of art by having passed under the hands of Mr. J. Northwood, who added to its sharpness by graving and polishing the hard jasper ware in the same way that he works glass cameos. It is this gentleman who has with rare skill and artistic knowledge succeeded in making a perfect copy of the Portland vase in cameo glass. This beautiful work of art was commissioned by Mr. P. Pargeter of Stourbridge, who himself cast the vase of a deep blue glass coated with white for Mr. Northwood[1] to work on, who has by patient hand carving reproduced a vase made in precisely the same manner as the great original. This work, of which its author may well be proud, was exhibited in Paris, showing that such objects of art may be reproduced in our day if only they are encouraged. What Wedgwood's opinion of such a work would have been may be imagined from his remarks when he proposed to make his own copy, and says he must call the engraver to his aid before he can hope to produce anything highly finished. "But here insurmountable difficulties arise, for how few artists have we in this branch whose touches would not carry ruin with them to those beautiful and highly wrought figures! and suppose one or two could be found equal to the task, would such artists be persuaded to quit a lucrative branch of their profession, and devote half a life to a single work for which there is little probability of their being paid half so much as they can earn by their present employment? for I do not think £5,000 for the execution of such a vase, supposing our best artists capable of the work, would be at all equal to their gain from the works they are now employed in."

[1] Mr. Northwood is the author of some original and beautiful works in cameo glass; one of these is the exquisite work presented by Mr. Stone to the Birmingham Art Gallery. The cameo glass tankard of Signor di Giovanni (Florence) representing the "Childhood of Bacchus" is spoken of in terms of enthusiastic praise by foreign critics.

The Naples vase, the great treasure of the Bourbon Museum, is of the same character and probably the same age as the Portland. It is in the form of an amphora, the shape is more graceful than that of the Portland. The ground is blue, and the white figures represent a vintage; some little genii collect grapes and carry them to others, one with a mallet pounds the mass, music plays to keep his strokes in time. Overhead hang grapes and acorns, underneath is a basrelief of rams and kids in various positions. Two vines cross above a masque at the side, and spread over the vase. From the symbols of vintage and the other emblems on this vase antiquarians suppose that it contained the ashes of a devoted follower of Bacchus, or some one initiated in the mysteries of the worship of that deity. It was discovered in 1837 in the house of Marco Frugi, Pompeii, sometimes called the house of the Medusa. The vase was taken out of a tomb in the presence of the king, and very probably contained the ashes of Frugi the owner of the house. There is another very beautiful cameo vase in the British Museum, nearly perfect. It was found at Pompeii in the house of the faun; it is of the shape called œnochoe, about nine inches high, the ground dark blue with a very lovely wreath of vine foliage in white round it. This was called the Auldjo vase.

Though few of these costly and exquisite works of art have survived the lapse of centuries, yet they must have been at one time common, as fragments of cameo glass, sometimes in various colours though generally blue and white, are to be met with in nearly all collections of ancient glass, and are still found in the hands of dealers in Rome. After cameo glass perhaps the cups showing the greatest ingenuity, and the most consummate skill of the workmen, are those enclosed in a network of circles of a colour different from the body of the cup. One beautiful specimen may be cited described by Winckelmann which was found at Novara in 1725. It belongs to the Trivulsi family at Milan. The body of this cup is iridescent, displaying all the changing hues of the opal; the network is blue; round the rim in green characters is an inscription, "Bibe vivas multos annos." Neither network or letters have been soldered to the cup, but the whole has been carved out of a solid mass of glass like a cameo, the marks of the wheel being still visible on the little props which connect the network and letters with the body of the cup, and which are more or less angular as the instrument was able to reach

them completely or not. A similar cup found in a tomb near Strasburg in 1825 has the name Maximianus Augustus on it, which fixes the date as the end of the third century. Mr. Nesbitt thinks the network and letters in this kind of cup were added to the body, and the connecting props worked by the wheel or hand. There is a cup of the same kind at Munich, and a fragment of one in the British Museum. Perhaps the finest example known of this work is a pail or situla of greenish glass in the treasury of St. Mark's, Venice; the upper part has a lion hunt with men on horseback and dogs in relief, some of the figures completely undercut; the lower part has four rows of circles united to the vessel only at those points where the circles touch each other. Examples are known in which the network of circles stands nearly a quarter of an inch from the cup. It is easy when looking at such specimens of manual dexterity to understand how the last touch of the workman sometimes ruined the fruit of his toil. Cups are known in which the whole surface is covered with figures and ornaments engraved with the wheel in shallow intaglio, perhaps the finer details added by the file or diamond; this style of work was probably of later date, and is more generally in bad and degraded taste. A situla of dark violet glass at St. Mark's, on which a bacchanalian dance is represented, may be cited as a specimen.

Later in time come the cups ornamented by threads of coloured glass trailed over the surface, forming coarse patterns, or with coloured enamels stuck in lumps or spots carelessly on them; no doubt these were cheaper and more common wares. The decoration of trailed threads is a favourite one among Frankish and Anglo-Saxon remains. Many vases were painted different colours by powdering glass very finely, mixing it with colour and water, and after painting the desired subject on the vase putting it into the oven. Earthenware vases were treated in the same way. Theophilus tells us the Greeks made precious drinking cups out of ancient mosaic tubes "formed of sapphire stones, and then ornamented them by cutting figures out of thick gold leaf, and applying them to the body of the cup, then with gold and silver ground very fine in a mill painting small circles on it with divers figures in varied work and covering them with clear glass, then taking glass of various colours such as is used for artificial gems grind each by itself separately on porphyry stone, and paint what you will of flourishes and other designs, with a border moderately thick round the mouth, and heating it all again in the furnace. Also

make cups from purple or light sapphire, surrounding them with threads made from white glass flung on them and divers colours as they will." The dark brown Byzantine vase at St. Mark's, with circles on it, exactly fulfils the description given by Theophilus.

Achille Tatius, a Greek writer of the fourth or fifth century, in his romance of Leucippe and Clitophen, describes a cup as belonging to Hippias of Tyre, who poured libations from it at the feast of Bacchus. His hero says, "they made us drink from a cup consecrated to Bacchus, and resembling those of the celebrated Glaucus of Scio; it was of chiselled glass, a vine taking root at the bottom wound itself round the cup, which it crowned with its foliage and branches; from it hung bunches of grapes which appeared green at first, but seemed to ripen as wine was poured into it; in the middle stood Bacchus tending the vine." Eusebius, bishop of Cæsarea, A.D. 340, describes the same or a similar cup. A very remarkable goblet, supposed to be of late Roman work, belonging to Baron L. Rothschild, seems to answer in a singular manner the poet's description, and may have been a copy of some more ancient vase. It is of an opaque greenish hue on the exterior, but by transmitted light of a deep red,[1] the colouring matter being possibly oxide of copper which has not reached the state in which it forms ruby glass. On the outside in very high relief are figures of Bacchus with vines and panthers, some portions being hollow from within and others fixed on the exterior of the vase.

De Rossi gives an engraving of a cup found in a tomb near Treves, on which are fishes, sepias, and shells, all it would seem moulded in high relief and stuck on, in the same manner as can be seen in some of our old Plymouth pottery. A similar cup was found in the cemetery of Calixtus, near Rome. Many cups of various forms, made by being blown or moulded, have been afterwards much undercut by the wheel or diamond, though this style of work usually belongs to a late and degraded kind of art. One very lovely cup in the British Museum looks like a silver cup studded with sapphires; the metal seems to have been pierced with numerous holes, and the blue glass blown into it so that it projects a little from each hole; this style of ornament would

[1] Some extremely light vases are made by the Royal Society, Murano, which look red when standing on the table, but appear green when held up to the light. They are made by a film of the darker colour being dashed over the paler.

present no difficulty to the modern worker. M. Deville describes one cup with a ring like that round the planet Saturn, others with covers made of engraved silver, and gives an engraving of a very unique specimen in the Rouen museum which has a bronze handle and a rim of bronze at the top and bottom, with long spiked teeth to protect the glass. Some cups have two bronze rings which must have been put on before the glass handle was welded to the cup. Such rings were probably meant to fasten to a chain, and must have been used in the bath, as one cup was found with a long bronze chain and by it a strigile. The cup of Chosroes, the verre de Charlemagne, and the Luck of Edenhall, and other celebrated cups, have been described elsewhere.

M. Jacquemart in his History of Furniture describes a marvellous cup belonging to Baron G. Rothschild, on which a wreath of birds perched on delicate branches are painted in enamel, surrounding the cup like a garland; this is probably Damascus or oriental glass.

BEADS.

"'O Lord!' she said, 'Jesu Christ,
That sinful mannes bedes hear'st.'"
Lay Le Fraine, from Marie's Lays.

"Our modern word 'bead' is derived from this word (prayer, bede), because it was by such articles hung on a cord that our ancestors reckoned the number of their prayers; a unique example of the deduction of a term for a visible object from a mental and spiritual act."—*Glossary to Piers Plowman, by Mr. Wright.*

WE may feel sure that among the very earliest manufactured objects produced either in Egypt or elsewhere for barter were found beads, probably rudely formed and dull in colour, but still possessing the same fascination for the ancient as they do for the modern race of mankind. We find the treasured necklace buried with the oldest mummies of Memphis, and carefully copied in the most ancient sculptures in India, and it would be difficult to point to a period in the world's history since then, when they have ceased to be objects of admiration and delight. Whether viewed only as personal ornaments, as objects of superstitious reverence, as ancient currency, or as throwing light on the habits and manners of the whole world, they deserve perhaps more attention than they have received. Indeed it has been suggested that an exhaustive history of beads would comprehend in fact the history of the human race. We have no certain knowledge that our remote ancestors the gorillas ever decked themselves in coloured berries, but ever since man has had a history at all he has found pleasure in this mode of adornment. In the earliest times kings, and naturally queens, did not disdain the aid of necklaces to heighten the splendour of their appearance, and the greatest poets have recognised the importance of beads and recounted their histories when describing the adventures of their owners.

The "fatal necklace of Eriphyle," sung by Homer, had a remarkable history, and being probably unknown to non-classical readers it may not be uninteresting to them. "Harmonia, daughter of

Zeus, received from her husband Cadmus (he who built Thebes and sowed the dragon's teeth) a fatal necklace. It was presented to Eriphyle to induce her to betray her husband. Her son Alcmaon slew his mother and gave the necklace to Arsinoe, daughter of Phegeus, whom he married, but pursued by madness for matricide he went to the oracle of Delphos, and then fixing his residence at Achelous married Callirhoe. Though men give way to foolish desires, the insane wishes of women are more vehement; Callirhoe desired to possess the necklace of Eriphyle, and her husband against his wishes had to seek it in Phegia, where he was slain by the sons of Phegeus, who dedicated the necklace to the oracle of Delphos. Callirhoe prayed Zeus that her sons might instantly be grown up to revenge their father's death, and they killed Phegeus and his two sons." Pausanias thinks that the necklace preserved in the temple of Amathus is not that in question, as it is composed of green stones set in gold, and Homer says only:

> "There Eriphyle weeps, who loosely sold
> Her lord, her honour, for the lust of gold;"

and yet Homer was not ignorant that there are many different kinds of necklaces, and describes some made with amber, but he does not say Eriphyle received a necklace varied with stones and gold. It was said to have been taken away by the Phocean tyrants. It wrought mischief to all who had been in possession of it, and continued to do so even after it was dedicated at Delphi, as Phayllus the tyrant stole it from the temple to gratify his mistress; she wore it in triumph for a time, but punishment overtook her, for her youngest son being seized with madness set fire to the house in which she perished with all her treasures. The date of this record belonging to fabulous times can scarcely be ascertained; but among our Egyptian remains we have fortunately more reliable chronicles to consult.

The well known bead of Queen Hatasou was probably in its day of greater value and more celebrated than the Koh-i-noor; and as it was inscribed with her name and titles it possessed decidedly a more personal charm. Bugles and beads were extensively used for ornament by ancient Egyptians during their lives, and served commonly to decorate their mummy cases after death. Capt. Harvey describes a bead he found at Thebes, engraved with the name of a king, 1500 B.C.; he states that it was the

same specific gravity as crown glass. Other beads are known inscribed with names of the eighteenth dynasty. In the British Museum may be studied a great variety of beads in glass[1] and vitrified pastes of innumerable forms and colours; some necklaces have figures of men and deities as pendants; one curious string has cats' heads hanging from it; one very peculiar bead presents three human faces. Numerous charms or amulets are mixed with the beads, such as the "mystic eye" in various forms, nilometers, horns, and delicately shaped vases, these latter probably belong to the Græco-Roman period. The immense mass of mosaic, twisted, and variously coloured beads found all over the world were probably dispersed by the first Phœnician traders, who seem to have used them as the earliest objects of barter with barbarous nations, a commerce which the civilized world appears to have continued ever since. Glass beads, Sir J. Lubbock says, were in use in the bronze age, but no vessels of glass have yet been discovered; just as there are many barbarous tribes now which are well supplied with European beads, but which possess no glass vessels.

The trio of colossal stone figures in the ruins of Tak-i-bostan near Bagdad are highly decorated with beads.[2] The dress of the principal figure (16 ft. high) is all spotted with large beads, and confined at the waist by a band of four rows of beads. The sword belt and sword are ornamented in the same manner. A smaller figure on the right side has two rows of large beads all round the tunic; that on the left side, supposed to be the statue of a woman, has a headdress formed of a sphere of beads fastened together, and a large mantle bordered with beads. Two figures of genii at the entrance hold each in one hand a chaplet of beads and in the other a cup full of beads. In another part of the building are statues of Sapor II. and King Bahram. It is probable these beads in the figures of royal persons represent precious stones. The beads now made for export to Africa bear a resemblance, doubtless not accidental, to the ancient specimens. Probably the factories of Tyre and Sidon produced most of the beads scattered by Phœnician traders in return for tin, amber, and gold. The Romans, who copied the arts of these earlier nations, seem to have had a passion for beads; in all Roman tumuli they are to be found buried with their possessors.

[1] See a square bead, Plate I. 6; also a blue bead from the Louvre, Plate II. 2.
[2] In the earliest Hindoo sculptures the figures all wear long chains of beads.

Trebellius speaks of the great commerce of beads in his day, "gemmas vitreas, bullas vitreas." To be buried in her necklace was a phantasy with Roman ladies. Papinianus[1] writes of a woman who took the trouble to put in her will that she was to be buried in her necklace of two rows of pearls. M. Campana found the habit general among the tombs he opened in the Via Latina. Even among the ashes of those who were burned after death are beads to be found. Holy martyrs are represented in the catacombs wearing necklaces of beads, some round, some of square shape. Among the many beads found in Roman and Saxon tumuli in Great Britain, perhaps none have excited greater interest than those supposed to have been made and worn as amulets or badges by Druid priests, and commonly called glain neidyr or holy snake beads. These have been by some considered identical with the ovum anguinum of Pliny, who says he saw one worn as a badge of office by a Druid. Higgins[2] says "it was a congeries of small snakes rolled together and incrusted with a shell formed by the saliva and viscous gum or froth of the mother. This egg is tossed in the air by the hissing of its dam, and before it falls again to earth should be received in the sagus lest it should be defiled." Pliny describes it very carefully and says, "the person who was to carry off the egg must make the best of his way on horseback, for the serpent pursues this ravisher of her young ones even to the brink of the next river; they also pretend that this egg is only to be taken from its dam at one particular time of the moon. The trial whether the egg was good in its kind and of sufficient efficacy was made by seeing whether it would swim against the stream even if set in gold. I have seen that egg; it is about the size of a moderate apple, its shell a cartilaginous substance, full of little cavities such as are on the legs of the polypus; it is the insignia or badge of distinction which all Druids wear. For getting the better of their adversaries in any kind of dispute, and introducing them to the friendship of great men, they think nothing equal to the anguinum, and of my own knowledge I can say that Claudius Cæsar ordered a Roman knight of the Vesontian family to be put to death for no other reason but that when he had a trial at law before a judge he brought into court in his bosom the anguinum."[3]

[1] Roman jurist, A. D. 200. [2] "Celtic Druids."
[3] Pliny, lib. xxix., cap. 3.

