

THE GLASS INDUSTRY

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THE FLOOR OF HEAVEN

The Definition of Glass

By DR. FRANK W. PRESTON

καὶ ἐνώπιον τοῦ θρόνου ὡς θάλασσα ὑαλίνη ὁμοία κρυστάλλῳ

Rev. 4. 6.

καὶ εἶδον ὡς θάλασσαν ὑαλίνην μεμιγμένην πυρὶ καὶ τοὺς νικῶντας.....ἐστῶτας ἐπὶ τὴν θάλασσαν τὴν ὑαλίνην, ἔχοντας κιθάρας τοῦ Θεοῦ καὶ ᾄδουσιν τὴν ᾠδὴν Μωϋσέως

Rev. 15: 2—3.

"And in front of the throne there is what resembles a sea of glass, crystal-clear like ice; And I saw this thing which resembles a sea of glass mixed with fire, and the victors standing upon the glassy sea, with the guitars of God in their hands; and they sing the song of Moses."*

The word "glass" is an ancient one, and of good repute, but of poor definition. It is used by the most reputable of authors, including St. Paul and St. John the Divine, so that its significance might almost be ascertained on divine authority. And many others have used the term throughout the ages, in the English language, and in other languages, and their right to use it has rarely been gainsaid, though they have used it to mean almost anything, and almost everything.

The question therefore, "What is glass?", cannot be answered, because it cannot be asked. The question itself is meaningless, a tale told by an idiot, signifying nothing. It is a Humpty-Dumpty word, and means whatever the speaker wants it to mean.

Therefore, I have refused in times past to testify as to its meaning, because it has all possible meanings, including many exactly opposite meanings, and, all things considered, it is a very fine word that should not be spoiled by being defined.

If it is decided that it must be spoiled, any definition should state the purpose thereof, and the limits within

which the definition is expected to hold; for there can be no comprehensive or all-including definition. We might proceed as follows:

"For George Morey's purpose, and for the purpose of certain other physical chemists, glass is an undercooled liquid (at room temperature, or some other temperature hereafter to be defined): but since not all undercooled liquids are glasses, (e.g. undercooled water is not usually so considered) page George Morey if you have an undercooled liquid and want to know if it is a glass."

"For the purposes of B. E. Warren and them that sport with x-rays, glass is a higgledy-piggledy arrangement of atoms, in which the coordination number requirements are taken care of, but the atoms are not 'arrayed'."

"For simple souls like myself, glass is a product of the glassmaker's art; if it is a substance made largely of sand, smelted in a furnace of some 2000° to 3000° F., calling for tizeurs (teasers), and after cooling down is a brittle substance most economically cut up by glaziers, wielding diamonds or glazier's wheels; or if, while not necessarily or usually so cut, it can be so cut, then it is glass. The behavior of the thing toward the glazier's wheel is, in fact, perhaps the best discriminant as to whether a thing is glass or not."

"From the point of view of Law, or of Commerce, glass is an artificial product (there is no trade in 'natural glass'), sold to the public and represented to

be hard (five or six on Mohs' scale), durable, and fire resistant. Unless some qualifying adjective is used, it contains volumetrically, and usually by weight, more than 50% silica; it will not char, or burn; it will not fuse at less than a red heat; and it is made by fusion in a high-temperature furnace."

These are definitions of a product or article; they are not definitions of a *word*. The word "glass," and the adjective "glassy," and the corresponding words in other languages from ancient Egyptian down to the present day, have many other meanings. These meanings are legitimate, in that a man is trying to say something for his hearer's or reader's benefit; he is often using the word in a more or less metaphorical sense, but he is trying conscientiously to give the right impression, to explain things in a way his listener will understand.

When applied to a *product*, especially to a product which the discourser hath an interest in selling, and when he coveteth the greater gain by describing as glass some thing which conventionally is not glass, then is the use of the term illegitimate, improper, and deceitful. Such foul use of a noble term proceedeth from the mouths of caitiffs, rapsallions, and knaves; and it shall nought avail them that saints have described as "glass" that which may turn out to be a Heavenly Plastic or polymerized resin.

