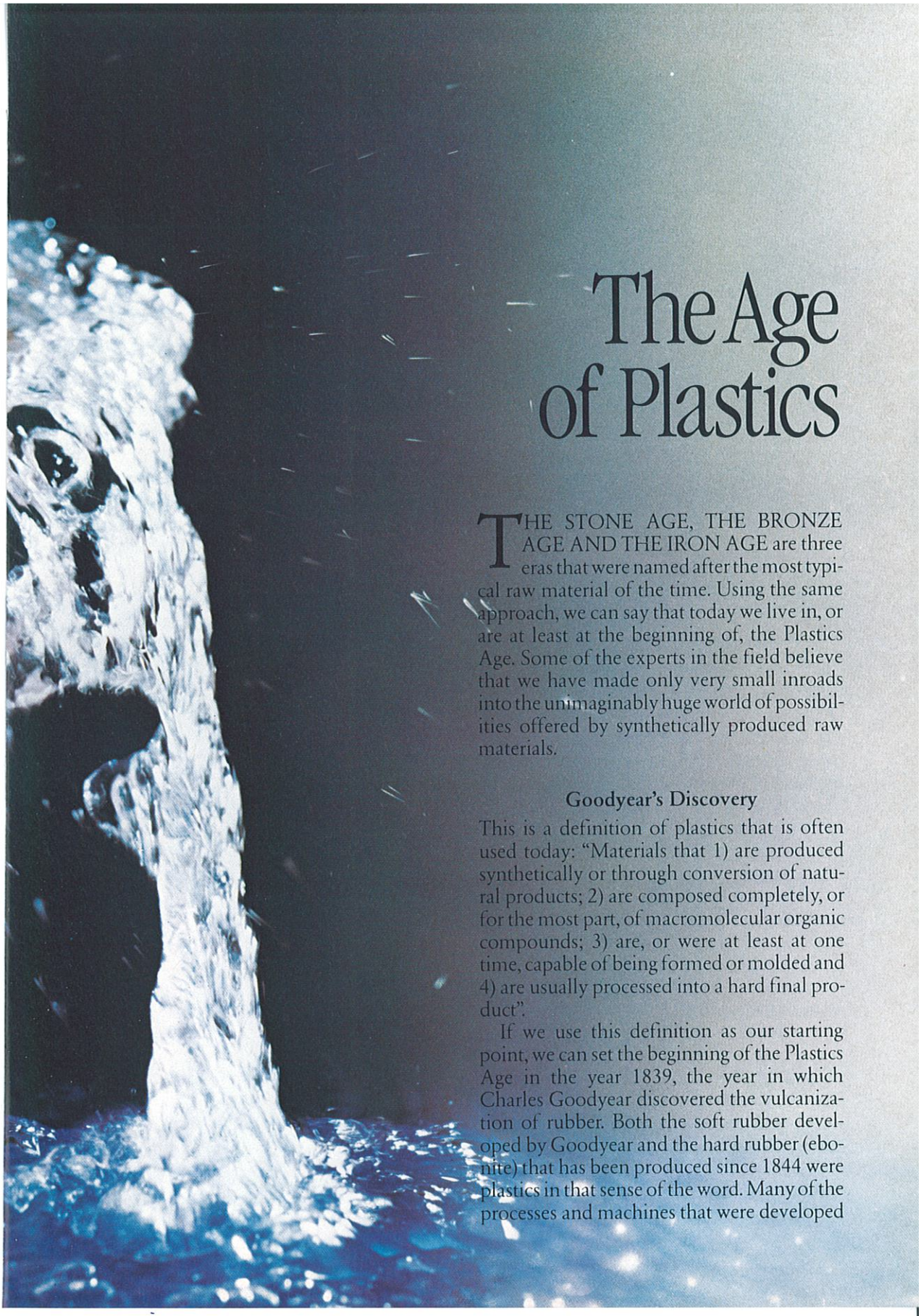


The Age of Plastics

THE STONE AGE, THE BRONZE AGE AND THE IRON AGE are three eras that were named after the most typical raw material of the time. Using the same approach, we can say that today we live in, or are at least at the beginning of, the Plastics Age. Some of the experts in the field believe that we have made only very small inroads into the unimaginably huge world of possibilities offered by synthetically produced raw materials.