The object which Pliny saw was evidently a natural substance, not an ornament made by art, and the description more nearly resembles an echinus than anything else, a view that is supported by the fact that a variety of this shell is still called "mermaid's egg." Bishop Gibson says "in most parts of Wales, throughout Scotland, and in Cornwall, it is a common opinion of the peasantry that about midsummer eve an innumerable company of snakes collect in one place, and joining their heads together commence hissing; from the foam thus produced a kind of bubble is formed round the neck of one of them like a ring, which by continual hissing was blown on by the others till it slipped off at the tail, when it immediately hardens into a ring like glass. The assembled mass of snakes continue to hiss, bearing the mystic egg aloft in air." Whoever wished to secure this magic charm had to catch it in a cloak before it reached the ground, otherwise it lost its virtue. The captor was immediately pursued by the whole troop of serpents, and unless enabled by swiftness of foot to cross a running stream before he was overtaken by his pursuers lost his prize. The fortunate possessor of one of these amulets was to prosper in all his undertakings. Instead of the natural one, which must surely have been very rare, artificial rings of stone, glass, or baked clay, were substituted. The Druids probably propagated wonderful stories about the value of these charms, to induce the credulous multitude to purchase them from their own order only, pretending they were never of full virtue unless procured from the hands of a Druid. Mr. E. Lhwyd says the Cornish people towards the Land's End have still charms of glain neidyr, which they call "mepreo" (or a thousand worms), and have a spell by which they can force the snake to make it, "when they succeed in finding one asleep and have stuck a hazel wand in the centre of her spira." Carew asserts the same peasants have a belief that snakes, breathing on a hazel wand, produce a stone ring of a blue colour, in which appears the yellow figure of a snake. He had one given him, and the donor declared he had seen a part of the stick still attached to it. Mr. Owen says these transparent or adder stones were worn by the different orders of the bards, each having its appropriate colour. There is no certainty that they were originally worn from superstitious motives. Whatever may have been the cause, the notion of their rare virtue was universal in all places where the bardic religion was taught.

Whether the glass beads commonly known as holy snake beads were ever worn as insignia of office among Druids or not, they are extraordinary specimens of taste and skill on the part of the British or Roman workmen. They are generally made of blue or green glass, much thicker than a finger ring, but with larger holes than a common bead; some are fluted, some of a flattened shape have wavy lines of white disposed round them in different patterns. Some are of very vivid colours and elegant form, with small spheres of spiral white and different coloured threads like little shells stuck on the outer circle at regular intervals; they were probably worn as the centre ornament of a necklace. Some of these beads are of vitrified clay, dark blue in colour, with white lines arranged round them as though intended to represent two snakes twined round the bead. Mr. Fosbrooke says a very fine glass bead mixed with gold was exhibited at the Antiquarian Society some years ago, which had a beautiful effect when placed in water. The test of a holy serpent's egg was to float in water, hence the effect of this glass in water was possibly substituted.

Mr. Mason's spirited version of Livy's description of snake beads may be quoted here.

"From the grot of charms and spells
Where our matron sister dwells,
Brennus, has thy holy hand
Safely brought the Druid wand?
And the potent adder stone
Gendered 'fore the autumnal moon?
When in undulating twine
The foaming snakes prolific join,
When they hiss and when they bear
Their wondrous egg aloft in air,
Thence before to earth it fall,
The Druid in his holy pall
  Receives the prize,
  And instant flies,
Followed by the envenomed brood
Till he cross the silver flood."

The ancient British name for glass was "glaine," in Irish it was "gloine"; both words derived from an ancient Scythian or Phœnician name for glass;[1] hence our word "glain neidyr" for these beads or glass charms. Bishop Gibson says he has seen twenty

[1] "Nenia Britannica": Rev. J. Douglas.

or thirty of these amulets in one place. It is a curious fact that, whenever discovered in modern times, they are regarded by the peasantry of Great Britain, Wales, Gaul, or Africa, as charms productive of good fortune to the finder. Near Abarfrair Palace in Wales some good specimens were found, and others may be seen in the British Museum, where are preserved some black and white balls or beads without holes, and also spotted opaque and clear glass beads from the north of Ireland, all called alike Druidic. There are some dark blue and red beads which have been erroneously called glain neidyr, but they are obviously of more modern make. They have been cut from a glass cane in which a white line with twelve starlike points divides the red centre from the blue outer coating;[1] there is a large piece in the British Museum. These beads are widely scattered over the world; in 1848 some were found at Keswick, one comes from Dakkah, Egypt and other places; it has been suggested that they are early Venetian, and the star alludes to the twelve apostles. Beads found in the form of the vertebral bone of a fish, and smaller at one end, meant to be placed between large oval beads to make the circle fit better, from their resemblance to a small pulley are designated as "pulley beads." A few of these are of the same imperfect vitrification, and resemble in substance the little figures found with mummies in Egypt. Some English beads found in tombs and now preserved in the Whitby museum are of this rough and careless make, and have therefore been supposed to be of native origin.

In ancient barrows a single bead is often found, no doubt looked upon as a precious amulet more than an ornament. In a tomb at Sarre in Kent was discovered a dark coloured crystal ball with silver mountings, resting on a silver spoon; a similar one was found in the Isle of Wight, another at St. Sabine, and one also in the tomb of Childeric. Similar balls or bulla have been taken from Frankish tombs, and are supposed to denote that the occupants were of the highest rank. Those who could not afford a crystal ball probably contented themselves with a glass one.

In a tumulus at Boxmoor with other glass remains were some light blue vitrified porcelain beads of a fluted shape, sometimes called Druids' beads; and from a moss near St. Olaf, Orkney, were dug up two variegated glass beads. In 1850 a grave was opened near Stamford containing the skeleton of a female with some articles

[1] See Plate VI. 4. This bead was found at Sibertswold.

of jewellery, and a string of coloured glass beads principally dark blue with white lines, but some nearly resembling in colour and substance the red Samian ware : there was also one double bead [1] of the same kind as two found in Lyston Park, Lincolnshire, and presented to the British Museum by Sir J. Banks, together with a very beautiful string of amber and coloured glass beads, some of which were ornamented with projecting spikes. In Linton Heath was also found a string of blue glass and amber beads.

In 1722 a barrow north of Stonehenge was opened, and beneath the usual layers of chalk and flint was unearthed an urn of reddish unbaked clay with rude lines and mouldings on it, containing burnt bones laid in a little heap, a small handful, supposed to be those of a girl about fourteen. With the ashes were a number of glass beads of various shapes, principally yellow and one black; many were in long pieces notched to resemble beads, and of a blue colour; these would seem to indicate they were of native manufacture, also several flat button-shaped beads; and some pulley shaped, all drilled for suspending, and several pieces of amber, all shapes and sizes; all had gone through the fire, and the amber was half burnt.

Many pieces of amber are taken from these old tombs, probably picked up then as now on the sea beach; most of these pieces are left in their natural shapes, either from the workman not knowing how to cut them or from his considering the substance too valuable to be reduced. Bryan Faussett describes finding in many Saxon graves quantities of coloured and variegated glass beads, not so finely worked as the Roman ones, but differing greatly in shape, some made in long drops as though for earrings, some wide and flattened [2] apparently for hanging, others were slung on knotted wire rings, and one bead had twisted gold wire. Numbers of beads found in Britain are really Roman and resemble precisely those found in Normandy and other parts of France and the continent, indeed in all countries that were subjugated by the Romans.

Abbe Cochet, who has excavated so much in Normandy, calculates that in every hundred tombs he found two or three neck laces of amber, glass, and jet; the glass beads are of all shapes, sizes, and colours, some square, some opaque red with rays of

[1] See Plate IV. 5.

[2] See Plate VI. 5.

colour, which seem to have been highly prized. At Tiétreville in one glass vase were preserved all the beads for a necklace, each one differing in shape and colour. A Frank woman and child buried in the same grave wore glass and paste beads, and in some children's graves at Cany were found loose beads, some white some coloured, probably used as toys.

Bracelets of glass and paste beads are common, and in some tombs are found bracelets made of the seeds of a sort of vetch, probably the occupants were too poor to wear anything else; the same custom exists still in the Fiji islands, and among other savages; the beads of Varney and Helvetia reproduce the same features as those of Normandy and Britain. In the museum of Rouen are preserved three necklaces, one of which has pendants of acorns, an emblem much venerated among Gauls.

M. H. Baudot describes thirty-five tombs at Charnay, Dijon; among these he discovered twenty-four complete necklaces formed of mixed amber and glass beads, the latter of every shape and colour, some like Roman mosaic, some striped, zigzag, wavy, or spotted, spirals, circles, imitation of leaves, in fact everything that chance or the hand of the workman could conceive; some clay beads with no variety of colour, others melon shaped. It is impossible to give any idea of the variety of these beads; one necklace was formed of small glass beads, blown and moulded, into the middle of each a small piece of silver has been introduced which imitates exactly the shimmering aspect of a pearl, between each three or four pearls is placed a long blue or green bugle, resembling the mummy necklaces of Egypt. These tombs are supposed to date between the fourth and fifth centuries.

Among the glass beads found by Mr. Douglas in tombs at Chatham were many specimens of imitation pearls, and he specially notices one dark opaque bead easily cut with a knife, and still retaining an aromatic smell, which had no doubt been brought from the East.[1] He also found ten rings made of a simple twist of silver wire with coloured beads on each ring; they seemed to have been attached to an ivory armilla or bracelet. Caylus gives an engraving of a specimen, and thinks it may have been some kind of musical instrument, Mr. Douglas thinks it was most likely used in incantations; some of the beads imitated malachite, a stone which preserved infants from harm. All these women's

[1] See Plate IV. 4, 6.

tombs contain numerous beads of various colours mixed with coral and amber. Tertullian is very sarcastic concerning ladies who spend large sums of money on these ornaments, and Clement of Alexandria pours a heavy denunciation on the practice, saying that women are so extravagant in these objects that neither Tyrian, Indian or Ethiopian treasures, or the golden sands of Pactolus, could satisfy their vanity.

The thousands of ancient beads of varied patterns, opaque or transparent, striped or mosaic, still so valued all over Africa, known by the singular name of "aggry," whether they originally proceeded from Egyptian factories, or were scattered by Phœnician traders, or owe their presence to Roman conquests, seem never to have lost their charm in the eyes of the native populations, indeed their value appears to increase with their age. The earliest notices we have of travellers who in modern times have striven to pierce the veil that shrouded the dark continent all speak of the extraordinary worth attached to aggry beads. Their peculiar make seems to have puzzled these old writers. Isert describes them as a sort of coral with inlaid work, and Dr. Leyden writes: "the aigris is a kind of stone of a greenish blue colour, supposed to be a species of jasper, small perforated pieces of which valued at their weight in gold are used for money." Bosman, who visited the coast of Guinea in 1700, says: "negros wear quantities of gold and coral ornaments; one sort of coral, called conte de terra, is sometimes of a quadruple value to gold, as also a sort of blue coral which we call 'agrie' and the natives 'accorri,' which being moderately large is so much valued that it is weighed against gold. Their legs, arms, and wrists are adorned with gold and the above mentioned sorts of coral. The King of Fida's daughter was richly adorned with conte de terra and aggrie, two sorts of coral I have already mentioned." Bowditch, who travelled in Ashantee (1817), was much struck by the profusion of aggry beads worn by chiefs; he says: "at Coomassie on the first reception of the mission a great crowd received the visitors, the superior captains wore silk cloths of incredible size and weight, with massive gold necklaces suspending Moorish charms and curious embroidery; some wore necklaces of aggry beads reaching below the waist, a band of gold and beads encircled the knee, from which several strings of the same were suspended; lumps of rock gold hung from their wrists, which were so heavily laden as to be supported on the

head of one of their handsomest boys." "The king wore a fillet of aggry beads round his temples, his bracelets were the richest mixture of beads and gold, his knee bands were of aggry beads, and he wore an infinite variety of other ornaments and charms." While the mission remained at Coomassie the king made a great sacrifice, imagining that if he washed the bones of his mother and sisters, who had died while he was on the throne, it would propitiate the fetish and make the war successful; the bones were therefore taken from their graves with great ceremony, and bathed in rum and water, then wiped with silk and rolled in gold dust, and wrapped in strings of aggry beads and other things of the most costly nature.

Aggry beads are used for charms by natives; if the successor to a property is a child, they grind aggry beads into a powder and rub him with it daily after washing, believing that it hastens his growth and maturity. When any one is suspected of a theft an aggry bead is placed in a small vessel of water and the person holding it puts his right foot against the right foot of the accused, who invokes the powder of the bead to kill him if he is guilty; he then takes it into his mouth with a little of the water, the rest being thrown on the ground; and their superstition generally overcomes their resolution and they confess the crime. The natives assert that these beads are found in many places, but always in the ground, the greater number in the Dankara country, being the richest in gold; they say they are directed to dig for them by a spiral vapour issuing from the ground, and they rarely lie near the surface; the finder is sure of a series of good fortune. They pretend that beads if buried in the sand will not only grow larger, but will increase in numbers; they also believe imitations are made in the country, which they call boiled beads, alleging that they are broken beads ground into powder and boiled together, and they know them because they are so much heavier than the real ones. They are of every kind, some rude clay, some plain colours, others of the most delicate mosaics. Tube shaped are valuable, one large one is worth four cows. The plain beads are blue, yellow, green, or a dull red; the variegated consist of many colours and shades. The Fantees prefer plain yellow, the Amanaheans the blue and yellow, for which they will give double weight in gold. Beads of inferior beauty often fetch a large price if they have belonged to a royal or celebrated person. One bead, called popo, is semi-transparent, of a bright blue, and re-

sembling cornelian; it is said to be obtained in the same manner as the aggry one, and also used for pieces of money.[1] Beads are sometimes cut in half for small transactions. The glass globes dug up in Lincolnshire, now in the British Museum, are very like one kind of aggry found more rarely than the others; they are as large as an apple, opaque; the ground is generally black, speckled with red, white and yellow. "'Aggry' is the generic not the abstract name; 'awynnee' means a bead, but 'aggry' is an exotic word no native can explain. When I first heard of similar beads being found in India I thought it might be in the neighbourhood of Agra, and so throw some light on the origin of the name, but they came from Malabar. The beads found in India closely resemble aggry beads, they are found in circles of stones near Calicut, but also in other parts of India; they were found at a depth of about five feet, in circles of stone enclosed in an earthen jar very like those found in Wiltshire, generally one jar found in each circle. Sir R. Hoare has described one of these beads in the History of Wiltshire; they were doubtless connected with the bardic religion." Hutton, in his voyage to Africa, 1821, saw the same profusion of aggry beads and gold worn by all the great chiefs described by other travellers; on one occasion a great procession of 20,000 warriors passed, all armed with long Danish guns, and all decorated with aggry beads and gold charms; the king wore a necklace and bands round wrists, knees, and ankles, all made of aggry beads.