I return now to Saint John, and what he said nigh nineteen hundred years ago. The authorized version of the English Bible does not give too good a rendering of John's Greek: I have ventured to try to improve it. It is a convenient and happy quotation, since the words "glass" and "crystal" both occur in it, and neither of them has anything like its present meaning, certainly nothing like its present *technical* meaning. To help matters out, the word "sea" also occurs, twice, and it does not mean sea, as is perfectly obvious, since the victors stand on it.

The English, authorized, translation says, "there was a sea of glass." What John says is, "(there is) *as it were* a sea of transparent stone" (hyaline), in other words, a vast expanse of shining polished floor, like the vast shimmering sunset sea that stretches west from Patmos. John several times uses the word "sea" to express the idea of a vast space, and perhaps once or twice to mean "space" in its scientific sense.

The transparent stone (hyaline) is apparently a material used in Egypt in certain coffins for mummies. The word itself is Egyptian. By the time of Pliny, Egyptian glass had apparently reached a stage of transparency that warranted its being called hyaline. * * So John does not warrant that the floor of heaven is vitreous, that its atoms are higgledy-piggledy, or that it is in danger of devitrifying when Morey gets there. It is merely hard, shiny, transparent (or at least highly translucent), and vast in extent.

". . . a vast expanse of polished floor, like unto crystal." The Greek word is *crystallos*, but *crystallos* means primarily clear ice, and secondarily, rock-crystal or quartz. Ice and quartz are often vastly clearer and more transparent than ancient glasses, or even our modern glasses, and what John is saying is, that the floor of heaven is more brilliant, purer and clearer than mummy-coffin material, carefully selected though this may have been. * * *

Thus John in a simple short sentence uses the words "sea," "glass," and "crystal," in senses far removed from their modern technological, legal, or commercial significance; and I have no fault to find with him, or with others, who, struggling to express the inexpressible, follow his example and do the best they can.

It is only when deceit, and the lure of lucre, enter in, that departures from modern exactness become reprehensible or inadmissible.

Before we turn from St. John to St. Paul, it might be noted that John uses the word "glass" twice in Revelation, and each time in the same phrase ("a sea of glass, as it were"), and each time the word is *hyaline*. This necessarily reminds our later generation of the French "Mer de Glacé" or Ice-Sea, upon Mount Blanc. And here it is worth noting that whereas, in English, glass and ice are two different words, and cannot be exchanged at all, in French, "Glacé" means first, clear ice, and then clear polished-plate glass. In Greek, it is crystal and ice that are confused, in French it is ice and (plate) glass.

From the purely human angle, it is not difficult, I think, to see the picture that John was painting. The aged Saint in his exile had seen the summer sun go down across a tideless, waveless, shimmering sea. The most splendid moment was when the sun's disk had cut the horizon, and a broad highway of light stretched from the cliffs of Patmos to the setting sun. There is no more impressive scene in nature than such a sunset.

The blazing sun upon the horizon is the effulgent throne of God; the vast expanse of sea "clear as ice" yet "mixed with fire" (the pathway to the sun) is a fitting floor of heaven. Solidified to glass, it will support the saints, many of them already dead at the hands of Roman sadists and Jewish fanatics. Perhaps some fire-edged western clouds suggested by their wierd outlines the strange beasts of the apocalypse: after two thousand years people still trace such images in the sunset clouds.

A minute or two passes: the sun is disappearing fast: in the gloaming the sea becomes in fact the floor of heaven. Upon its vast expanse is standing a countless multitude of saints and John is no longer alone; they are not silent ghouls, no pale wraiths of the past, but the troubadours of heaven, a victorious host, facing the throne, and to the accompaniment of their singing guitars, they raise the Battle Hymn of the Republic. "I will sing unto Jehovah, for he hath triumphed gloriously," the paean that Moses composed some sixteen hundred years before, the Song of Redemption, when the quicksands of the Red Sea were safely past, and the pursuing tyrants overwhelmed.

We turn to St. Paul: I Corinthians 13, 12: 2 Corinthians 3, 18. (We see as in a glass, darkly.)

Paul is not speaking of hyaline, but of a mirror, a very imperfect mirror, made of speculum metal, probably tarnished, and certainly far from flat. The word is "eisoptēr," or "catoptēr," a thing you "look into," or "look down on" (for the purpose of seeing a reflection). There is no glass involved: the modern equivalent would be a piece of tin-plate, that ignoble, poisonous, and imperfectly-reflecting competitor of glass. Paul

(Continued on page 38)

THE FLOOR OF HEAVEN . . .

