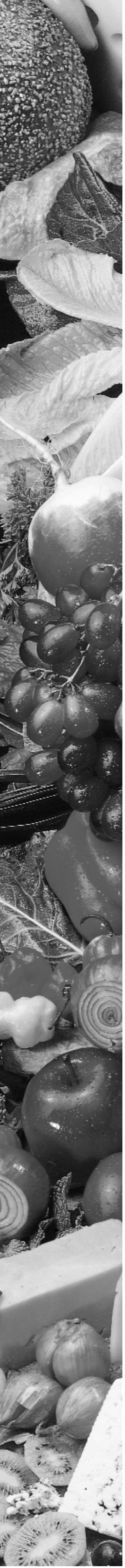


The History of Cutlery

Knives! Although they are not the most expensive piece of equipment in a commercial kitchen, knives are the most valuable! Think how often each member of the brigade picks up a knife to dice, slice, fillet or split each and every day! Now imagine how labor intensive, difficult and costly it would be to do these tasks if today's assortment of quality knives was not available.

The development of cutlery has paralleled mankind's progress throughout history. Let's begin our journey in the Stone Age, with its axes, knives and spearheads made of fragments of hard stones such as flint.

THE STONE AGE...

Some 300,000 years ago, the very first cutler fashioned knives and spearheads from stone so that he and his family could feed and defend themselves.

The first knives ever made by man were splinters of the particularly hard stone, flint or silex. Flintstone was common, thus readily available. The sharp edges on these splinters formed a type of cutting implement that made skinning and hacking up animals killed in the hunt an easier chore. Flintstone was also excellent for scraping pelts that were used for clothing.

Scientific research and archaeological diggings have lead to the discovery of tools used by early mankind in the daily struggle to survive. Early man made flint knives (or stone splinters) in a great number of shapes. Sizes varied from that of a small pocket knife to the considerable length of a scrub-clearing scythe. Edges were usually straight, but in exceptional cases, curved. Some blades thickened out into triangular or rounded handles while others were attached to wooden handles.

Ancient man required great practical experience to skillfully craft early flint knives. The job began with the selection of a good flintstone. Next, the stone had to be fractured and the sharp-edged strips knocked off. To do this, the stone was held in the left hand, and a pebble was held in the right hand. The pebble was used to hammer the flat edge of the stone fragment to loosen a long chip with two sharp edges – this formed a rough blade which then had to be carefully finished by continuing to chip the flintstone until the desired blade was obtained.

People of the late Stone Age used flint more than any other stone for making weapons and tools. Artisans knew how to choose the right types of stone to fashion weapons and tools and went to great efforts to find the required stone. In fact, in parts of France, earth-works worthy of being called "mines" have been found; they feature proper excavation shafts and subterranean galleries. When diggers came across an extremely large flintstone, they cracked it by heating it with fire. Occasionally, flint was worked right at the mine, normally, however, blocks of stone were brought from far and wide and worked on flat stretches of ground near the dwelling of a clan.

Flintstone was traded during the late Stone Age. Grand-Pressigny in France had an abundant supply of good quality stones that were sold to distant tribes. The huge amount of chippings found at the work site of the Grand-Pressigny community indicated that this was where stone was worked on a scale large enough to support trading flintstone and flintstone artifacts.

The "chipped stone era" in Europe and Asia came to an end as mankind made a giant leap forward and began to work with metal in place of stone.

THE BRONZE AGE...

Metals replaced stone slowly, hence, even though bronze (an alloy of copper with tin) was available, stone continued to be used for a long time. However, once the merits of bronze knives became known, they took hold and far surpassed the capabilities of their stone ancestors.

THE IRON AGE BEGINS ABOUT 1000 BC...

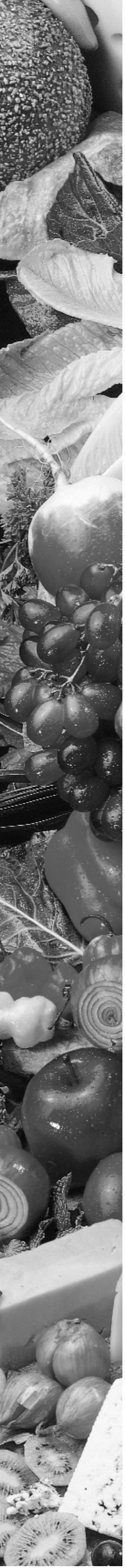
Iron is one of the most common metals in the earth's crust. It can be found almost everywhere, combined with many other elements, in the form of iron ore.