Marco Polo is said to have been the first who excited the Venetians to make beads for the African market, and to have pointed out to them the proper routes by which their goods could be spread over the country; the trade seems to have been a very thriving one ever since. Burckhardt, who travelled in Nubia in 1814, says that every district has its own particular kind of bead which is not in fashion in the neighbouring districts. At Shendy glass beads have not the same currency that they have in Abyssinia and Darfour, though they are seen in the market; the white glass beads of Bohemia are most liked at Darfour. He calculated that four or five hundred chests of Venetian beads weighing ten hundredweight each were sold at Cairo annually. At Djedda he describes some dozen varieties of Venetian beads prepared for the inland market, each packet arranged with its

[1] Some beads, blue in shadow and yellow when held up to the light, are also called popo.

sample bead outside and each known by its special name, as the Renowned, King's Saddle, Whore's Eye, Hassan Beg, and so on; modern travellers see the same practice in Arab shops of to-day. Burckhardt describes one particular sort of bead called "reysh" which come from Surat in India, which he thinks were coloured agates; these formed the principal article of exchange for slaves at Djedda, these beads were worth fifteen dollars a thousand, which would purchase at Kordofan six female slaves; as the beads were easily transported the trade must have been very profitable. He describes the chiefs adorning themselves with amber and coral, but says the Venetians[1] sent false coral into the market. The Venetian beads were made, doubtless intentionally, as much as possible like the ancient ones so dear to Africans, but they seem to have been unable to make the mosaic beads, an art rediscovered in more modern times. It is these ancient mosaic beads which command such high prices in Ashantee; after the late war our officers described the desire of even civilized people to purchase the aggry beads brought from Coomassie, which they valued more than coral of the same weight, doubtless from a lingering half belief in the charm supposed to belong to them.

At present quantities of beads are made at Murano of every size and colour. The process of manufacture is very simple; a piece of glass, once perforated, may be drawn out to a tube of any length without losing the hole in its centre; these lengthened tubes are then cut into small pieces, and the bits placed in a mixture of lime and charcoal to fill up the holes and prevent their closing when again heated; they are then placed with sand and charcoal in an iron vessel over a furnace, so adjusted that a rotatory motion can be given to it (exactly as round sweetmeats are treated); by this means the sections of tubes are rounded, then they are shaken in bags to take the stopping from the holes, and finally polished by being shaken in sacks with bran. In 1764 twenty-two furnaces at Murano were employed in this industry, and the quantity made annually was prodigious; it may be imagined what a variety of patterns were produced. A tariff drawn up at the beginning of this century enumerates 562 different species and a vast number of sub-species of beads. The manu-

[1] The republic endeavoured by repeated prohibitions to prevent workers from imitating in glass such objects as were generally made of crystal or stone, proving that such imitations were often attempted.

facture continues to be one of very great importance, the annual export amounting in value to about £200,000 per annum.

There are in the British Museum some very beautiful glass beads, clouded and coloured, of various shapes, from both China and Japan, but they are all of modern make.

The habit of using beads to keep count of the number of prayers said seems to be very widely extended and of great antiquity, it would be difficult to say which nation originated the practice. All Turks habitually finger beads during their prayers; the Arab pilgrims from Mecca bring numerous rosaries home with them. Capt. Hawkins describes the great mogul of Agra; "at break of day at his devotions he has eight chains of beads, four hundred in each chain, formed of all kinds of precious stones; he turneth over his beads and saith 3200 words, and then his prayer is ended." And Marco Polo tells us that between Malabar and Zeilan where they fish for pearls the king has a silken thread to his breast "with 104 faire pearles as beads to number his prayers, of which he must daily say so many to his idols."

The Christian adaptation of beads is first mentioned by St. Augustine, A.D. 366; the intention was that no prayer should be omitted. That the name of the "bede" or prayer should gradually come to indicate the symbol is not unnatural. Bead-roll was the catalogue of those who were to be specially mentioned at prayers, the king's enemies were thus cursed by name at Paul's. Many monumental brasses show a double necklace of beads hanging down from the neck of the figure represented; in the case of men these were probably used for counting their prayers. Early in the fifteenth century, 1407, Bishop Wickham bequeathed to Bishop Arundel a pair of beads with a gold chain. Herrick bids his Corinna to

> "Wash, dress, be brief in praying;
> Few beads are best, when once we go a-Maying."

MIRRORS.

"The one true essence is like a bright mirror, which is the basis of all phenomena; the basis itself is permanent and true, the phenomena are evanescent and unreal; as the mirror however is capable of reflecting all images, so the true essence embraces all phenomena, and all things exist in it and by it."—*Avatamsaka Sutra* (*Buddhist*): *translated by S. Beale.*

WHO can doubt that the first known mirror was a calm mountain pool? Classical authors represent goddesses and shepherdesses alike contemplating their charms in limpid water instead of glass, a method of employing the laws of reflection which Dame Nature could scarcely have intended. Mr. Burne Jones has lately taught us how Venus might have instructed some of her elder daughters in the art of admiring themselves, a lesson they have never forgotten; Narcissus followed their example with fatal results. When we leave the misty realm of fable and come down to prosaic history, we find Venus' descendants in Egypt striving to replace the mountain pool of early days by polished metal. So admirably did the chemist of those times succeed in making mirrors of a mixed metal, capable of receiving a very high polish, that the brilliance of some ancient metal mirrors discovered in Thebes has been partially revived after being buried in the earth for so many centuries. These mirrors were chiefly made at Brundisium of a mixture of copper and tin. This produces a white metal, which unless preserved with great care is apt to become dim; and to preserve untarnished the splendour of ancient mirrors a sponge with powdered pumicestone was fastened to the setting. After the invention of glass mirrors the art of making metal ones was entirely lost; no one thought any circumstances could occur to render metal mirrors again necessary as has been the case in these days with the telescope, when chemists were obliged to make new experiments to determine the best metal for mirrors. "No art should be suffered to become extinct, at least the written process should be preserved for posterity. According to

experiments made by Mr. Mudge the Brundisium mixture of copper and tin produces the best metal for specula."[1] Egyptian mirrors were generally oval in shape, with a handle, and were held up by slaves during the lady's toilette. In the East mirrors had a connection with religion; females held them before the images of goddesses, thereby testifying their own humility as servants of the deities, and also showing the prevalence in private life of a similar custom, which in later times we sometimes find was performed by the lover when admitted to the toilette of his mistress. The Israelitish women must have followed the Egyptian habit of wearing their mirrors when Moses collected them at the tabernacle to make the brazen laver. Egyptian artisans must very early have observed the reflections given by their polished stones and obsidian, and if they tried to imitate this effect in glass would probably, as their glass was chiefly opaque, have used black glass. In the Turin museum are two little glass mirrors framed in wood, and fixed at the base of small Egyptian figures in white stone. M. Batissier says he has seen in Egypt some of these little mirrors, round, slightly convex, and all framed at the bottom of pottery figures found in the diggings of Sakkarah; and though by reason of their fragility very few have been preserved, yet enough remain to show that mirrors were sometimes made of glass, and not only of metal. To Sidon has been ascribed the original invention of glass mirrors, but whether that honour belongs to her or to Egypt cannot now be ascertained. That glass mirrors must have been made in Sidon seems probable, for though in Pliny's day, and many years after him, people still used metal ones, yet Aristotle four centuries before Pliny says "that if metal or pebbles have to be polished to serve as mirrors, glass or crystal require to be lined with a leaf of metal to throw back the image presented to them." And then Alexander Aphrodisius his commentator explains why the glass mirrors are so much more resplendent than others. Theophrastus, the pupil of Aristotle, observes that "mirrors were made of carbuncles from Orchomenos in Arcadia," this shows the idea was familiar to the ancients. Some mirrors are reported to have been made of rubies, but that stone, at least in modern days, is not found large enough for such a purpose. Some authors describe Nero as using an emerald mirror, but that legend most probably alludes to the magnifying

[1] Beckmann's History of Inventions.

glass his short sight required. Mr. Nesbitt quotes a curious passage from the Mahawanso chronicle of the Singhalese kings, 306 B.C., "mirrors of glittering glass were carried in procession." Small pieces of coloured glass, talc, and mirrors of a triangular shape arranged in patterns, form a favourite mode of decorating Burmese and Hindoo idols to this day, and some of the figures so adorned must belong to a remote age.

There seems little doubt that glass mirrors must have been made in the old world, but it is equally certain they did not succeed, which is not surprising when we remember that the glass of the time was greenish in colour, slightly opaque, full of defects and dull in surface, and therefore could not reward the gaze of inquiring beauty with the same glittering reflection that was returned by the brightly polished metal one. That the latter were more costly and required daily and hourly care to preserve undimmed their burnished splendours, while the glass required comparatively little or no trouble, would be of small importance to a classical belle, as her surrounding bevy of slaves could hardly find more fitting employment for their time than in keeping everything connected with the important toilette requisites of their mistress in perfect order. So, notwithstanding the undoubted invention of looking glasses, the feminine world clung to their metal mirrors, and we find preserved in their tombs many exquisite specimens, in the decoration of which artists must have expended a world of delicate and ingenious fancies.

Cœlius Rhodiginus assigns a moral reason for the invention of mirrors (lib. viii.). "Apuleius writes that Socrates the philosopher (468 B.C.) made use of a mirror (and this perhaps may seem strange) for moral instruction. For he urged his pupils, we are told, to look at themselves frequently in the glass, that he might beg any of them who should be gratified at his own beauty not to spoil the dignity of the body by a dishonourable state of mind." Here is a novel hint for modern instructors to consider. These ancient philosophers seems to have looked on the mirror as an assistance to their teachings, as Seneca some three centuries later says, "the mirror was invented that man might recognise himself"; no man therefore ought to neglect carrying one always about with him.

Though the glass of that day did not equal the crystal pureness which modern fastidiousness requires, yet some pieces must have approached it, or Virgil would not have thought of comparing it

to the "smooth clearness of the Fucian lake." There is a curious account written by Dom Boucher, 1749, of the so called mirror of Virgil, preserved among the treasures of the abbey of St. Denis. It came originally from Naples, that town which Virgil loved, where he studied, and near which he is buried. Many objects belonging to him may well be supposed to have remained in Naples, and some French officers who during the war were often in that town brought home this mirror and placed it in St. Denis. It is said there is, or was, another in the cabinet of the Pitti palace. The mirror at St. Denis is oval, the size is fourteen inches by twelve, and it weighs thirty pounds. It was whole until 1663, when it is said to have been broken by a too curious stranger; at all events, Mabillon, then custodian of the church treasures, was dismissed from his employment for having broken or suffered it to be broken. The greater part remains; it is of a greenish yellow colour, one piece melted in a crucible proved it to be glass, with a large mixture of lead in it, which doubtless made it so heavy and gave it the yellow colour. Virgil like many other great men was accused of being an enchanter and magician of the first rank, and above all was able to predict events by means of this mirror. Dom Boucher attributes to a certain Englishman, Gervais de Tilis, 1200, the invention for Virgil of this new quality, which all antiquity had ignored for eleven centuries.[1] Romans ornamented their walls with plaques of glass and mirrors, and had a kind of black glass like jet which they placed between the others, so that the spectator was startled to see only his shadow not his image. Though the ancients used mirrors for decoration we may suppose them to have been more an assemblage of small pieces of glass than the large sheets we use. When they wanted a great effect they used sheets of phengites, possibly we owe our large glasses to the desire moderns had to unite the beauty of small mirrors with the grandeur of phengite. Lucretius, 95 B.C., speaks of two opposite mirrors reflecting your image several times, and imitating all your actions; and Pliny and Seneca both speak of multiplying mirrors. We have only added to their beauty and effect. Seneca describes a mirror of many facettes, before which instead of one man you saw the same figure repeated in all the facettes; he also

[1] Can the publication of the romance of Virgilius, which was attributed in the middle ages to Virgil, have given rise to this report? In the beginning of the sixteenth century the adventures of the poet-magician Virgil were very favourite subjects with German artists.

writes of mirrors as large as a man, ornamented with silver and gold and precious stones, (it must have been such a mirror in size at least before which Demosthenes is said to have practised his oratory,) and upbraids his countrymen for their effeminate luxury in having their baths lined with large and costly mirrors. Pliny describes a semi-opaque glass fixed on a wall serving as a mirror;[1] this description certainly could never have meant a window. As soon as people saw glass windows, mirrors must have been at once invented, whenever chance placed an opaque body behind them.

Domitianus, A.D. 81, when he suspected that plots were formed against him, caused a gallery in which he used to walk to be lined with phengites, which by its reflection showed everything that was done behind his back. This transparent stone was much used for windows, and no doubt its power of reflecting objects had given the emperor this idea of using it as a mirror. Rochette thinks the guild of glassworkers at Rome who used the inscription "collegium specularіorum" only alluded to those workmen who made the round mirrors called specula. Pliny mentions obsidian (Iceland agate) as a very suitable material with which to make mirrors; he also describes silver mirrors framed in gold; when he describes gold applied behind a mirror we must suppose he alludes to the setting.

The French and Spanish Academicians discovered in the tombs of old mummies in Peru mirrors made of a volcanic vitrified stone like obsidian, some concave, some convex, and as highly polished as they could be in this day, also mirrors made of Incas' stone, so called because the Incas had ornaments and hatchets made of it. It is a compact pyrite or marcasite, capable of a very brilliant polish; old ladies still show ornaments made of it which look like white bright steel but which never rust, a very suitable stone for a mirror.

The very oldest mention of a glass mirror is that found in the Chinese classics[2] when the king says, "Now that Yiu has lost its appointment ought we not to look much to it as our glass, and learn how to secure the repose of our time?" The date of this book is more than 2000 B.C., but we know so little of old China that the bare statement is all we have to depend on; still there

[1] In Pompeii has lately been discovered a mirror of square black glass, fixed to the wall by three holes; when it is wetted all near objects are reflected in it.

[2] The Shoo King, Part V., book 10, p. 12, translated by J. Legge, D.D.

are many other allusions to glass in the classics, showing a high state of civilization and scientific knowledge.

Concave mirrors, whether of glass or metal, were much used in ancient temples; they served the vestals to light the "sacred fire of Vesta" with, when necessary, and they were useful for the purposes of divination; divination by means of a mirror was very common among the Greeks.[1] Pausanias tells us it was much used among the Achaians by those who were sick or in danger of death. "In Patræ, before the temple of Ceres, is a fountain, which is separated from the temple by a stone wall; there is a descent to it by steps on the outside. This temple has a true oracle, but it does not predict all events, only those relating to disease. They let down a mirror which is suspended by a slender thread, and balanced in such a manner that it may not be merged in the fountain with its anterior parts, but so that the water may lightly touch its circumference. After this, having prayed to the gods and made a fumigation, they look into the mirror and by this means perceive if the sick person will live or die, for when looking into the glass if they see a ghastly disfigured face they take it as a sure sign of death, but on the contrary if the face appears fresh and healthy it is a token of recovery. And thus far does the truth of this water extend. At the oracle of Apollo near Cyanæa there is also a fountain, into which those who descend in a similar manner perceive whatever they wish to behold." "Four stadia from Acacesium is the temple of Persephone, where there is a curious thing; on coming out of the temple where stands the statue of the goddess there is a passage, and on the right hand there is a mirror fitted in the wall. Whoever looks into this mirror will behold himself very obscurely or not at all, but he will see very clearly the statue of the goddess and the throne." This mirror was evidently fixed for reflecting at a distance the figures of those worshipping in the temple, and in which you could see all the objects brought into it.

There is a curious use of a mirror mentioned by Captain Colin Mackenzie, who in 1797 visited the pagoda of Maldecarjee, about a hundred miles from Hyderabad, India. There seemed no means of introducing light into the principal temple, and the ceremony of displaying the idol is thus described. The door of

[1] Pausanias says "that Dionysius, establishing the image of Bacchus in a mirror, pursued it, and thus became distributed into the universe." Bacchus was the exemplar of our intellect.

the temple is darkened by a stone building enclosing a well which by its shadow prevents any light entering the building till the sun rises above it, thus rendering the sight of the idol more rare. At the right instant a boy placed in the doorway waved and played a concave mirror in such a manner as to throw gleams of light into the temple, in the darkest recess of which was discovered by means of these rays a small oblong whitish stone with dark rings (probably an agate or onyx) fixed in a silver case. The mirror used in this ceremony was made of a whitish metal, possibly a mixture of tin and brass.