Goodyear's Discovery

This is a definition of plastics that is often used today: "Materials that 1) are produced synthetically or through conversion of natural products; 2) are composed completely, or for the most part, of macromolecular organic compounds; 3) are, or were at least at one time, capable of being formed or molded and 4) are usually processed into a hard final product".

If we use this definition as our starting point, we can set the beginning of the Plastics Age in the year 1839, the year in which Charles Goodyear discovered the vulcanization of rubber. Both the soft rubber developed by Goodyear and the hard rubber (ebonite) that has been produced since 1844 were plastics in that sense of the word. Many of the processes and machines that were developed

Plate 4:1

by the rubber industry were later put to use in plastics technology.

A New Kind of Bone and Horn

There are many scientists who want to make a clear distinction between rubber and plastics technologies. At the most, they are only willing to admit to a borderline relationship between the two. For those with this viewpoint, the birth of plastics technology took place in the year 1869. At that time, the American John Hyatt invented a substitute for ivory. This was celluloid, a material that was used at first primarily for producing billiard balls.

In the year 1897, the next type of plastic material was developed. Called "artificial horn" at the time, it was a casein plastic (a casein-formaldelhyde compound). At about the same time, the production of phonograph records made of shellac began. The introduction of Bakelite in 1909 represented another and a very decisive step forward in plastics technology. Patents for Bakelite were awarded quite quickly all around the world and led to the production of a large variety of products. It is a plastic that is still in demand today.

After that, the development continued at an even faster rate. At first, plastics were used as substitutes for rare, natural materials such as ivory, horn, tortoise shell or silk. Then from 1920 on, there was an active search for new products that possessed certain specified characteristics.

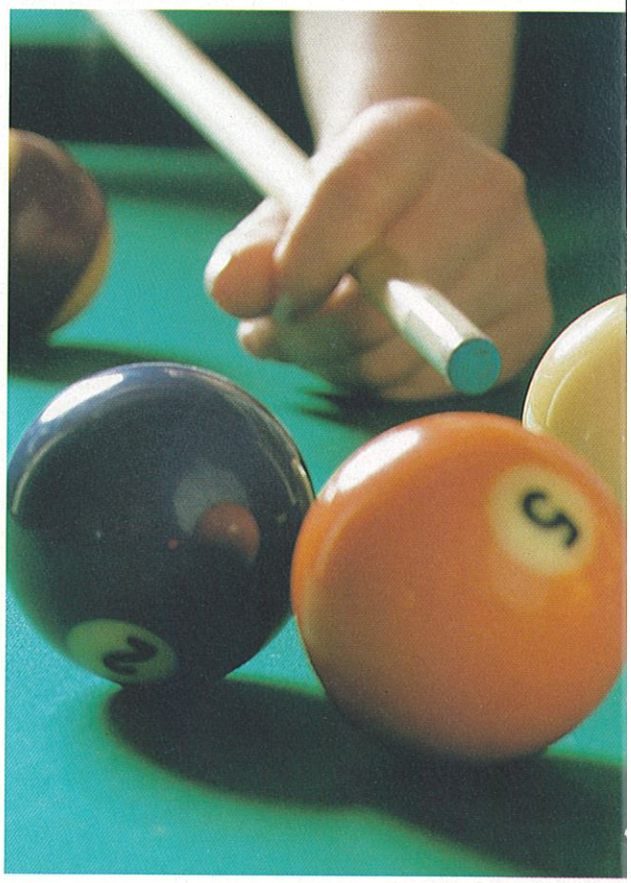
It is easier to get a better idea of the usefulness of plastic after one finds out that the volume of plastic production today is much greater than the volume of steel production.

Thermoplastics and Thermosetting Plastics

A few explanations are in order to make what follows easier to understand.

Plastics are usually divided into two main groups. One of them is known as "thermoplastics" and the other as "thermosetting plastics".