The many sagas about the "Iron Age" suggest that the first skills in metalworking, originally deemed holy, came from the east, or more exactly, from Phrygia in Asia Minor, to Greece.

The Chronicle of Paros (a marble tablet found on the Greek island of Paros), suggests that the discovery of iron occurred in 1432 BC, while other documents suggest that the "Iron Age" began about 1000 BC. After 1432 BC, actual written records show that iron was used for weapons, knives and farm tools. Iron knife blades were far superior to any of their predecessors.

The Etruscans were working iron ore mines on the island of Elba (now part of Italy) in 600 BC. The Etruscans seem to be the first people to have extracted iron ore from the Island of Elba and they supplied iron to the Romans during the early centuries. During this period the number of tools and weapons made from iron grew tremendously and replaced those made from bronze. Cutting and shaving knives, scythes and sickles, then ultimately scissors with springs completed the list of cutting implements being made by the end of the Iron Age.

With the end of the era known as the Iron Age, prehistoric times were left behind and a new era began.



THE MIDDLE AGES TO INDUSTRIAL PRODUCTION IN THE LATE 19TH CENTURY…

The preparation of iron was critical to the evolution of the "Cutler's Craft." Therefore, it is important to present a brief history of the production of iron prior to discussing the cutler's craft.

IRON PREPARATION

From its discovery to the end of the Middle Ages, the preparation of iron remained the same: alternating layers of iron ore and wood (or charcoal) were heated in a hearth until a mass of molten ore was obtained. The molten ore was then hammered while it was hot to remove impurities not removed during the heating and melting process. Raw iron, ready for forging was obtained.

In the beginning, the hearth was a simple conical hole or pit in the ground; as progress was made, the hearth became a furnace. The first furnaces were known as Renn or Bloomery furnaces. Later on, bricked-up shaft kilns were used as Renn furnaces. Oxygen was force-fed into the kiln by means of bellows that were initially pumped by manpower, then later driven by water wheels. Shaft kilns, were followed by lump furnaces, then flux furnaces, and finally by blast furnaces which are still used today.

In the 15th century, construction of the first "high forges" 13 to 20 feet tall resulted in a lucky and major discovery: a ferrous metal in liquid form, known as cast iron. Cast iron was used to manufacture all types of objects (cooking pots, cannon balls, pipes, etc.).

Cast iron also allowed iron to be produced in quantity. Cast iron was refined by heating it and blowing air over it. This caused the carbon in the cast iron to burn off and the pure iron to run off drop by drop, forming a molten mass of raw iron.

Iron processing did not change again until three hundred years later. In the late 18th century, two important discoveries about carbon were made. In 1779, C. W. Scheele distinguished between molybdenite (MoS_2) and graphite. Additionally, in 1786 three French scientists, Berthollet, Monge and Vandermonde, precisely defined the nature of the iron/cast iron/steel relationship and the role of carbon in the preparation and characteristics of these three materials. Their findings follow:

Material Type	Carbon Content
Iron*	Less than 0.10%
Cast Iron	2.5% – 6.0%
Steel	0.10% – 2.0%

*Today, iron is referred to as "low-carbon steel."

THE CUTLER'S CRAFT

The beginning of the cutler's trade dates back to the 10th and 11th centuries. During this time period the making of cutlery was separated from weapons manufacturing. The "Ceremonial of Cutlers" records that the cutler's craft was taught in Cologne by a Roman, Marius Marcus Aurelius. It took men a long time to learn their craft; not only did they make an entire knife, they also made their own manufacturing tools – hammers, tongs, files, etc.

Items made in the Early Middle Ages, and on display in museums today, have ornamental handles. Many included precious materials like gold, silver, enamel, amber, gems, rock crystal, marble, mother-of-pearl, etc. and were made more precious with artistic carving, engraving and inlaying. These knives, and later forks, were owned by the nobility and the wealthy people of the day.

SHEFFIELD & SOLINGEN – FAMOUS CUTLERY TOWNS

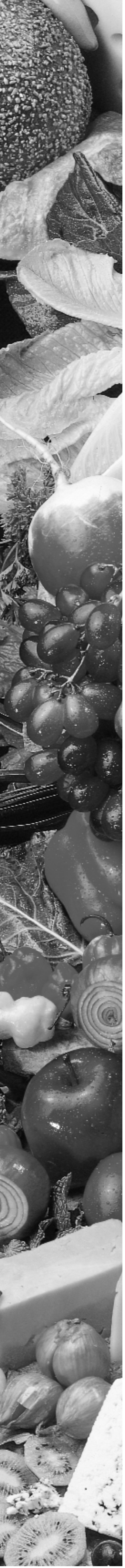
Although cutlers could be found extensively throughout various parts of the world during the Middle Ages, this report focuses on Germany and England, two major European cutlery producers.