Sometimes divination was performed with a looking glass without water, and the images of future events represented in it. Lucian tells us it was the "sacred fury" which enabled the great orator Demosthenes "to go through with the grotto, the looking glass, and the sword." In his dialogue of "the portrait" he describes a cynic philosopher who, in running from a too importunate questioner, drops his wallet, which instead of containing only some lupins or black bread, as might have been expected, is found to hold some gold, pomatum, a sacrificial knife, a mirror, and a pair of dice. In his burlesque true history he says, "in the king's palace in the moon a looking glass is placed in a well not very deep; whoever goes down into the well hears everything that is said upon the earth, and if he looks into the glass beholds all the cities and nations of the world as plainly as if he were close to them. I myself saw several of my friends, and my whole native country, whether they saw me also I will not pretend to affirm. He who does not believe these things whenever he goes there will know that I have said nothing but what is true." This witty philosopher has a keen eye for the little weaknesses of his countrymen, and laughs at the vanity which makes them like to see themselves in large glasses. "Observe the barbers: you shall perceive that the best artists among them have a common razor and a moderate sized looking glass; while the bunglers and those who know little of their trade produce a multitude of instruments and immense specula, though these are generally ignorant of their business; yet it is the custom, which is foolish enough, for people to go to the one to be shaved and to the other with the large glasses to have their hair done."

To the use of magic mirrors Lucian alludes in a dialogue between Melissa and Bacchis on the subject of love spells; when Melissa begs her friend to find her a Thessalian woman who can

bring her lover back to her, Bacchis replies that she knows a Syrian woman who can do it, it is only necessary to give her some hair or trifling keepsake of the absent one, which she will hang up on a pin and make a fumigation under it, "she will then throw salt into the fire, pronouncing both your names. Then drawing forth from her bosom a magic mirror, she will turn it on all sides, murmuring several words in a low voice. This did she for me, and spite of the remonstrances of his friends my Fanias returned to my arms." From this graphic description it would seem the magic mirror must have been a well known divining spell in Lucian's day. Pretended soothsayers in Egypt still practise divination by making a species of mirror with a little water in a child's hand and drawing conclusions from what the child thinks he sees in it. Mediæval superstitions cling thickly round mirrors, and the magic looking glass of the middle ages was always a most important point in the possessions of charlatan astrologers and fortune tellers, and formed the nucleus for many a romantic and poetical story. Scotch maidens to this day consult a mirror under certain elaborate conditions, when they wish to see the human semblance of the man they are destined to marry.

Among the Japanese the metal mirror holds a most prominent place and is thought so important as to be almost an object of worship; it is considered an emblem of the soul of woman, and two at least are included in every bride's trousseau. These are selected especially for her with great care and by a species of second sight, as the qualities of the mirror should be in accordance with the characteristics of the possessor. Tradition asserts that the great sun goddess Amateram presented to her grandson (who subdued the world and was the first emperor of Japan) a sword emblematical of the spirit of man, and a mirror emblematic of her own spirit, which she desired him to keep always by him and to worship it as if he were worshipping herself. These mirrors are generally made in bronze and very highly ornamented; some among them are magic mirrors (which seem as much used by Japanese fortune tellers as they were in the middle ages), when held to the light in a particular manner not only is your own face reflected in it but also a hidden ornamentation in the mirror can be thrown on to a wall. A curious explanation of the means by which these so called magic mirrors are manufactured was given by Professor Ayrton at the Royal Institution, who in the same lecture quoted from the historian Muratori an account of the

magic mirror found under the pillow of the Bishop of Verona, who was afterwards condemned to death by Martin della Scala, as well as of one discovered in the house of Colla da Rienzi on the back of which was the word "Fiorone." It has been stated that the fleet of Alexander the Great was guided along the Persian Gulf by means of mirrors and that the ancients understood the art of utilising the rays of the sun for signalling purposes; so they and the North American Indians who carry on a system of signals by sun flashes have both preceded us in the invention of the heliograph, though Mr. Mance's instrument is doubtless more perfect than its predecessors were.

Although from the evidence of tombs mirrors were made of marble, polished, and precious stones, gold, silver, bronze, and mixed metals, and even of wood as well as of glass, still the greater part of the world clung to metal mirrors, and the most elaborate work of the day was expended on decorating them. Many hundreds of very beautifully engraved bronze mirrors are found in Etruscan tombs, probably the work of native artists, as the inscriptions on them are generally in the Etruscan character. The style of execution varies considerably, as might be expected from the lapse of time covered by the different dates of these entombments, some of them being of a rude and archaic character while others are among the most artistic treasures of which our museums can boast. From time to time we find notices of glass appearing during these ages, showing the art was not lost but only slumbering; thus fragments of a circular glass mirror foliated with a thin sheet of lead have been discovered among the excavations at Lillebourne; and Isidore, Bishop of Seville, who died A.D. 636, speaking of glass, says there is no material better adapted for making mirrors; yet they could never have come into common use, and must have been forgotten, as Alhagen the Arabian, who wrote his well known treatise on optics about 1100, speaks of iron and silver mirrors but never mentions glass. Then Johannes Peckham, English monk, writing also on optics in 1272, undoubtedly mentions glass mirrors, and says they were covered on the back with lead, and no image was reflected if the lead was scraped off.[1] Still ladies must on the whole have preferred metal, as we find Anne of Bretagne, queen of Louis XII., fourteenth century, using a metal mirror. The extreme delight which the

[1] Roger Bacon states the same thing.

middle-age Persian world took in mirror glass ornamentation is noticed fully in the chapter on Persia. The Persian poet Jámi, born 1414, must have been acquainted with magic mirrors, from the following passage in his "Saláman and Absál":[1]

> "Then from his secret art the Sage-Vizyr
> A magic mirror made, a mirror like
> The bosom of All-wise Intelligence,
> Reflecting in its mystic compass all
> Within the sevenfold volume of the world
> Involv'd; and looking in that mirror's face,
> The Shah beheld the face of his Desire."

Mr. Franks considers all the bronze mirrors found in Britain (they are very rare) may be attributed to late Celtic times. It is curious that these British mirrors are the only ones known, besides Etruscan, which have the ornamentation on the backs engraved, not cast or stamped.

At the coronation dinner (1422) of Henry VI. and Catherine of France, described in Fabian's chronicles, among many "sotyltyes" provided for the occasion was one of a tiger looking at himself in a mirror, and a man sitting on horseback armed, with a tiger's whelp held before him and a scroll saying: "Per force sans reason je ai prise ceste beste," while the tiger holds a scroll which reads: "Gile le mirour ma faite distour." In "Richard III." Shakespeare says: "I'll be at charges for a looking glass." Mirrors were publicly worn in his day by men as brooches and ornaments in the hat; by women on their fans or hanging from the girdle, as they are still worn by Arab women.

After Obsidius on his return from Ethiopia made known the black glass from volcanoes, it was used for mirrors inserted in the wall. It was cut into plates, and such a plate, plastered at the back with black bitumen, might have served for those glasses the size of a man which Plutarch says Demosthenes used. Plutarch, A.D. 60, also adds that a faithful representation was much valued. Juvenal sneers at young men who made use of mirrors. It may have been one of these early black glass mirrors with foil behind it which Montany saw. Alexander Aphrodisius in the second century certainly mentions glass mirrors. Vopiscus speaks of a silver cup lined with mirrors for divination. Ingherami supposes the metallic disks with handles, called Etruscan pateræ, may, when fitted with specula, have been used for magic mirrors.

[1] B. Quaritch. 1879.

Montany asserts that he saw in a collection of antiquities glass mirrors covered behind with foil. This was probably one of the first attempts to make them; later, blown glass was covered inside while hot with lead. Beckmann says before 1500 mirrors were made at Nuremburg by blowing into the glass bubble, still heated, a metallic mixture with a little resin or salt of tartar, the bubble was then cut into small round mirrors.

The first mention of glass mirrors in Venice is in 1317, when artists at Murano conceived the idea of covering plates of glass with an amalgam of tin and quicksilver. At that date we read that Nicolo Corro and others state in a petition made to the government that they had arranged an agreement with a certain "magister d'Alemania," who knew how to work glass into mirrors; he had broken his agreement and departed. In 1507 we find a monopoly of twenty years' mirror making granted to the brothers D'al Gallos by the council of ten. There was a corporation of mirror makers in Venice, 1569; after this time mirror workers increased so much that the republic had to separate them from other glassmakers and give them a distinct establishment, whence proceeded all the mirrors the world required till 1665, when Colbert, envious of the great manufacturing reputation of Venice, determined to grasp some of her laurels for France, and having already succeeded in tempting away and establishing at Alençon some of her renowned lacemakers, managed, spite of her jealous watchfulness, spite of the death penalties incurred by recreant workmen, to wrest from the great republic the carefully guarded secrets of mirror making, and founded a manufactory in France, whence have sprung the countless establishments of to-day. The importation of Venetian mirrors into France was prohibited in 1669. The manufacture of mirrors was introduced into England first by the second Duke of Buckingham, who brought workmen from Venice and established a factory in Lambeth in 1677.[1]

The goldsmiths and lapidaries of Venice lavished all the resources of their arts on adorning and perfecting the frames of mirrors destined for presents to crowned heads by the republic. Perhaps one of the best preserved specimens of this kind of work is the mirror presented in 1600 to Marie de Medicis by the republic of Venice, and now exhibited in the Louvre, Paris. It

[1] Evelyn says they "made looking glasses far finer and larger than any which came from Venice."

is a perfect blaze of rock crystals and gold, agate, diamonds, emeralds, antique gem cameos, and small busts made of hyacinth and gold. In 1791 the value of the gems and gold was estimated at £6000; what its artistic and historical value may be now it would be difficult to suggest. Some authors assert the face of this mirror is not glass but rock crystal. As Venice was celebrated for glass however it seems most probable that a mirror made there should have been of glass. When Colbert's effects were valued after his death, a Venetian mirror framed in silver was estimated at eight thousand livres, while a picture by Raphael only brought three thousand. In the book of the Duc de St. Simon, historian of the court of Louis XIV., 1699, we are told the Countess de Fiesque, who died at an advanced age at Fontainbleau in great poverty having been robbed by her man of business, had some splendid mirrors, then rare and expensive; not satisfied with these she purchased one still more perfect, and when her friends asked where she had got it from replied: "I had a bad piece of land which brought me in nothing but corn. I sold it, and with the money procured this mirror; have not I managed wonderfully, to possess this beautiful glass instead of dull corn?"

LAMPS.

"And sacred lamp in secret chamber hide,
Where it should not be quenched day nor night
For fear of evil fates, but burnen ever bright."

SPENSER, *Book* i., *c.* 12, *v.* 5.

ANCIENT authors have combined to throw such a halo of mystical and poetical fancies over the subject of lamps that it seems better to treat them as well as mirrors in a separate manner. A lamp may literally be described as lengthening the days of mankind. Perhaps our first recorded example of this useful invention is the burning lamp which Abraham saw in a vision, Gen. xv. 17 ; then we find Moses making a six-branched candlestick for the service of the tabernacle, and in the book of Job lamps and candles seem well enough known to be used as metaphors.

St. Clement of Alexandria ascribes the original invention of lamps to Egypt. There is a description in Herodotus of a festival at Sais of burning lamps; he says these were small vessels filled with salt and olive oil. As the Egyptians were then perfectly well acquainted with the manufacture of glass, there is no impossibility in the suggestion that these may have been made of glass, as clay vessels would have given very little light; but there seem to be no glass lamps preserved in the tombs. At Alabastron there is a sculpture representing a guard of soldiers, one of whom holds before him a long stick from which hangs what may be considered a lamp or lantern; if so, this must have been partly formed of some transparent substance.

In the British Museum are two coloured glazed tiles which were fixed in the centre of the ceiling, each has a large knob pierced through the base to receive a cord for suspending a lamp; round the base of each is an inscription stating that it formed part of the decoration of the temple of Kammuri at Kalah Nimroud, in the time of Assuru-Abla, 885 B.C. What these lamps were made

of we cannot now ascertain, but there is plenty of contemporaneous glass which has been discovered in the neighbourhood.

The sacred lamps in Greek temples whose undying flames were perpetually watched by vestals were probably of metal and the wick formed of asbestos. The celebrated lamp made by Callimachus for the most holy statue of Athena, the one that fell from heaven, is described by Pausanias as formed of gold; "when filled with oil it burns night and day for a year, this is owing to its wick being made of Carpasian flax, which alone of all things is inconsumable by fire; above the lamp is a brazen palm tree, which rising to the roof of the building dissipates the fume." It was one of the offences charged against the tyrant Aristion that he allowed this lamp to die out during the siege of Athens by Sulla, 86 B.C. Aristophanes, 427 B.C., in his comedy of the "Wasps" gives a comic account of a party of philosophers picking their way home through the mud by the light of a lantern, which we must infer was a light enclosed in a transparent case of some kind, such as Plautus, 254 B.C., who had a happy gift of nomenclature, calls "Vulcan in prison." Virgil must have been acquainted with an ancient equivalent to our chandelier when he says:

> "Lamps display
> From golden roof an artificial day."

Ovid, 43 B.C., had evidently been familiar with night lights in the passage:

> "Near morn, when lamps are dwindling out their light,
> And seem to nod for sleep, that part of night
> When dreams are truest offered to our sight."

In the public baths at Pompeii two lamps were used, each to light two rooms; these lamps were protected by circular convex glasses, fragments of which were found on the spot. At the entrance of the small bath, or balinea, there is still to be seen a niche in the wall closed with glass, which at night contained a lamp, and the tepidarium which by day was lighted with four windows was resplendent at night from the brilliance of a lamp suspended above the labra.

Though glass was used for lamps in Pompeii, yet they also made lanterns of horn and oiled paper, and Martial describes a lantern as being more brilliant than bladder. "If I am not of horn, am I darker? or does he think I am a bladder?" Besides these lanterns for common use in Pompeii there was one found of a much more

elegant form, which is now in the Naples museum. It was made of twenty-eight divisions of bronze wire, shaped like a basket; on these wires have been threaded numerous beads of crystal, the handle formed by a chain to suspend it like a lustre; in the middle of the basket is the place for the light, which would be reflected by all the crystal beads. This is a unique specimen.

Romans had a veilluse lamp with a single wick, and also a fixed lamp with several beaks, possibly very like the common Italian lamp of to-day. The Egyptians and Israelites, and the Greeks and Romans their imitators, had golden and brass candelabra made like trees, with branches, and bearing, instead of fruit, lamps fed with oil; they knew how to make artificial crystal and precious stones, and would probably ornament their candelabra with these substances, but we can hardly believe they made lustres as brilliant as ours. They had suspended lamps, "pendentes lychni," as well as girandoles attached to panels. Lucian tells us that lamps belonging to celebrated people were held to have special virtues and narrates in his usual satirical vein how he was acquainted with a man who had given three thousand drachms for the lamp of Epictetus the stoic, satisfied that if he only read every night by the light of that sage's lamp he should inherit his wisdom and become in time as learned as the philosopher. It is Lucian who describes for us the golden statue of Juno at Hierapolis, which was richly adorned with precious stones, the most extraordinary among them being a jewel upon her head which they call the lamp; "from its lustre by night it shines with such a splendour as to light the whole temple, though in the daytime it is less bright and has the appearance of a pale fire." The Greek priests had evidently learned from their Egyptian brethren the secret of this nightly illumination.

Lucian gives an amusing description of the city of lamps, which he pretends to have seen during his travels. "In this city there were no men, only a number of lamps running to and fro in the market place and round the port; some little ones, the poor of the town, others the rich and great among them, very large, splendid, and bright. Every one had its own habitation or candlestick to itself, and its own proper name as men have; their death is to be put out. Here I found my own lamp, talked to him, and asked how things went on at home, and he told me everything that had happened." In his "Banquet" he gives an account of a great philosopher's feast which ended in a riot. "At length there

was nothing but crying and roaring on every side, when, to crown all, Alcidanus threw down the light and left us all in total darkness; the affair then grew still more serious, for we could not easily procure another light, which when it was at last brought in discovered some very bad transactions that had been carried on, thus one philosopher was just making off with a cup."