(Continued from page 62)

condemned it nearly two thousand years before it was invented.

Thus, so far as the English Bible is concerned, the word "glass" includes speculum metal and the tin can; and since this kind of glass is condemned on such high authority, I have no objection to his use of the word.

Now Archimedes, also in very ancient times, is said to have invented the "burning glass," and to have burnt up the enemy ships in the Harbor of Syracuse, Sicily. He probably used quartz; or if not, it is certain that burning glasses have in much more recent times been made of quartz crystal. Any convex lens suitable for starting a fire by forming an image of the sun upon tinder, is a burning "glass," independently of the fact that it may be made of crystalline quartz, or of CR39, or Plaskon, or Lucite.

It seems, therefore, that for literary purposes, a "glass" is anything transparent and hard, like oriental alabaster, or quartz; anything that is reflecting, and hard, like speculum metal or tin-plate; anything that can form an image of the sun, like a concave mirror or a convex lens, whether of quartz, plastic or modern glass; a highly polished floor; and anything cold, inhuman, or dead, like a glassy stare.

It can be crystalline or amorphous, real or metaphorical, metallic or non-metallic, organic or inorganic, crystal-clear or obscuring, a prototype of perfection or a metaphor for imperfection. It is all things to all men. Only those of universal sympathies can appreciate it, only citizens of the world can understand it. It is the word men use when they are completely stumped. It should not be used on other occasions.

*The Song of Moses will be found in Exodus 15.

**The noun is hyalos. John uses the adjectival form, hyaline.

***In parenthesis, we note that the English authorized version says "they stand on the sea with the harps of God", which gives the wrong impression to a modern reader; for you cannot stand and play a modern concert harp. You have to sit. Therefore the saints do not have harps: what John says is, that they have "kithars", that is "guitars"—it is the same word come down through the ages. So I have once more taken the liberty of amending the English version.

SAFETY MEASURES BROUGHT TO SMALL INDUSTRIAL ORGANIZATIONS

The National Safety Council has inaugurated a new membership service designed exclusively to fit the needs of industrial organizations with 100 employees or less.

A recent survey of organizations of this size, in seven different industries, showed the average accident frequency rate for these organizations actually 47 per cent higher than the average for the largest organizations in the same industries.

Some of the services to be included in this membership are as follows: A safety manual on what management should know about organization and operation of an industrial safety program; monthly poster service with selections made especially for small unit operations; and a full year's subscription to *National Safety News*, the Council's official magazine, which will contain a section devoted exclusively to the problems of this type of member.



Left to right: Bert Cremers, I. H. Taylor, and E. M. Ford.

IRVING H. TAYLOR TO LEAVE WYANDOTTE CHEMICALS CORPORATION

Mr. Irving H. Taylor, former vice president in charge of sales of the Wyandotte Chemicals Corporation has relinquished this position to devote his entire time to the Merchants Chemical Company, of which he is president. Mr. Taylor is well known in the heavy chemicals industry and has been associated for thirty-two years with Wyandotte Chemicals and its predecessor, the Michigan Alkali Company.

At a recent luncheon Mr. E. M. Ford, president of Wyandotte, presented Mr. Taylor with a Commemorative Scroll signed by representatives and executives of the company.

Mr. Bert Cremers will continue as vice president in charge of sales of the Michigan Alkali Company.

NEW EMPLOYEE FOR PENNSYLVANIA SALT



Pennsylvania Salt Manufacturing Company of Philadelphia has announced the acquisition of L. H. Brandt, Ch. E., for their Technical Service Department. Mr. Brandt comes to Pennsylvania Salt from the National Ammonia Division of duPont, which position he held for more than ten years.

During his career Mr. Brandt has been identified with ammonia and other heavy chemical utilization in the fields of refrigeration, oil refining, and heat treating. In his new position with Pennsylvania Salt his services will be principally devoted to rendering assistance to heavy chemical users.

• Word has been received from the Diamond Alkali Company that Mr. Raymond Diaz joined the staff of the Diamond Alkali Sales Corporation on January 1st of this year as Supervisor of District Offices. Mr. Diaz was formerly treasurer of Benner Chemical Company, Chicago.