The development of trade routes and the flourishing of commerce during the 15th century meant that pig iron was easily transported to the major centers of trade and craft. In the 16th and 17th centuries, "knifers" worked in many cities throughout Europe. Long-lasting fame and a reputation for quality knife blades only stuck to a few places. Solingen, Germany is one of these towns.

The availability of water power was the main reason why blade makers were initially attracted to Solingen. In the beginning, iron quarried from nearby sites was used, later on, iron was brought from Siegland, about 100 kilometres away.

The Continental Blockade erected by Napoleon in the latter part of the 18th century effectively halted all exports from Solingen and created difficult times for the Solingen cutlery trade. After Napoleon fell from power there was a surge of production and trade at first, but competition from England was stiff, particularly in overseas markets. The Continental Blockade and the advent of the Industrial Revolution in England had enabled Sheffield to gain a significant technological advantage over Solingen. To stimulate business, Solingen cutlery traders had books of samples compiled. These early catalogues used water paintings to display the products available. These books were used until printed catalogues started appearing in the mid-19th century. Traders and travelling salesmen would take these sample books with them to fairs and show them to wholesale clients, in an effort to obtain contracts and orders.

By the late 1820's, Solingen began to take up the threads of its export trade. Although the trade barriers of the Napoleonic period had a very negative impact on the Solingen cutlery trade, the law disbanding the old privileges



of the guilds was an equally positive development. There was now extensive freedom to exercise trades, and every industrious master acquired the possibility of developing his business in the most profitable way. The practice of dividing trades was still largely maintained, and manufacturing a knife would involve the smith, the grinder and polisher and the handle maker as before. In keeping with the structure of Solingen's industry, these craftsmen were self-employed, primarily working at home. Articles being manufactured would be hauled from one place to the next, until they reached the final stage and were ready to be delivered to the salesmen.

In the 1830s and 1840s, efforts were made to centralize cutlery manufacturing in Solingen. Factories and complexes where many production processes took place under one roof began to emerge. Salaried workers began to replace self-employed craftsmen. Productivity and employment escalated. Steam power by the middle of the 19th century broke the old dependence on water power. By 1852 there were ten steam-driven grinding mills in the Solingen area and steam hammers made the process of forging blades far easier and more rational. Solingen had begun the move towards the Industrial Age and mass production.

By today's standards, methods and materials were still very basic at the beginning of the 20th Century. However, this was to change very quickly with the widespread application of electricity to the industry, the invention and refinement of stainless steel, and more recently, computerization.

By the early 20th century, the bulk of the cutlery trade had moved from the self-employed home workers to large scale factories operated under the leadership of master cutlers. The requirements of the First World War, coupled with strong competition, brought about phenomenal advances. The discovery of stainless steel was one of these advances.

THE DISCOVERY OF STAINLESS STEEL

Henry Brearley, the inventor of stainless steel, was born in Sheffield, England in 1871. Henry began his first job, washing bottles in a chemical laboratory, at the age of twelve. Through years of private study and night school he became an expert in the analysis of steel and its production. Henry had a reputation for solving metallurgical problems, and in 1908 was given the opportunity to set up the Brown Firth Laboratories (BFL). BFL was financed by the two leading Sheffield steel companies of the day. Its objective was to find solutions to steel making problems.

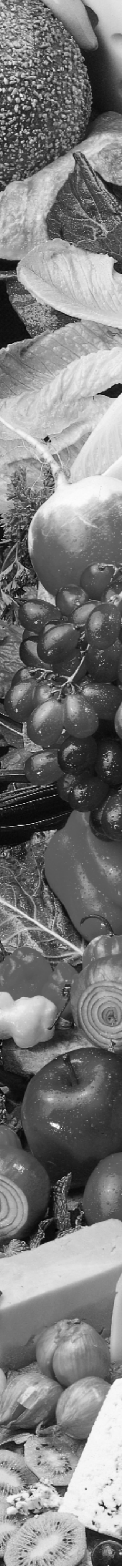
In 1912, Brearley was asked to consider the problems being encountered by a small arms manufacturer, whereby the internal diameter of rifle barrels was eroding away too quickly because of the action of heating and discharging gases. Brearley was therefore looking for a steel with better resistance to erosion, not corrosion. He decided to experiment with steels containing chromium, as these were known to have a higher melting point than ordinary steels. Chromium steels were already being used for valves in early aircraft engines. Iron has an atomic weight of 56, chromium 52, so chromium steel valves are lighter than their carbon steel counterparts, a key reason why they were adopted so quickly by the emerging aircraft industry.