The Athenians[1] established in the Academy an annual festival, during which men raced from the altar of Prometheus to the city, carrying with them burning lamps, and at the same time contended while running with each other about keeping the lamps alight, "for he whose lamp is in the race extinguished yields the victory to his successor, and he again if equally unfortunate to a third, but if the lamps of all of them are extinguished the victory is not left to any one." So writes Pausanias, and the propriety of employing burning lamps in a contest sacred to Prometheus is sufficiently apparent, as this divinity was the inspective guardian of rational souls, and fire from its tendency upwards is an emblem of the rational soul. "As a burning lamp therefore may be considered as a very proper image of our rational part, it appears to me that the custom adopted by the Athenians of running from the altar of Prometheus into the city with lamps, in which he alone was victorious whose lamp remained unextinguished in the race, was intended to signify that he is the true conqueror in the race of life whose rational part is not extinguished, or in other words does not become dormant in his career."[2] The Abbe Banier considers that this festival was generally spread among all nations, and is kept to this day in China, Mexico, and other places, as the feast of lamps; the ceremony consists in lighting numbers of lamps and torches, and is no doubt a tradition of the universal joy expressed for the use of fire.[3]

Apuleius, second century A.D., describes a lamp which furnished indications of the weather like a modern barometer. St. Aldhelm, in the seventh century, says, "let not the glass lantern be despised, or that made of a shorn hide or of a thin skin, although a brass lamp may excel it in brilliance," which proves that even at that early period our ancestors made use of various materials for their lanterns. St. Willibald describes with admir-

[1] Vulcan taught men how to make lamps, Minerva showed them the use of oil, and Prometheus brought fire from heaven; hence the feast of lamps was in honour of all three.

[2] Priestley.

[3] The moccoli at a Roman carnival will occur to most travellers.

ation the benefit of a glass lamp, which was probably a novelty to him: "there is a small lamp, and around it on all sides is clear glass, that it may always continue to burn in the rain and sun." Among the quantities of lamps and lanterns of all kinds of materials used by the Chinese, the most remarkable are grotesque lamps, made generally in porcelain, as a ship all in one piece, and a cat painted after nature; the light coming through her eyes frightened the rats at night! The festival of lighted lamps among the Hebrews, which takes place on the 25th December, was instituted in memory of the victory gained by the Maccabees over the Greeks. On the first day they light one lamp, on the second day two lamps, and so on to eight. This is done in remembrance of the time when, the enemy having already entered the temple and profaned it, Jochanan and his children succeeded in chasing them out, but on their return found they had no pure oil with which to light the lamps of the temple; after some search they discovered enough in a little vase to last for one night, but this oil by a miracle became sufficient for eight nights; therefore the lamps are lighted as above described.

The marvellous accounts left us by mediæval authors of perpetually burning lamps found in ancient tombs seem too numerous and too well attested to be altogether fabulous. When the tomb of Pallas, son of Evander, who is mentioned by Virgil, was discovered about the twelfth century by a countryman digging near Rome, it is said a lighted lamp was still burning over his head, which must have been lighted more than two thousand years, and might be called "eternal." William of Malmesbury giving an account of it says: "the lamp was constructed by magic art, so that no violent blast, no dripping of water, could extinguish it. While many were lost in admiration, one person expert in mischief made an aperture beneath the flame with an iron style, which introducing the air the light vanished." Baptista Porta in his treatise on natural magic relates that about 1550 a marble sepulchre of the Roman period was discovered in an island near Naples; on opening this tomb was found a phial containing a burning lamp. This light became extinct on breaking the phial and exposing the flame to the open air. It was supposed that this lamp had been concealed before the Christian era; those who saw it reported the lamp emitted a most splendid flame. In 1550 a remarkable lamp was found near Atestes, Padua, by a rustic digging, who unearthed a terracotta urn containing another urn in which was a lamp

placed between two cylindrical vessels, one gold and the other silver, each of which was full of a very pure liquid by whose virtue the lamp had been kept shining upwards of fifteen hundred years. This curious lamp was not meant to scare away evil spirits from a tomb, but was an attempt to perpetuate the profound knowledge of Maximus Olybius, who effected this wonder by his extraordinary skill in chemical art. On the outside of the urn were inscribed some Latin verses to this effect:

"Plunderers, forbear this gift to touch,
'Tis awful Pluto's own;
A secret rare the world conceals,
To such as you unknown."

During the reign of Pope Paul III., in the sixteenth century, a tomb was opened in the Via Appia, supposed to be that of Tullia, Cicero's daughter; in it was the body of a woman with hair tied with gold thread, and also a lighted lamp which must have been burning at least 1550 years; this wonderful spectacle did not last long, no sooner did the exterior air rush in than the flame extinguished itself and the body faded away like a ghost before the eyes of the beholders, leaving only a heap of dust. St. Augustine says a lamp was found in the temple of Venus exposed always to the open weather, and which could never be extinguished; this was certainly the greatest triumph of the chemist's art. Ludovicus Vives mentions another lamp which was found a little before his time, that had continued burning for 1050 years. Licetus is of opinion that the perpetuity of these lamps was owing to the consummate tenacity of the unctuous matter with which the flame was united being so proportioned to the strength of the fire that, like the radical heat and natural moisture in animals, neither of them could conquer or destroy the other. In order to preserve this equality of proportion these lamps were hid in caverns or closed monuments; on opening these tombs the admission of fresh air to the lamps has produced so great an inequality between the flame and the oil that they have become extinguished. They were placed by Romans in tombs as a mark of honour, doubtless also the knowledge that a light was there gave a feeling of safety that was satisfactory to the friends of the deceased, who were always inclined to fear supernatural enemies. Several of these lamps were discovered near Viterbo, Italy, and two are still preserved (unlighted) in the

museum of Leyden. In Henry VIII.'s time a lamp was found in a monastic tomb that had been burning for 1200 years. In the romance of Virgilius, a book which the middle age authors attributed to Virgil, is the following very singular account of a lamp. "For profit of common people Virgilius on a great mighty pillar did make a bridge that came up to the palace; that palace and pillar stood in the midst of Rome, and upon this pillar made he a lamp of glass that always burned without going out, and nobody might put it out, and this lamp lightened over the whole city of Rome from one corner to the other, and there was not so little a street but it gave such light that it seemed two torches there had stand, and upon the walls of the palace made he a metal man that held in his hand a metal bow that pointed ever upon the lamp for to shoot it out, but always burned the lamp and gave light all over Rome. And upon a time went the burgesses' daughters to play in the palace, and beheld the metal man, and one of them asked in sport why he shot not; and then she came to the man and with her hand touched the bow, and then the bolt flew out and brake the lamp that Virgilius made; and it was wonder that the maiden went not out of her mind for the great fear she had, and also the other maidens that were in her company, of the great stroke that it gave when it hit the lamp, and when they saw the metal man so swiftly run his way and never after was he any more seen; and this aforesaid lamp was abiding burning after the death of Virgilius by the space of three hundred years or more." Friar Bacon believed in the possibility of making lamps that should burn for ever, and old chemists affirm there is a way of reducing the flame back into wax or oil, so as to keep up a perpetual supply, the wick being made of asbestos. The founder of the Rosicrucian sect is said to have discovered this secret and made an eternal lamp, which was discovered years after his death still lighted in his tomb. In Burton's Melancholy a lamp is described which is to burn as long as the man with whom it has a certain mystical connection continues to live. The poet Cowley must have been thinking of these "eternal" lamps when he wrote the line, "life's light goes out when first they let in air." The many thousands of little hand lamps that have been disinterred from Pompeii and are found in nearly all Etruscan, Greek, or Roman tombs or towns, though much varied in pattern and design, are invariably formed of clay; the only exception to this rule is the beautiful blue and white

lamp made in the usual shape, but of glass, which is figured by M. Deville; it represents under a vine tree a winged figure of Harpocrates, god of silence, son of Osiris and Isis, with his finger on his mouth and the legend "to the great god." Such a lamp could obviously have only been made for ornament, as it could never have been used. M. Deville does not say where it was found. The Persian traveller Nasir, who visited Jerusalem[1] in the eleventh century, speaks of lamps and lustres suspended every here and there in the mosques by chains; also a lustre sent by the Sultan of Egypt to one especial building where he sends every year a candle seven yards high and three spans in girth, made of perfumed camphor and ambergris. Eastern nations appear to have delighted in glass lamps, there are some enamelled of very elegant form in the mosque of Sultan Hassan, at Cairo, of the thirteenth and fourteenth centuries. In the British Museum is a very beautiful lamp of a thistle form, made for the Arab emir Sheikhoo, who died in 1356; this lamp was brought from a mosque in Egypt; near it is one of the fourteenth century brought from Damascus. The Kensington Museum has acquired some very fine specimens of these lamps, which are nearly all shaped like a thistle flower, and have a smaller lamp, also glass, inside, to hold the oil and wick. The Persian Ibn Batoutah, 1332, talks of clusters of lamps made of glass from Irak. Many lamps, of these flower shapes, some with painted and enamelled flowers and large letters outside, some painted inside, can still be procured in Cairo and Damascus; they generally contain the name of the person for whom they are made, but these names are not always known to fame, so do not assist us in fixing the age of the lamp. Clavijo in his embassy to Timour Beg, 1403, says he saw many glass lamps in the church of St. John the Baptist at Constantinople; they were most probably lamps of this form, and of Byzantine manufacture. In the calendar of the Treasury of Exchequer of Edward III. are mentioned "two glass lamps," one called that of "St. Lucia." The list seems to be of the fourteenth century, and is among the relics of the cathedral of Durham. A lamp of very original design was found in the tomb of Maria, wife of Honorius, at Rome, A.D. 393. A glass, snail shaped like a large sea shell, held the oil; this shell was twisted round with its point

[1] Sir J. Maundeville, 1322, says: "and there is one lamp which hangs before the sepulchre and burns bright, and on Good Friday it goes out of itself, and lights again of itself at the hour that our Lord rose from the dead."

fitted to a lamp of gold, which covered the mouth of the snail, leaving only a hole for the oil; beside this hole was fastened a movable golden fly which covered or uncovered the hole as required. In Purchas' Pilgrimmes we find a description of Muscovy glass for lanterns. "Near the river Deyna towards the North Sea there groweth a soft rock which they call slude; this they cut into pieces, and so tear it into thin flakes, for which naturally it is adapted, and so use it for glass lanterns and such like."

OF TRUE AND FALSE MURRHINE, AND FLEXIBLE GLASS.

"Murrhine vases have a lustre without strength, more properly a polish than a lustre. But their value lies in their variety of colours, the spots occasionally turning themselves into purple or white and a third made up of both, the purple by as it were a transition of colour becoming fiery or the milky part turning red. Some especially admire the edge of these spots and a kind of play of colours such as is seen in the rainbow. Opaque spots are most esteemed; any part transparent or pale is a defect, as are also flaws and warts not projecting from the surface but as if implanted within the substance itself. There is some recommendation also in their agreeable smell."—*Pliny.*

MURRHINE.

THE much disputed question as to what substance murrhine really was has occupied the thoughts and pens of many learned writers. The enormous sums paid for vases formed of it show that it was an object greatly admired and eagerly sought after in ancient Rome. The true precious murrhine came from Parthia and Caramania, but even the imitation made in Egypt, of glass, commanded a ready sale both in Rome and the provinces. It may be interesting to collect here all the evidence procurable on the subject, with a view not to pronouncing any decided opinion on the subject but of enabling readers to form their own. The article called murrhine was first introduced to the Roman world at the triumph of Pompey,[1] when six vases found among the treasures of Mithridates and other specimens, especially a draughtboard four feet long and three wide, formed of two slabs of murrhine, were exhibited to an admiring populace. Pompey afterwards dedicated some unworked pieces, together with the vases carried in his procession, to the temple of Jupiter. After the defeat of Antony and Cleopatra, Augustus brought from Alexandria a murrhine vase as one of the most precious objects wherewith to grace his triumph; this was also placed in a temple. That the new

[1] "Murrhine was not agate, as that stone was known in Rome before Pompey's time." (A. Billings.)

material became immediately in great request and was used at the banquets of wealthy citizens is proved by the fact that the luxurious Verres (who was so denounced by Cicero) made his guests drink from crystal and murrhine of Alexandria; whether this was the true or false murrhine we have no means of ascertaining. True murrhine appears to have been generally found in veins in the earth, of just the depth required to make the saucer shaped cups called trulla, used in Rome; pieces large enough to be formed into a scyphus, a deep hemispherical bowl, were very rare and extremely expensive. In spite of the large price demanded however, Roman collectors must have accumulated great numbers of murrhine vases before the reign of Nero, as the collection of these objects belonging to a single senator which were seized at his death by Nero were sufficient, when displayed as a spectacle for the people, entirely to fill the theatre which Nero had built in the palace gardens, that very theatre which he had hoped to see filled with people anxious to hear him sing. One remarkable object of this show consisted of the fragments of a scyphus preserved in a glass case with as much care as the corpse of Alexander the Great and exhibited to the public to excite their pity. These fragments are supposed to have been the shattered remains of that cup for which Petronius had given three thousand talents, and by destroying which in his dying moments he deemed himself fully revenged on the emperor who was greedily waiting to take possession of the coveted prize. Nero afterwards himself gave three thousand talents for a smaller vase, and by this acquisition surpassed all other collectors in Rome. Pliny blames this excessive luxury, it seemed to him scandalous that the master of the world should drink out of a cup at such a price and thereby set an example of reckless extravagance to others. We must suppose the enormous price of these two vases and a few others was due to their extreme beauty, as the greater number and especially the imitations made in Egypt were much cheaper, there being indications in many authors that they were very generally used in Rome.

Juvenal speaks of "maxima murrhina," and Martial often alludes to murrhine and says it gave the wine a more agreeable taste and flavour; that it was not transparent we gather from his epigram: "We drink from glass, and thou O Ponticus from murrhine; and why? because for fear lest a transparent cup should allow to be seen two different wines." Among the numerous

substances suggested as true murrhine are gum, shell, porcelain, precious stones, crystal, obsidian, soapstone, the rare "yu" stone of China, real alabaster, fluor spar, and oriental agate. Christius suspected it might be an onyx; Bruckman says a sardonyx; Winckelmann supports this idea; M. Pauw devotes many pages to the subject but without advancing it materially, indeed he ends the discussion by merely saying it was not of a chalky nature.

Many of these suggestions cannot stand the least examination. How could gum vases bear spirituous and hot liquids? "If you drink it hot, the murrhine suits Falernian wine and improves its flavour" (Martial). Would people have imagined a shell a vitreous substance, and made out of it utensils and small pieces of furniture of various forms? The want of bright colours and white lines in obsidian and soapstone excludes them altogether from the question. It was brought to Egypt from various eastern countries. Pliny says, "and they bring it yet from little known places"; it was therefore abundant enough in nature, and if at one time scarce in Rome became common afterwards, so could not have been the "yu" stone, still so rare in China. Justinian distinctly says it cannot be classed among precious stones, on the authority of Cassius, who writes that "murrhine vessels are not ornamented with gems." It differed from gems in not being hard. "A consular person drinking out of a murrhine cup was so struck by its beauty that he could not help taking a bite out of it,[1] and this accident instead of diminishing the value of the vase augmented it." Pliny who gives this story places murrhine next to rock crystal. It would have been impossible for a cultivated man like Pliny to have confounded painted porcelain with a natural stone drawn from the earth. The only ancient authority for this idea is the line of Propertius, 50 B.C., "murrhine vases baked in Parthian fires"; but this is surely only a poet's conceit, or possibly he scarcely distinguished between true murrhine and that made in Egypt. English workmen have some means of heightening by fire the colours of Derbyshire spar, much as Germans stain heated spar or crystal different colours with nitre or nitrate of silver; some such method may have been practised by ancient workers in murrhine, as pale colours and transparency were defects. Sir W. Gell says in 1555 Chinese porcelain vases

[1] This consul showed an analogous taste to those mediæval people who were so passionately fond of point lace they could not help eating it.

were called "mirrha de Smyrna." It is not impossible that tales of the fabulous prices given for murrhine may have induced the Chinese like the Egyptians to endeavour to imitate it and give the name of mirrha to the production as something valuable, indeed the splashed china for which collectors still give enormous sums looks like an imitation of some natural substance, and the Chinese have always been celebrated for their successful imitations of stone.