The thermoplastics are characterized by the fact that their molecule chains do not take up a completely static position in relationship to each other. That is, they become liquids when they are heated up to their melting



points and so are "plastic" or moldable. Examples of thermoplastics are polyamides, polyethylenes, polypropylenes, polystyrenes and polyvinyl chlorides.

In the case of the thermosetting plastics, the molecule chains are so incapable of changing their positions in relationship to each other that once they have been given the desired form, they cannot be reformed through heating. Among the thermosetting plastics are the amino plastics, epoxy resins, phenolic resins, unsaturated polyesters and others.

Plastics and Polymers

Up to now we have been using the word "plastic" in the nontechnical way in which it is popularly understood. In the strict sense, however, the word "polymer" instead of "plastic" should be used for substances consisting of long molecule chains (macromolecules) built up through polymerization, polycondensation or polyaddition from small hydrocarbon molecules (monomers).

The gas ethylene (also known as ethene) is, for example, the simplest monomer that can form giant molecules through polymerization.

Ethylene: $CH_2 = CH_2$
Polyethylene: $(-CH_2-CH_2)$

Figure 4:1

In this case, the polymerized molecule is easily one thousand times larger than its monomer.

In the strict sense of the terms, one should only use "plastic" and "moldable material" after the polymeric raw material has been combined with any of the various possible additives to make them technically ready for actual use. That is why the technical literature specializing in plastics often uses the term "polymer" instead of "plastic".

A MARKET THAT NEEDS TO BE UNDERSTOOD. The use of plastics for water systems has become quite acceptable throughout most of Europe. They have been used for many purposes from drainage to water supply to under-floor heating systems.

Nevertheless, there is still no generally accepted testimony concerning the suitability or unsuitability of plastic pipes for transporting water. The main cause for this might be the fact that plastic is a relatively new material insofar as its use for the purposes of climate control and water transport are concerned. There are still no internationally accepted testing methods. Some pipe manufacturers forego conducting any serious long-term tests. It sometimes even happens that test results are referred to in misleading ways in some of the advertising that is done.

We at Wirsbo intend this book to do what it can toward bringing to light some of the facts concerning plastic pipes. The people who are responsible for making decisions regarding the type of pipes to be used should have some sort of dependable resource at hand to guide them.

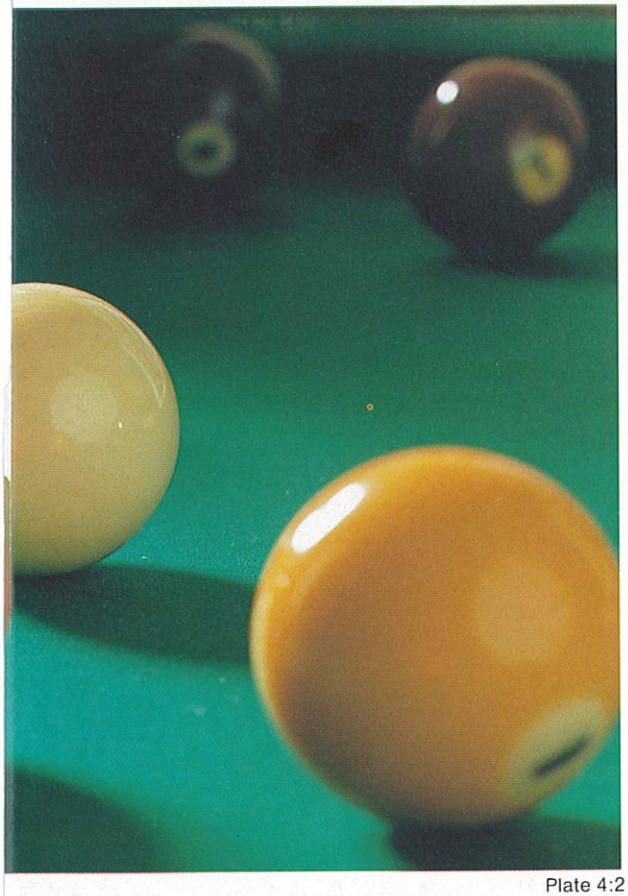


Plate 4:2

***At one time, billiard balls** were made of ivory, a very costly material. In 1869 an American, John Hyatt, invented a substitute material, celluloid.*