Using the crucible process first, and then more successfully an electric furnace, a number of different melts of 6% to 15% chromium with varying carbon contents were made. The first true stainless steel was melted on August 13, 1913. It contained 0.24% carbon and 12.8% chromium. Brearley was still trying to find a more wear-resistant steel. To examine the grain structure of the steel he needed to etch (attack with acid) samples before examining them under the microscope. The etching re-agents he used were based on nitric acid, and he found that this new steel strongly resisted chemical attack. He then exposed samples to vinegar and other food acids such as lemon juice and found the same result.

Brearley immediately realized the practical uses of the new material he had discovered. At the time, cutting knives were made of carbon steel which had to be thoroughly washed and dried after use, and even then rust stains would have to be rubbed off using Carborundum stones. Brearley immediately saw how this new steel could revolutionize the cutlery industry, then one of the biggest employers in Sheffield, but he had great difficulty convincing his conservative employers. On his own initiative, he had knives made at a local cutler's, R.F. Mosley. Initially, Brearley referred to his invention as "rustless steel." Ernest Stuart, the cutlery manager of Mosley's first referred to the new knives as "stainless." Stuart coined this name after his experiments with vinegar failed to stain the steel. Today stainless steel is a generic term for a family of corrosion resistant alloy steels containing 10.5% or more of chromium.

In 1912, Krupp in Germany (ThyssenKrupp today) was also experimenting with steel by adding nickel to the melt. ThyssenKrupp's corporate history states that it was experimenting with stainless, acid-resistant steels at just about the same time as Brearley was conducting his experiments.

Stainless steel development all but stopped as World War I raged. After the war, in the early 1920s, a whole variety of chromium and nickel combinations were tried including 20/6, 17/7 and 15/11. Dr. W. H. Hatfield, also of Brown Firth Laboratories, is credited with the invention of 18/8 stainless steel (18% chromium, 8% nickel, austenitic grade stainless steel) in 1924. In just over ten years, the Brearley and Krupp discoveries had lead to the "400" series of martensitic stainless steel (commonly used for knife



blades, surgical instruments, shafts, spindles and pins) and the "300" series of austenitic stainless steel. Austenitic stainless steel accounts for more than 70% of stainless steel production today.

Today there are five basic categories of stainless steel. For the most part, these were invented between 1913 and 1935, in Britain, Germany, America and France. Once these standard grades became accepted, the emphasis changed to finding cheaper, mass-production methods, and popularizing the use of stainless steel as a concept. This tended to stifle the development of new grades. However, after World War II, new grades with a better weight-to-strength ratio were required for jet aircraft, which led to the development of the precipitation hardening grades such as 17:4 PH. From the 1970s onwards the duplex stainless steels began to be developed. These have far greater corrosion resistance and strength than the grades developed earlier and are really the future for the increasing use of stainless steel. Duplex stainless steels are commonly used in marine applications, heat exchangers and petrochemical plants.

THE UNIQUE ADVANTAGE OF STAINLESS STEEL

Stainless steel's one unique advantage over carbon steel, is its high resistance to corrosion. This resistance to corrosion is due to the naturally occurring chromium-rich oxide film formed on the surface of the steel. This film forms at the molecular level and is extremely thin; it is invisible to the human eye. This film or layer is described as passive, tenacious and self-repairing. Passive means that it does not react to or influence other materials. Tenacious means that it clings to the layer of steel so that it is not transferred elsewhere. Self-repairing means that if damaged or forcibly removed more chromium from the steel will be exposed to the air and this will form more chromium oxide, repairing or replacing the lost oxide film. Over a period of years a stainless steel knife can literally be worn away by daily use and by being re-sharpened and will still remain stainless. Silver plated cutlery will eventually wear through to the base alloy, but stainless steel cutlery cannot wear through.

The cutlery industry was not able to simply take stainless steel as it was invented and use it with total success initially. The first stainless steel did not produce blades that held an edge nor could edges be put onto blades easily. It took almost 30 years of expensive research by large cutlery manufacturers to develop the right combination of alloys to produce the grade of stainless steel that is still used today.