Propertius, writing a century earlier than Pliny when murrhine was still very rare, says, "and let the murrhine box anoint the nostrils with unguent." It is possible that his idea of onyx was simply any arrangement of red or black and white lines.[1] La Roziere thinks onyx was only meant to express any stone with concentric lines. The same word was also applied to some kinds of alabaster, but alabaster is not brilliant enough in hue to fulfil our idea of murrhine. Pliny describes not only sardonyx but many kinds of agate with such distinctness that it could scarcely be better done in our day. It was the variety and richness of its colours that excited such admiration, and gave murrhine such a high price; the predominant tints were violet or purple (this colour included all shades from red to indigo) with bands of milky white disposed in undulations, some parts nearly transparent with a reddish brown, giving changes of hue as the light passes through the vessel at different angles. Pliny's description is very precise;[2] this description is quoted equally by those who try to establish the theory that fluor spar is true murrhine and those who hold that agate is meant. No doubt the words are very applicable to fluor spar, and many early Egyptian bottles much resemble spar. The "brilliance without force" and the "polish more than lustre," with the richness of colouring, are all characteristic of spar, also the undulating bands of white with an edge partaking of the two colours and imitating the clear colour of flame which Pliny remarks, and the reflections giving the hues of a rainbow, may all be found in spar. M. Haüy says "the bright agreeable colours of spar seem to rival gems," he distinguishes six principal colours of which the most common is red or violet. M. Werner says "there is perhaps no mineral which presents colours so varied, severed, and mixed in the same piece, and with ribands or spots." Buffon says "the colours of spar are so varied that they are called

[1] A passage in Lampridius speaks of murrhine and onyx vessels.
[2] See heading of this chapter.

after the precious stones they imitate, and the most common tint is amethyst." Spar has been called "vitreous alabaster," to represent at once its vitreous aspect and disposition in zones and different shades; this is very like the poetical expression of Propertius, "murrheus onyx." These opinions would make it appear conclusive that spar is true murrhine, were it not for the fact that no remains of it are to be found among ancient ruins. La Roziere cites one instance in the collection of M. Gillet-Laumont of a vase made of fluor spar which by its form and the character of its workmanship is undoubtedly an antique. It is spotted with a number of little metallic grains like particles of antimony, and La Roziere thinks it incontestably an old murrhine vase. This appears however the sole example, while the immense number of fragments and whole vases of agate, both real and imitation, found in quantities in all Roman ruins, besides the numerous specimens met with in the hands of dealers and in collections, prove them to have belonged to a class of vessels in constant use. Small pieces of these vases are constantly polished and set as brooches and bracelets in Rome, and the imitations of agate are most wonderful. Pliny when he speaks of imitation murrhine "finds it very like the real"; it was fabricated in Egypt.[1] Arrian speaks of "glass and murrhine vessels wrought in the city of Diospolis." La Roziere says he found in the ruins of Thebes abundant fragments of glass showing beautiful shades of purple, which he thinks were debris of false murrhine, though he adds naïvely that if so it confirms what old writers have said, "that they only imitated nature very rudely," which was doubtless the reason that false murrhine was of small value and little sought after in Rome. They sent it rather to the ruder people of Arabia and the north of Africa, with many other vases made at Thebes or Coptos. That spar is not now found in Caramania would be no conclusive argument that none had ever existed there, as in our own time the Blue John spar of Derbyshire (which rivals the amethyst in colour) has become almost extinct. ~~Mr.~~ Billings says a recent traveller has seen fluor spar in the neighbourhood of the Caspian Sea, just the locality of the Parthian expedition. Possibly the Romans never acquired the right method of heating and bringing out the colours of the raw material. Spar is much more brittle and friable than marble or glass, and the process of

[1] Ancient writers called it "vitrum murrhinum."

heating may have rendered it even more likely to crumble away; still it is difficult to conceive that any possible combination of circumstances could have swept away all fragments of a class of stone vessels which at one time were so plentiful among Romans. Pausanias, a century later than Pliny, speaks of murrhine as one of the substances broken by contact with the waters of the river Styx, and also places it in the same rank with glass and crystal for fragility. Marcus Aurelius, a thrifty minded monarch, sold by public auction in the forum cups and vases of crystal and murrhine, belonging to the imperial service; but we are not told if this was true or false murrhine. It was in use down to the close of the empire, as a legal writer distinguishes murrhine carefully from glass or precious metals. The large price still paid for agate vases seems a confirmation of the notion that some variety of that stone was the ancient murrhine; £1500 was paid for the splendid vase still one of the gems of the Naples museum.× Collections of Indian agate vases are often sold in auction rooms in London, and sometimes realize startling prices; and their great fragility is sometimes unfortunately shown by their being dashed to fragments even in the auction room. Mr. King laments over the grievous waste of skill and labour and value annihilated in a moment when, at the siege of Delhi, the soldiers smashed chests full of these productions, which are sometimes worth much more than their weight in gold.[1] It is only wonderful so many treasures have escaped destruction, considering the numerous wars of the world. Dr. Birch tells us that some vases found in Egyptian tombs are painted in distemper, the ground perhaps blue, with wavy lines on it in red, white, and yellow, then varnished with resinous substances; these were humble imitations of Egyptian murrhine opaque glass vases, and placed in tombs instead of the real ones, which the relations wished to retain for themselves.

× not merely as an onyx vase, but for the cameo thereon.

Coccio Sabellico, 1495, describing the works at Murano, says: "hence come vessels the equals of the murrhine, unless cost be a source of pleasure." These were doubtless the imitations of chalcedony called by the Germans "schmelz," and show what in the fifteenth century was thought to be murrhine. Jerome Cardan, 1501, says he saw a glass showing at the same time

[1] It is a melancholy fact that our soldiers imagine that nothing is valuable if it cannot stand smashing. A gentleman has described to me seeing a soldier at Delhi crushing up an emerald necklace on a stone, who when remonstrated with said, "It's no good, it breaks like glass."

white, blue, black, purple, and green, and which by its beauty and the variety of its colours imitated perfectly agate; was this false murrhine? Neri, who wrote in 1612, gives some recipes for making false murrhine; he obtained vases which being smooth and polished offered all the colours of jasper, chalcedony, and agate, and appeared red as fire when seen with the light through them. After reading all the evidence authors can give respecting the substance so much admired by the Romans, we can only say that, should any fragments of an undoubted murrhine vase ever be discovered, it is to be hoped they will be preserved in the same manner that Nero enshrined his precious relics, under glass.

In the time of Papias all glass vessels were called myrrhina. Mongez asserts they were formed of the cacholong of Cronstedt, a variety of chalcedony which gives all the characteristics mentioned by Pliny. The Calmucks still make vases of the cacholong.

FLEXIBLE GLASS.

That a vision of flexible or malleable glass haunted the dreams of the ancients is obvious from the many references to it found in their writings, and these constant allusions to such an article would seem to infer that there must at one time have been some tangible reason for the dream. The first notice we find on the subject is that "glass which might be bended and yet not broken" was included in the list of treasures placed in the pyramid of Chephren; the list is given by the court poets of El-Mamoum who opened the pyramid, and it is singular that the poets do not speak of such glass as an impossibility but only as a thing to be desired. In classical times the first account of flexible glass is found in the satire of Nero's court, written by Petronius, "The Supper of Trimalchio"; it is to the effect that a certain artist, having discovered a way to make glass vessels as strong as gold or silver, made one so fine as to be worthy the acceptance of Cæsar, to whom he presented it. The cup was received with great admiration; but then the artist, to increase the importance of his gift, dashed it to the ground with great force, only making thereby an indentation on the glass, which he beat out again with a hammer as if it had been metal; then Cæsar, instead of rewarding him according to his expectation, demanded if any one knew

this secret excepting himself, and being answered in the negative immediately ordered the artist to be beheaded, lest silver and gold should lose their value if such an art became once known. Pliny relates almost the same story, but gives Tiberius as the emperor concerned; he also says, the art of making glass malleable being discovered by an artist in Rome, the populace who imagined their interests would be thereby injured conspired and destroyed his dwelling and his goods. Dion Cassius, A.D. 155, also alludes to flexible glass. Isidore, bishop of Seville, who died 636, relates Pliny's story but amplifies it with many details, such as may well have gathered round a tale in the course of six centuries.

The art of rendering glass more fusible by means of litharge was well known to Eraclius, who wrote between the seventh and tenth centuries; and Theophilus, who wrote about the twelfth century, gives the following recipe for making glass fuse easily. "When crystal is soft over the fire, take well purified oil of tartar, throw it in drop by drop, and it will be easily fused; also when lumps of crystal are red and glowing over the fire, quench them in oil of tartar; repeat this seven times, and you have a glass which melts easily and is proper for making artificial gems." Surely here is a gem of toughened glass! A large number of alchemists pretended in the middle ages that malleability of glass was due to the great elixir. Neri, whose book on glass was published at Florence in 1612, says: "in the time of Tiberius was invented a way of making glass malleable, a thing afterwards lost and to this day wholly unknown, for if such a thing were now known, without doubt it would be more esteemed for its beauty and incorruptibility than silver or gold; since from glass there ariseth neither smell, nor rust, nor taste, nor any other quality." But though unknown to the old Italian, the art was practised in Persia if we may believe Bailey, who says that in 1610 Sophi, emperor of Persia, sent to King Philip III. of Spain six glasses that were malleable and would not break by being hammered; and Blacourt tells us that an inventor having presented a bust of malleable glass to Richelieu, 1620, was rewarded for his ingenuity by perpetual imprisonment, lest the vested interests of French glassworkers should be injured by the new invention. How slowly the world learns anything! Neumann says muriate of silver while being fused forms a ductile kind of glass, which can be moulded or turned into different figures, and

may be pronounced to a degree malleable, a fact to which Henchal reduces all the stories of the ancients. The mines of Quantajaia in the South Sea yield beautiful vitreous masses of muriate of silver.

The art of making flexible glass was said to be reinvented by an Italian at the court of Casimir, king of Poland. The process of annealing in oil to which a great deal of attention has lately been directed is said to decrease the brittleness of glass in a great degree; the process is described in the article "Glass," in Ure's "Dictionary of Chemistry." The use of toughened glass however does not increase in popular favour; further experiments are required to remedy its defects, one serious one being its total destruction under the least fracture.

The lieou-li, the flexible glass of China, is noticed in the chapter on the glass of that country.

ANALYSIS, OXIDES, AND GLAZES.

"Chemistry dissipates little by little the dark shadows of ignorance, and throws light on every object. All the elements of the universe are used by chemists to further and perfect their art; and fire, of these, is the most serviceable. The discovery of glass, which it procured them, was regarded by them as the most useful and the most marvellous."—*Shaw's Lectures on Chemistry.*

ANALYSIS AND OXIDES.

"*PERHAPS* iron alone can dispute with glass the pre-eminence in utility to man." It is strange, though the chief quality of glass is transparence, all the materials composing it are opaque; stone gives silex, ashes potash, marble lime; the only mysterious agent is fire, for, like gold, glass is tried in the fire and perfected, and acquires brilliance. Neri tells us to note "that those stones which strike fire with a steel are fit to vitrify, and those which strike not fire with a steel will never vitrify; which serves for advice to know the stones that may be transmuted from those that will not be transmuted into glass." He directs us to take the whitest tarso which has not black veins or yellow spots like rust in it, to make fair crystal. Tarso is a hard and white marble found in Tuscany and many other places, and he assures us that "glass is more gentle, graceful, and noble than any metal, and its use is more delightful, polite, and sightly than any other material at this day known to the world." All that the artist in glass has to guard against is fragility. At present modern ordinary white glass is composed of silica, soda, and lime; in Bohemia soda is replaced by potash; thus three substances enter into the composition of modern glass, while the ancients only used sand and alkali of some kind; thus, as M. Peligot points out, the almost entire absence of lime in ancient glass forms between it and modern glass a line of demarcation which it is useful to remember. He thinks that ancient glasses, formed of pure sand, with salts

furnished by the washing of cinders, would have disappeared by this time, as they belong to the category of soluble glasses which Fuchs discovered, so that in reality all the antique glasses left us are probably only those best made which contain the most lime. His analysis of white glasses (choosing those least iridescent) is given from samples nearly all found at Autun, and belonging probably to the second century.[1]

Silica	66·7	66·0	67·4	70·9	69·4	69·4
Lime	5·8	7·2	2·7	7·9	6·4	7·1
Alumina, Oxide of Iron, and Manganese...	2·8	3·0	5·7	4·5	2·9	2·8
Soda and Potash	24·7	23·8	24·2	16·7	21·3	20·7
	100·0	100·0	100·0	100·0	100·0	100·0

In all these glasses the proportion of lime is small, about half or a third of what is used in modern factories. Pliny says, "to the materials of glass they began to add the magnetic stone, then they joined little slimy stones of all kinds, then shells and fossil sands," and he notices lime as an advance made in his time. Still the use of lime seems to have escaped the notice of glassmakers to a much later date, and they seem to have all taken manganese (the soap of glass) to be a kind of loadstone, which it resembles. It was doubtless the use of manganese which made Pliny say the magnet stone was added to glass, the ancients used this name for it; Pliny seems to have attributed to it a power of making glass more liquid.

How the art of applying manganese to glass was first discovered is unknown, and we can only offer hypotheses as to the reason why it deprives glass of its dirty colour. Agricola thinks "it has the property of attracting the liquor of the glass in the same manner as it does iron, and cleaning and making it white, free from bubbles and greenness as it was before"; the fire then consumes the "magnes." This author is evidently under the impression that the ore of iron and of manganese are the same thing. Mr. Nesbitt gives the following analyses of Roman and modern glass.

[1] "Annales de Chimie et de Physique," for 1878. "Glass of the Ancients." (Peligot.)

ROMAN.

	Silica.	Alumina.	Oxide of Iron.	Manganese.	Lime.	Magnesia.	Soda.
Roman base (?) ...	70·58	1·80	·53	·48	8	trace	18·86
Flattened Glass ...	71·95	trace	3·45	·57	7·33	·60	15·30
Lachrymatory ...	71·45	2·15	1·02	·17	8·14	trace	16·62

MODERN.

	Silicic Acid.	Potash or Soda.	Lime.	Oxide of Lead or Iron.	Alumina.	Water.
Soluble Glass	62	26 (potash)	—	—	—	12
Crown ...	63	22 ,,	12	—	3	—
Bottle ...	54	5 ,,	20	6 ox. iron	—	—
Common Window Glass	69	11 (soda)	13	—	7	—
Plate Glass	72	17 ,,	6	2 ox. iron	2	—
Crystal ...	61	6 ,,	—	33 ox. lead	—	—
Flint ...	45	12 (potash)	—	43 ,,	—	—
Strass ...	38	8 ,,	—	53 ,,	1	—
Enamel ...	31	8 ,,	—	50 ,,	10 ox. tin	—

An analysis of window glass from Herculaneum gives a composition very nearly the same as that of to-day.

It is only lately that the presence of lime in glass has been appreciated at its real value, the want of it makes glass exposed to damp decompose. Window panes from an insufficiency of lime in their composition become so corroded and lined by the action of the atmosphere that they have had to be replaced. This was observed by Bernard Palissy, who remarks that "not only stones are consumed by the dampness of the air, but also glass, thus you shall find in the churches of Poitiers and Brittany an infinite number of panes of glass which are incised outside by the injury of time, and the glassmakers say it is the moon that has done this, but they will pardon me, it is the damp and rain which have melted part of the salt of the glass." Lavoisier distilled and condensed successively the same water in a glass alembic, and found after a hundred days that the glass had lost one gramme of its weight, and the residue of the water was strongly alkaline from the alteration the glass had undergone.

Well made glass in the present day contains from twelve to twenty parts of lime, to 100 pounds weight; this proportion has been arrived at slowly and by many careful experiments, it represents nearly equal equivalents of lime and alkali, and renders our modern glass almost unalterable. Ancient factories were always placed at the mouth of rivers, where there was facility for embarking the products of the factory, and where abundance of sand could be found, as at Belus, at Cumes and Volterno; at that time the presence of fuel, now such a "burning question," was of no importance. The Venetian workers sent to Belus for sand, and in our days sand has been brought even from New South Wales for experiment, so anxious are our manufacturers to perfect their productions.[1]

Ferrandus Imperatus speaks "of the glass stone called quocoli, which is almost like white marble, but something transparent and hard as flint, of a light green colour like a serpentine stone, and having veins like Venice talc. This being put into the fire loses its transparency and becomes more white and light, will not turn to lime, but in length of time is converted into glass." Neri says the pebbles from the river Ticino are much used for making glass. It would be an interesting experiment to try whether the siliceous bark of the pottery tree of Para (*Moquilea Utilis*) could not be converted into glass; the wood is strongly impregnated with flint, and when mixed with river clay the Indians make a strong pottery ware from the ashes of the bark. Fritte is nothing but a calcination of those materials which make glass. Abbe Spallanzani, who visited Stromboli 1788, gives a very interesting account of volcanic glass (obsidian) there: "the scoria from the volcano has nowhere been changed into true glass, except as a vitreous coating on small pieces. Other bits seemed to consist of semi-transparent vitreous threads, as fine as those of a spider's web, the heat of the volcano seeming insufficient to turn these into true glass, but when placed in the glass furnace of Pavia they were converted into glass with ease. This would appear to show that the heat of the volcano was not so great as that of the furnace, or the substance was not kept long enough in fusion." On Vulcano he found pumicestones with one end fused into a hard glass, nearly black, which gave sparks when struck by steel. These were easily fused in the furnace into true glass. The island of

[1] Lynn in Norfolk, and Alum Bay, Isle of Wight, are celebrated for the purity of their sand for glassmaking.

Lipari, which consists principally of vitrified substance, has a cavern of which the sides are composed of solid glass. He failed to make lava or pumicestone in his furnaces, they either refused to melt or became glass. Vulcano and Lipari are entirely formed by an accumulation of vitrified substance of fifteen miles in circuit. Lava means a heterogeneous mixture of vitrified substance thrown out by volcanos; the purest part is called obsidian, and was used for making mirrors. The name is possibly derived from the Greek word meaning "seeing images in." The lighter part of lava, scoria, is properly a species of glass; it signifies the vitrified particles of melted metals, it can be remelted and turned into glass. The scoria or slag from metal furnaces is often very beautiful in colour, and it seems strange it should not be more utilized than it now is.[1] Lead is found in many specimens of ancient glass. M. Chevreul found in the tomb of St. Medard-des-Prés a very fine fragment belonging to the glass called crystal which contained oxide of lead; it was heavier but more brittle than real rock crystal found in the same tomb. The recipes given by Eraclius make a very heavy but fragile glass; they all contain silicate of lead, like the mirror of Virgil. Ancient imitations of stones, glass of the time of Pliny, of the Jews in the middle ages, probably also all the little Gaulo-Roman bottles and objects preserved in museums, were made in this manner. M. Alliot gives a recipe for making lead glass, which he says is yellow, heavy, and easily melted. Merret says lead glass is not used in our works on account of its great fragility. There are hints of crystal glass in Neri's book, but M. Peligot after reviewing all these facts comes to the conclusion that there is "no proof that real flint glass was known to the ancients, and that to the English[2] should really be attributed the honour of having created in their flint glass a new product which, by the progress made in the quality and selection of the materials used in its fabrication, has become without dispute the most beautiful glassy substance which we know and which it may be possible to produce." The extreme lightness and strength of Venetian glass is due to the absence of lead in its composition, but the processes used in its manufacture were so jealously guarded that few particulars can be found of them. A manuscript treatise on

[1] Slag glass is made into common bottles under a patent of Mr. Britten's, its chief recommendation being extreme cheapness.

[2] "Le Verre": E. Peligot, Paris, 1877.

glassmaking, dated 1443, has recently been published at Milan, but the recipes given are difficult to understand as the terms used are obscure. Alum was used as a material supplying alkali early in the fourteenth century, but in the fifteenth it was forbidden as it produced bad glass. The "herba calida" reduced to ashes and brought from Syria or France, or the ashes of fern or seaweed, made the alkali; and white quartz pebbles, or white sand, (two parts of sand to one of alkali,) were to be melted with some manganese in a furnace, and the fritte thus obtained was made into glass. Fern ash, Garzoni says, made a yellow and weak glass. It is not improbable that the herb called "uznea" in some recipes really means kelp, made from seaweed, traces of which Peligot found in Roman glass. When fritte has been melted into glass, the longer the process of cooling gradually is kept up, the less likelihood there is of the glass decomposing, as the atoms arrange themselves with their poles lying naturally together. "In rock crystal, which is pure silex, and other regularly crystallized bodies, their atoms unite in virtue of regular laws, the pole of one atom uniting with the similar pole of another.[1] Such substances therefore do not decompose under the ordinary action of the elements. The lens of rock crystal found by Layard at Nineveh is as sound as it was many thousand years ago when in the form of a crystal. In the case of glass however the silex has been melted, and forced into fusion with other bodies to which it has no natural affinity; therefore its atoms, which have their poles lying in every possible direction, have a constant tendency to recover their original position when in the state of silex. For the same reason the alkalies or metals, with which the atoms of silex have been constrained by fusion to enter into union, all tend to resume their primitive state and separate themselves from the silex. There are some remarkable cases when flint glass without any rude exposure to the elements has become opaque; and we have seen specimens in which this disintegration of the same kind of glass has commenced a few years after it was made. In general however the process of decomposition is very slow, excepting in stables, where the presence of ammonia hastens the decomposition and produces upon its surface all the beautiful colours of the soap bubble. It is from the

[1] The strength and durability of a stone is greatly increased by laying it in the building in the same direction as that which it had in its quarry. A stone not so placed is said in French to be "en délit."

ruins of ancient buildings that glass is found in all stages of disintegration; and there is perhaps no material body that ceases to exist with so much grace and beauty when it surrenders itself to time and not to disease."[1] The beautiful colours on iridescent or decomposed glass are formed by thin films of disintegrated glass on which the light has been depolarised cylindrically as it were by refraction in passing obliquely through the little hemispherical cups formed by these films, of which perhaps twenty or thirty are crowded into the tenth of an inch. In salt water the decomposition of glass goes on very rapidly, as is proved by the bottles brought up from the wreck of the *Royal George*; M. Brame succeeding in producing on glass in a very short time the regular and irregular circles of decomposition by plunging fragments of thick glass into a mixture of fluoride of calcium and concentrated sulphuric acid, or by exposing them to the vapour of fluorhydric acid. White glass is much less liable to decomposition than coloured, which contains quantities of metallic oxide. "A very interesting experiment can be made by placing in the apparatus a square bar of well annealed glass. On examining it by polarized light it will be found that before any pressure from the screw is applied to the glass it allows the light to pass equally through every part of it, but when, by turning the screw, the particles have been thrown into a state of strain distinct bands will make their appearance in the body of the glass. The shape of the figures thus produced varies with every change in the strain and in the mode of applying the pressure."[2]

The stones intended for glassmaking should be very finely pulverized. Neri says "a fine sieve and plenty of dry wood bring honour to a furnace." Plutarch advises "heath" and Pliny "tamarisk" as the most proper wood for heating a glass furnace.[3] Glass can be made from calcined bones by digesting them for two or three days in sulphuric acid. M. Chaptal says "it was a pity the Scythians, who drank from disgusting skulls, were not acquainted with the art of converting them into so cleanly a substance as glass"; and he shows the possibility of forming a gallery of family effigies, moulded from glass, the produce of the identical bones of the originals, in which the likenesses might be preserved as truly as by the painter's art, an entirely new kind

[1] Sir David Brewster.
[2] "Discoveries and Inventions," by Robert Routledge: 1876.
[3] Lardner's "Cabinet Encyclopædia," vol. 115.

of *memento mori.* A skeleton, he adds, "of nineteen pounds weight will yield five pounds of this phosphoric glass which, when first made, will emit strong electric sparks, but this property ceases after a day or two." On extracting the phosphorus from bones, the residue consists of lime and phosphoric acid, this can be readily turned into glass. Bone glass, which is now manufactured in France, can be worked with the same facility as any other glass, and possesses the valuable property of not being attacked by fluoric acid.

Owing to the presence of metallic oxides in alkaline carbonates or quartzous fragments, the production of a coloured glass would be easier and of earlier date than a pure and colourless vitrifaction. The surprising brilliance of many ancient colours found in glass, pottery, and paintings, has incited chemists to devote much time and labour in endeavouring to discover the secrets of their manufacture. Klaproth, Minutoli, Davy, and a host of learned professors have aided in this research. But, though we know with certainty the substances anciently used, we are yet far from understanding all the old methods of manipulation, as Winston[1] warns us that "the same colouring matter produces different tints according to the different degrees of heat or length of time occupied in fusion, thus analysis of ancient glass will not help workers as much as might be expected." Some chemists direct blue to be made with filings of copper, then suboxide of copper yields a red colour, while copper which has received its full proportion of oxygen gives a green.

Klaproth gives the following analyses of three specimens of Roman glass from Capri:

OPAQUE RED.

In 200 grains:

Silica	142 grains.
Oxide of lead	28 ,,
Oxide of copper	15 ,,
Oxide of iron	5 ,,
Alumina	2 ,,
Lime	3 ,,
	195 ,,

[1] "Inquiry into Glass Painting": 1867.

OPAQUE GREEN.

In 200 grains:

Silica	130 grains.
Oxide of copper	20 ,,
Oxide of lead	15 ,,
Oxide of iron	7 ,,
Lime	13 ,,
Alumina	11 ,,
	196 ,,

SEMI-TRANSPARENT BLUE.

In 200 grains:

Silica	163 grains.
Oxide of iron	19 ,,
Alumina	3 ,,
Oxide of copper	1 ,,
Lime	0·5 ,,
	186·5 ,,

Ancient workers appear to have had fewer varieties of red at their command than of other colours, and the same fact is observable in all ancient potteries, where dull reds are only used as foils to the brilliant blues and greens. One of the reds found in glass, probably derived from *minium*, has all the intenseness of rosso-antico with the brightness of glass, thus combining the properties of a rich enamel; there is another semi-transparent red which, when light is passed through it, appears of a dull green colour. Dr. Percy thus describes a fragment from Nineveh, "the surface of which was dull and green, as though encrusted with green carbonate of copper. This colour was superficial, the glass itself was opaque and of a fine sealing-wax red colour, due to suboxide of copper, the external coating due to atmospheric action on the surface of the glass, and consequent conversion of the suboxide into green carbonate of copper." Probably ferruginous earth was the principal substance by which all reds, violets, and yellows were obtained; for common red this is sufficient, but when pure clear glass of a lovely red hue and free from flaws is required, iron is not fit, because its colour by continued heat either disappears or becomes blackish and dirty. German artists in the last century employed gold, and made artificial rubies which deceived many connoisseurs unless they

were tried with a file. The substance they used was called "gold purple," and was supposed to be made by Cassius.[1] Something of this kind was doubtless meant by old chemists, who speak of gold, chief of metals, last and most perfect work of nature, and delight in phrases such as red lions, the purple soul of gold, the golden mantle, and so on. Ruby glass was a most remarkable production; though it might have been produced in ancient days it was certainly reinvented and brought to perfection by Kunckel, 1679, when director of Potsdam. He never left full directions for making ruby glass, but affirmed that he could produce it without gold. It is now known that a perfect ruby colour can be got with copper, but the manipulation is difficult and the result uncertain, a little more or less exposure to heat producing different tints. Eraclius says in making carbuncles use gold separated from all salt. M. D'Arcet says that during the French revolution, when it was proposed to melt all the ruby glass in the church windows for the sake of obtaining the gold which it was supposed to contain, the chemist who was charged to ascertain by experiment the probable quantity of gold derivable from this source, on analysing some pieces, found that the principal colouring matter was composed only of a weak proportion of copper and iron; thus the threatened destruction of the glass was arrested. Pliny describes the non-translucent red called hæmatinum, and also mentions protoxide of iron for colouring strong red glass. Some think a red glass called gallien was so named from the Greek word for beauty; some say it was derived from Gallienus, under whose reign the arts were cultivated and encouraged in Rome.

The culminating triumph of Egyptian colouring was the famed "bleu de Nil," unrivalled to this day. Pliny says it was the most beautiful colour in the world, a judgment posterity seems inclined to endorse. Theophrastus describes it as being originally invented by a king of Egypt, and made there in great quantities. We know the Egyptians got tin used in their white enamels by commerce, and they also got cobalt (called saffre by old chemists) from India. Fourcroy says cobalt was unknown to the ancients, and though used before was only recognised as a metal by Brandt, a Swede, 1732; but ancients, like moderns, might have employed cobalt without knowing it was a metal.

[1] Beckmann's "History of Inventions."

At all events we know from conviction that the beauty of some Egyptian blues must have been due to cobalt. Sir H. Davy thinks probably the ancients took it to be a sort of copper; he examined numerous antique blues from various parts, and found copper in many blue and green pastes, but "though I experimented on nine different specimens of ancient transparent blue glass, I found no copper in any, but cobalt in all. If M. Hachette or Klaproth found copper in blue glass, I imagine it must have been opaque." Davy found in Pompeii a small vase filled with a pale blue colour, which he says was a mixture of lime and Alexandria fritte. Nestorius imitated Alexandria blue at Pozzuoli, and gives the composition thus: carbonate of soda, 15 parts; flint pebbles, 20 parts; filings of copper, 3 parts. This mixture kept at a great heat for two hours gave him a fritte which pulverized was a beautiful dark sky-blue. Vitruvius gives this same composition for Egyptian blue. Davy thinks this same blue was used in painting the baths of Titus and the "Aldobrandini marriage." These azures have not changed at all.

Pliny describes one method of making these blues thus. "There is a kind of paint made from the ultramarine sand. This paint is procured by rubbing or washing out the sand, and is (when made) of a brighter colour than the sand itself." Theophrastus speaks of copper being "used to give beautiful colour to glass," it is probable the Greeks took cobalt for a sort of copper. Cardan speaks of "zaffer" without clearly knowing what it is, and seems to confound it with "magnes lapis" as some ancients called manganese. "Syderion, which Italians call manganese is an earth very fit for clarifying glass, tinging it of a cærulean hue, and some people call this zaffer." Minutoli[1] describes an amulet of transparent blue glass which was dug up in ancient Memphis; it is cast, and represents in low relief a beetle with the head and outspread wings of a hawk, carrying a globe, which he thinks would indicate the use of cobalt at a very early date. Analysis shows that opaque blue glass in Memphis owed its colour to copper, semi-transparent to manganese and cobalt, and black to iron. Davy says blue glass from Etruria and Greece owed its colour to cobalt, but more recent specimens of

[1] Minutoli established at Liegnitz in Prussia an institute for educating artisans, which seems very rich in glass models and fragments; he also wrote in 1836 a learned work on the use of glass by the ancients.

Gallo-Roman glass to copper. Theophilus says most ancient writers have confounded lapis lazuli, lapis Armenus, blue jasper coloured with carbonates and arseniates of copper, mountain blue (bergblau of the Germans), one with another, and errors have arisen which even now are to be dispelled. The Persian lazoard blue is probably the origin of the term "lazu." Persians are very fond of ultramarine blue, and use a great deal in their coloured illuminations, but Persia only produces blue copper ore (the male cyanus), real lapis comes from the Tartary mountains in Bokhara, extending east from the Caspian.[1] "The true lapis lazuli is permanent, that which is placed on the fire does not change colour, this is the legitimate, it is mostly brought from the east; that found in Germany is not permanent, it is lasurstein, and this is the mean between the Armenian stone which is friable and the lapis which is equal in hardness." Some old blue glass[2] was coloured with iron, but since the discovery of cobalt the art of obtaining blue from iron has been neglected.