Today, with more than 75 years of cutlery steel technology behind it, the cutlery steel industry is highly sophisticated and constantly experimenting with new and improved methods. Today's cutlery steel manufacturers have fully integrated operations, computerized processes and control procedures that enable them to produce the highest quality medical and cutlery grade steels, at a lower cost than ever before. For example, recent developments have resulted in the volume of steel ground away in the grinding operation being reduced, resulting in a more economically finished blade.

Since World War II the cutlery industry has undergone major structural changes and attracted new global competitors. Famous brand names disappeared if management did not embrace the new technology and processes necessary to stay competitive. For this reason, Sheffield, England is no longer a leading cutlery center. In Solingen, Germany some large manufacturers underwent massive modernization and rationalization and consequently are leaders in numerous markets around the world. Other Solingen manufacturers rationalized their cutlery operations by subcontracting their production to smaller, more efficient firms, much like those that existed prior to the turn of the 20th Century.

At the same time, manufacturers from Japan, Portugal, and Switzerland have added a new degree of competitiveness to the quality cutlery market. Today, quality knives can be made almost 100% by machine or they can still be made using the skills of a master cutler. The two manufacturing processes are discussed below.

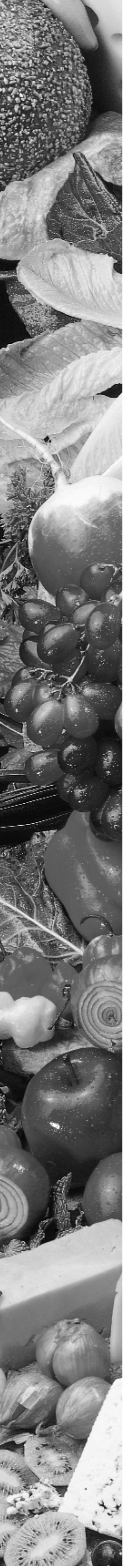
TWO KNIFE MANUFACTURING PROCESSES

HAND-FORGED BLADES

The hot drop hand forging process is the ultimate production method used to produce high quality cutlery – it combines the best of the old and new; the old is the master cutler's skill and expertise and the new is the latest in advanced steel processing technology. Master Cutlers must hammer raw cutlery steel into the desired blade shape. This is just the beginning – the knife will go through more than 60 different processes before it is finished. These operations involve almost 100% hand work and the dedication and skill of a true craftsman able to blend his skills with modern technology.

STAMPED BLADES

With this process, cutlery steel is prepared at the steel mill rather than being hammered out by hand. The steel mill produces and delivers the desired grade of stainless steel in coils to the knife manufacturer. The shape of the knife blade is cut from the coil of steel by a machine designed for this task. The remaining processes, such as grinding, tempering, polishing, sharpening and finishing are completed using a combination of highly skilled labor and machinery.



THE FUTURE…

It is predicted that advanced materials like titanium alloys, carbon fibers, new polyethylenes and plastics, synthetic fibers, composites and advanced ceramics will reshape our lives in ways that we cannot imagine. Many of these new materials will eventually find their way into the kitchen in one shape or another. It appears that the applications of these advanced materials will be limitless. To date, the only advanced material used in knife manufacturing is a high-tech ceramic called zirconia. Ceramics are suffering the same fate as iron – they have been around for thousands of years but continue to linger in their infancy as a result of a limiting weakness. In the case of iron, man had to learn the technique of iron extraction; in the case of ceramics, it is how to overcome brittleness.

Ceramic blades are harder, lighter, stiffer and more resistant to heat and corrosion than stainless steel blades. All of these things are wonderful, but drop a ceramic knife blade and it shatters due to brittleness.

The crystalline structure of a properly tempered metal allows it to deform under stress and still do its job. Ceramics are a different story – they cannot bend to absorb an impact and instead they fracture, in fact, they shatter – instead of simply deforming. The atomic bonding present in ceramics prevents the crystalline planes from sliding over each other and simply deforming. Although billions of dollars have been spent developing useful ceramic devices, in most cases they have failed because of brittleness.

Before ceramics are accepted as reliable, they must be made so they can fail gracefully. Finding the solution may not be easy, but ceramics offer too many advantages to discourage trying to solve the brittleness problem. To date, defences such as "stress toughening" and "toughening ceramics with fibers" are being used to try and combat the problem. It appears, however, that these defences are still in the experimental stage.

Today's advanced materials will become tomorrow's commodities. Tomorrow can be a long time off as was the case with iron and stainless steel. But one thing is certain, advancement takes far less time now than in the past. The problems of today's advanced materials may be solved in as little as 10 to 15 years.

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