M. Girardin analysed a blue bead from the Roman tombs of Cany, and found in it traces of iron and magnesia, the colour was due to oxide of copper. The Roman workers were able to produce blue, green, purple, or amethystine, amber brown and rose colour in transparent glass, of these there are several tints of blue; in opaque colours they succeeded in making white, black, red, blue, yellow, green, and orange. Of opaque blues there are about ten varieties, and of green not so many; many of these colours are mixed together, and opaque and transparent hues are mingled when imitating agates, and other stones sometimes; this admixture of colours produced a gaudy effect, but in the generality of cases the result is harmonious. Mr. Nesbitt gives the usual glass colours as obtained from the following materials: yellow, from charcoal, antimony, or silver; a peculiar canary yellow from uranium; red from suboxide of iron, oxide of copper, and from gold; brownish red from protoxide of iron; green from protoxide of iron, oxide of copper, of chromium, and mixtures of oxides of nickel and uranium; blue from cobalt, also from iron; amethystine from manganese; brown perhaps

[1] The loss of four chapters on coloured glass in the manuscript of Theophilus is much to be regretted, they leave a void in the history of the art of that age.

[2] Can this be the steely blue glass which is found in old church windows up to the fifteenth century, which is not due to cobalt?

from the same; orange from peroxide of iron with chloride of silver, also it is said from arsenic; black from scoria of iron or charcoal. But these lists of names do not assist the worker much; the art of colouring glass is very subtle, and requires great care and skill on the part of the artificer; much depends on the proper adjustment of the degrees of heat, and the length of time the glass is kept in fusion, a very slight difference in the quantity of some one ingredient may produce very great difference in the result. In fact knowledge and experience on the part of the artificer would seem to be of much more importance even than the kind of oxide employed. The writer has been assured by Mr. Hawkes, a gentleman who for many years was engaged "con amore" in repairing the coloured windows of French cathedrals, that he could produce every colour by the use of iron alone. M. Bontemps' authority confirms this assertion, at a meeting of the British Association at Birmingham he brought forward some very extraordinary facts in connection with the colouring powers of different bodies. "He showed that all the colours of the prismatic spectrum might be given to glass by the use of the oxide of iron in varying proportions, and by the agency of different degrees of heat, the conclusion being that the different colours are produced in their natural disposition in proportion as the temperature is increased. Manganese, copper, silver, gold, and charcoal were all found to produce corresponding results; gold for instance giving a great many tints varying from blue to pink, red, opaque yellow and green. M. Bontemps was of opinion that in the case of manganese light is the agent which produces change, and doubted whether any change in the oxidation of the metal will explain the photogenic effect. He is disposed to refer the chromatic changes in most if not all cases rather to some modifications of the composing particles than to any chemical changes in the materials employed." Analysis of ancient glass has shown that various colours have been obtained from the same metal; thus Roman opaque red glass usually contains copper, but it has recently been shown that oxide of iron and not copper was in some cases the colouring agent. M. Peligot points out that the simple action of light colours glass yellow, rose, and violet. Mr. Gaffield, of Boston, cut a piece of glass into squares and exposed each piece to sunlight, one for a week, the next for two weeks, and so on up to ten. The yellow colour came first, then appeared rose, each week making a dis-

tinct difference, which was not effected by heat alone; it is the action of sunlight. M. Peligot gives this interesting account. "The curious drops of glass ending in a very fine delicate point, known as Batavian drops or Prince Rupert's tears, are made by dropping very liquid glass into cold water. They give the highest point of the fragility of glass; they have the singular property of resisting the blow of a hammer on the thick end, whereas the slightest break at the thin end reduces them into powder with a violent explosion. They were first brought into England in 1661. When the drop of glass falls into the water the outside cools suddenly, while the inner part is still red hot; when this has cooled, it is kept in a state of great compression by the outer layer to which it is fixed. Berzelius compares this bursting of the glass by the destruction of its solidity to that of a piece of stuff very tightly stretched, which resists the tension while it is whole, but the slightest cut makes it tear at once."

Enamel is a glass (opaque) with a ground of lead and tin, which melts on the surface of glass at a temperature which only softens the latter. The dust from enamel is very dangerous to the health of workmen employed in making it. M. Paris has invented a sort of indiarubber muslin mask to prevent the worker from breathing the dust, but the men are so careless that it is little used. Aventurine is a transparent yellow glass in which are fused numerous little particles of copper (or silicate of copper), it imitates exactly the sort of gold stone which is often mixed with lapis lazuli. It was invented about the beginning of the seventeenth century by one of the Miotti family, and was long preserved as a trade secret. Aventurine and the glass imitation of chalcedony do not melt at the same heat, and the secret of mingling the two compositions together as is done for the handles of walking sticks, beads, and other objects, was for a long time only known to one old workman in Murano; it has however lately been successfully practised by the Royal Society of Murano, who have also succeeded in faithfully copying the celebrated "coppa nuziale" of the Correr museum at Venice; it is of a beautiful sapphire colour, enamelled with figures and landscapes and medallion portraits of the bridegroom and bride. This was shown in the Paris Exhibition with a copy of the famous tazza of St. Mark's, enamelled with various colours and gold, and having round it medallions and Coptic inscriptions.

GLAZES.

Glazes are glassy substances made of metallic silicates and borates; the materials composing them are usually quartz, flint, felspar, gypsum, borax, boric acid, common salt, potash, soda, and red oxide of lead. Some glazes are first formed into "frits," imperfectly vitrified bodies, and then pounded for use. Mr. Franks suggests that a knowledge of glazing would travel with the wheel. Very ancient Chinese pottery was glazed, though its composition does not appear to be exactly known; those glazes we see on their earliest wares would seem derived from the same substances as those now in use, a mixture in which felspar forms a chief ingredient, and which requires very high firing to melt.

Small glazed objects in Egypt belong to the sixth or possibly earlier dynasties. These objects are generally made of grains of sand, cemented together by some vitreous matter, commonly silicate of soda; this substance was shaped in moulds and covered with a greenish blue glaze due to a silicate of protoxide of copper and soda. This cupreous enamel seems to have been largely used; these glazed frits are often incorrectly known as Egyptian porcelain. Many objects in the British Museum are carved in some steatetic substance resembling soapstone, then covered with a cupriferous glaze, and exposed to the necessary heat for vitrifying it; the cavities have then been filled in with coloured pastes, as these cavities are lined with greenish glaze they must have been carved previous to glazing. Mr. Franks thinks the Egyptian mode of enamelling frits composed of siliceous sand cemented by alkaline silicate was introduced by Mahommedans into India, where we find frits enamelled with different coloured glasses and then cut to form a mosaic design, embedded in a wall of chunam; the pedestals of idols are so treated. These frits have been used in India since the thirteenth century, and it is said they are still made in Scinde. Sir G. Birdwood describes the glazing and colouring of Indian pottery as made of "kanch," literally glass and oxides of lead. In the Punjaub the two kinds of glaze used are distinguished as English glaze and country glaze. The art of glazing pottery in India is said to have been introduced from China by the influence of Tamerlane's Chinese wife, and the custom of ornamenting walls with glazed tiles is contemporary with the Mongol conquest of Persia, where the art of glazing had descended from Assyrian traditions in an unbroken line. Some of the Burmese

glazes are said to resist the action of acids. The glazes from Nimroud are formed of silicate of soda with lead coloured by metallic oxides. But the analyses of glazed wares from Babylonia made by Salvetat and Dr. Percy give different results, so it is possible they used different kinds of glaze. Dr. Birch thinks glazed vases coeval with the dawn of Hellenic civilization, perhaps nine or ten centuries B.C. The glaze on Greek vases is very fine, thin, and lustrous. The recipe for making it appears to be lost, it has been fused by baking, but yields neither to acids or the blowpipe. Hausmann considers it a varnish, of which soda, saltpetre, borax, and salt are supposed to have been the ingredients used; there is no lead found in it. It is far inferior to our modern glazes as it is permeable by water, but cannot be decomposed by the same chemical agents. The black glaze found on some Greek vases is supposed to be a volcanic substance spread with a brush over the portion required, and the vase exposed to sufficient heat for its fusion. The Kabyles in North Africa, who derive their pottery by tradition from the Greeks and Romans, use a varnish made from resin, and succeed in producing very strong vases in which they carry oil, water, and various liquids.

The glazes used in some ancient potteries are infinitely harder than those now made, though ancient Bristol ware seems to be an exception, as at the burning of the Alexandra Palace, in which a great deal of porcelain was destroyed, some specimens of Bristol china were found with the entire glazed coating remaining untouched by the heat of a fire which had completely burnt out the clay composing the body of the object. The phenomena of devitrification can be induced in all glass (easily in inferior, with difficulty in the finer kinds) either by slowly cooling it from a state of fusion, or by heating it in a mixture of sand and plaster of Paris till it softens, and cooling slowly. It loses its translucent and amorphous character, and by the formation of innumerable minute crystals becomes opaque. When such a change penetrates the entire mass, it assumes a milky, porcelain like appearance, and in this condition is known as Reaumur's porcelain. Devitrification renders the material much harder and less fusible than the same glass in a transparent state, and less subject to fracture on the application of heat. It has been suggested that some invention of this kind might be applied to making cooking utensils of glass. The existence of an Egyptian glass porcelain

has already been noticed. The application of spun glass to textile fabrics has perhaps hardly received the attention it merits; the colours would be extremely fine and unalterable by weather, a great recommendation for banners and many other articles used in our uncertain climate. It has been proved in Germany that large masses of glass make better millstones than the French "burr." A Mr. Thom has cast large blocks of hard glass, six to twelve inches thick, and four and a half feet in diameter; they grind smoother flour than burr, and always remain cold, so the flour does not get heated; they do not wear out faster than stone. An old suggestion that our roads might be paved with cubes of glass does not now seem an impossibility; if the slipperiness could be obviated, a city paved with glass could surely be kept clean.

NOTES.

NOTE A.—TRADE WITH INDIA.

NUMEROUS ancient writers seem to agree that the commerce of the world was in the hands of the Arabians and conducted through the Red Sea. Actual history begins for us with Senefroo, third dynasty, 4235 B.C., the explorer of the copper mines of Wady Magarah, and the conqueror of Arabia, whence he would no doubt have drawn tribute. A papyrus found at Karnak records in detail the great battle of Megiddo between Thoutmes III. and one of the kings of Palestine. This campaign seems to have assured to Egypt the submission of the neighbouring countries, and extended her power to Nineveh and possibly to India itself. We find in Exodus xxx. 23 that cinnamon was one of the ingredients used in preparing the anointing oil. Now cinnamon is one of the peculiar products of India, Ceylon, and the Eastern Archipelago; and Herodotus, some twelve hundred years later, says Arabia is the last inhabited country towards the south, and the only region of the earth which produces frankincense, myrrh, and what we, instructed by the Phœnicians, call "kinnamon"; he also states that the Arabs were unacquainted with the particular spot in which it was produced, but some asserted it grew in the region where Bacchus was educated, from which we infer it was the product of a distant country, possibly India, and was obtained by the route of the Red Sea. In Dr. Vincent's disquisition on a work called the "Periplus of the Erythrean Sea," he says, the most ancient record of trade between Arabs and others is found in Ezekiel, and this trade must have been carried on before the siege of Tyre and must have been at its height long before any visits paid to the Red Sea by Greeks or Romans. "All this induces a belief that in the very earliest times, prior to Moses, the communication with India was open, that the intercourse with that continent was in the hands of the Arabians, that Memphis had owed its splendour to that commerce, that Thebes from the same cause came to the same preeminence, and Cairo succeeded to both in wealth, grandeur, and magnificence." Pliny records that a regular communication was known to be open between Arabia, India, and parts beyond, and the Arabs who were established at Ceylon were receiving the trade of China from the Chinese who had reached that island, and the father of the rajah who came on an embassy to Claudius had been in that island. We read of Sabea or Yemen the blest, "the people are robust, warlike, and able mariners; they sail in very large vessels to the country where the odoriferous commodities are

produced, they plant colonies there; in fact, there is no nation on earth so wealthy as the Gerrhei and Sabei, as being the centre of all the commerce which passes between Asia and Europe." Herodotus says Pharaoh Necho, 610 B.C., sent Phœnicians down the Red Sea, who sailed round Africa and returned to the mouth of the Nile in three years. Ptolemy Philadelphus sent Dionysius as ambassador to the princes of India, 309 B.C.

NOTE B.

STATUE OF MEMNON.—"The more northerly of the two statues at Karnak is that colossus of Memnon, so renowned among those travellers who in the two first centuries of Roman dominion in Egypt visited the land of the Pharaohs. Destined by Amenophis as an ornament to the façade of his temple, the colossus had been known to all the world as his statue till the upper part was destroyed by an earthquake, 27 B.C. By this accident the colossus became celebrated. It soon appeared that from the headless trunk a sonorous ringing sound, resembling the human voice, was heard when the first rays of the morning sun fell on the statue. Doubtless this effect was caused by the crackling of the stone wet with dew under the influence of the sun's rays; but it was looked on as a miracle by Greeks and Romans. Memnon was the legendary founder of this part of the city. Was not the voice thus heard Memnon plaintively imploring his divine mother, Aurora? The fame of the phenomenon spread, people came from all parts to hear the marvellous voice, and the mania rose for engraving on the legs of the statue inscriptions betokening the admiration of those fortunate enough to become witnesses of the miracle. The most ancient of these are in the reign of Nero. After two centuries, Septimus Severus, thinking to stay the plaintive cries of the hero and to impart clearness and beauty to his voice, restored the colossus: all sound was effectually smothered and for ever silenced under the blocks of sandstone we see to this day. Here are two of the inscriptions: 'He announces the return of day to the mortals here assembled, complaining to his mother of the outrage of Cambyses'; 'Twice, oh divine being, I have heard thy voice when the sun left the majestic waves of the ocean.'"[1] Sir A. Smith visited the statue of Memnon in 1820, with a numerous escort, and says: "At six in the morning we heard very distinctly the sounds so much spoken of in former times, and which have generally been treated as fabulous." He attributes the sounds to a certain arrangement of the stones. —("*Asiatic Journal*," 1821.)

THE recent discovery of a carefully hidden royal mausoleum at Thebes has brought to light the mummies of twenty kings and queens, and those of sixteen persons connected with them. Many of these mummies appear to have been brought from other tombs and placed for greater safety in a vault constructed at a depth of forty feet below the surface of the soil. Among the valuable objects (nearly six thousand in number) recovered from this vast tomb are some rare papyri and many articles in alabaster, bronze, glass, and wood. The mummies

[1] "Monuments of Upper Egypt," by Mariette Bey: 1877.

date from about 1700 B.C. to less than 1000 B.C., and the presence of many glass objects confirms the impression that during the eighteenth dynasty glass-making was much practised in ancient Egypt. The especially beautiful coloured glass goblets found with the funeral equipage of Queen Isi-em-Kheb belong to the comparatively modern age of less than 1000 B.C.

NOTE C.

LANGLÈS thus describes the travelling tent of Nadir Shah, 1736. The outside was covered with red cloth, the inside lined with violet satin, on which was represented birds and all animals of creation, enriched with pearls, rubies, emeralds, amethysts, and other precious stones. At each side of the throne (formed as a peacock) stood a screen on which was embroidered in diamonds two angels; the piquets were of pure gold, the whole concern in travelling took seven elephants to carry it. It was always placed on fête days in the salle du divan in Herat. Nadir Shah carried his conquests into India, and brought away enormous treasures from the moguls of Delhi. The blaze of jewels exhibited by Futteh Ali Shah to Sir R. Porter formed part of these Indian spoils.

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