GLASS
is our business

HADELAND

HADELANDS GLASSVERK - NORWAY

GLASS –
a product rich in tradition

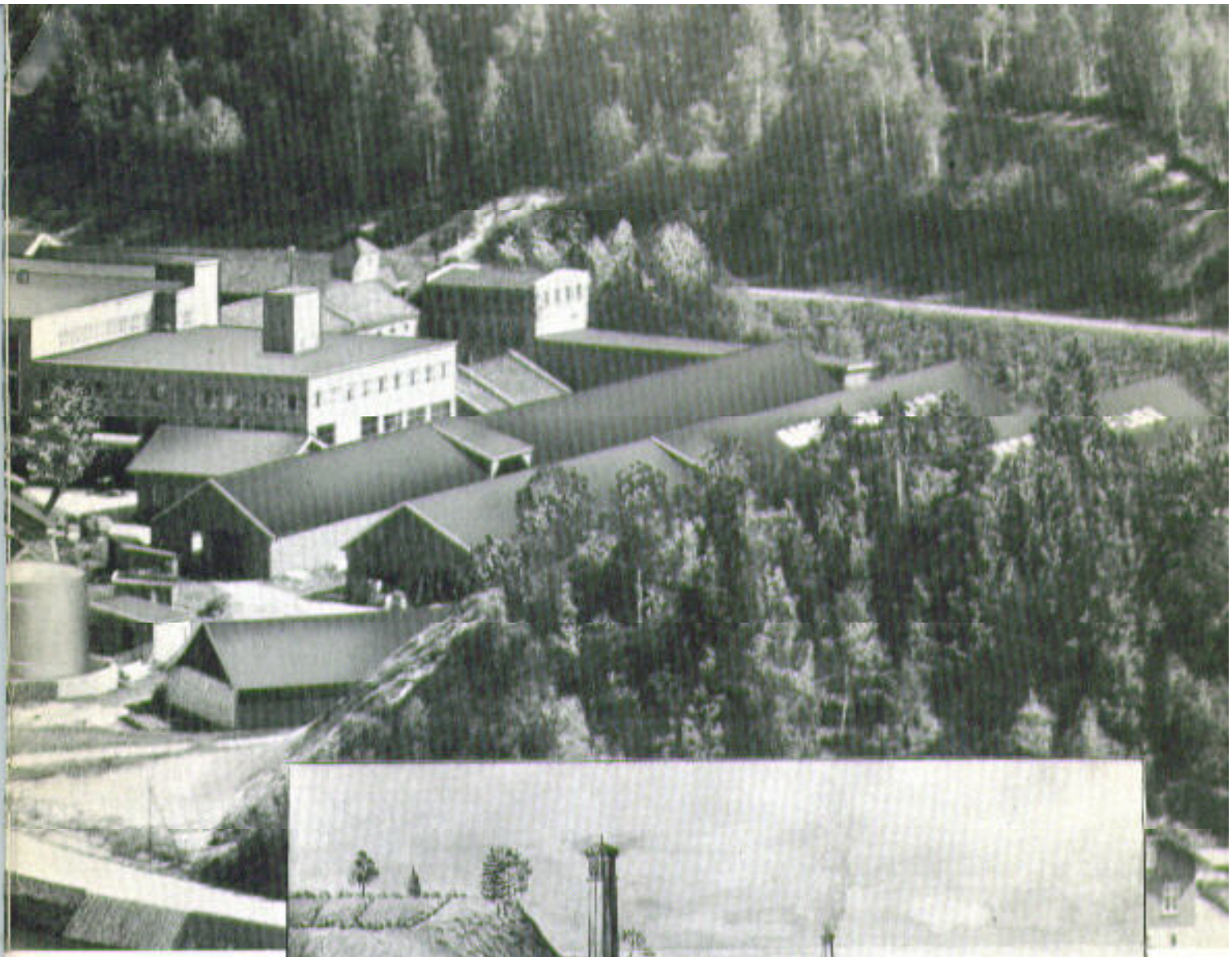
Glass is among the most interesting materials produced by man. Its history is that of man himself and its development has similarly been subject to periods of progress and decline.

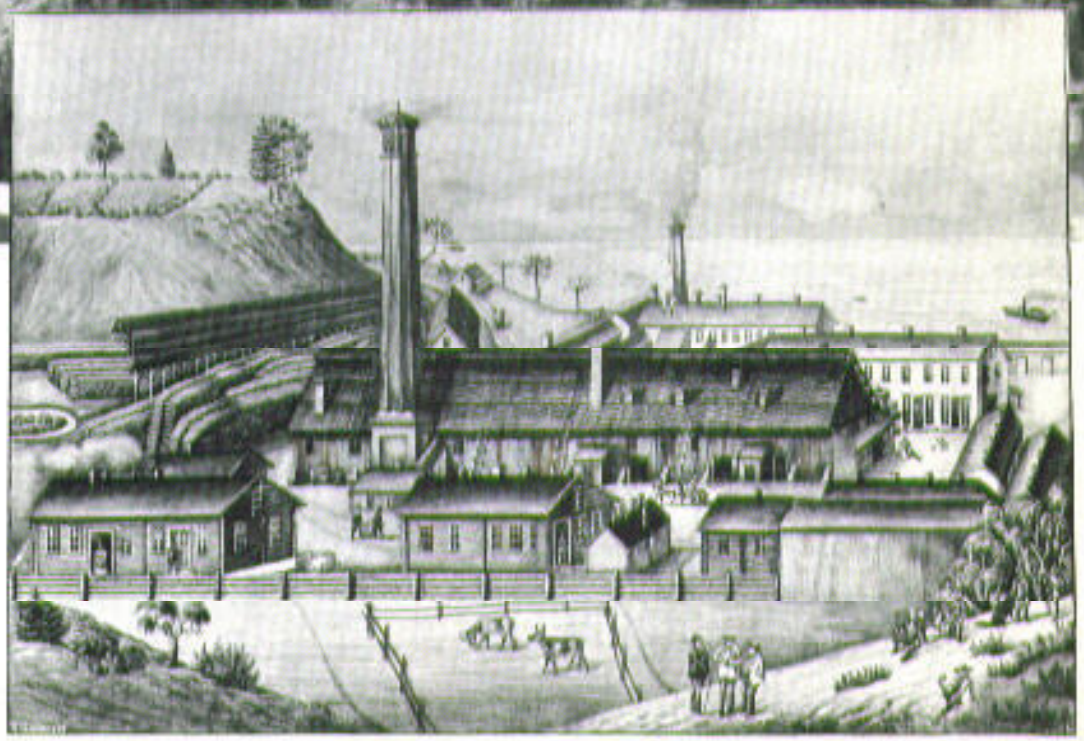
In earlier times the making of glass was surrounded by great secrecy and mysticism. Nowadays the situation is different, with the industry making full use of scientific research and modern techniques. As a result glassware is now available to all and plays a significant role in our everyday lives. Fortunately, however, the machine has not taken over completely. Glass-making still demands the creative qualities of the human mind, not least where form and design are concerned. In this field a perceptive imagination, a craftsman's hand and a sure eye can open up new paths to be subsequently followed and gradually developed by industrial methods.

Hadelands Glassverk

Founded 1762

The 230-year-old glassworks are today the largest of their kind in Scandinavia.
Since their foundation the works have been continually enlarged and modernised, in order to keep abreast of technical progress within the industry.





Hadelands Glasverk 1879

Bottles at first

Today few people associate Hadelands Glassverk with bottles, although the large-scale manufacture of such articles was in fact the express purpose behind the foundation of the works in 1762. Contracts were drawn up for the delivery of building-timber and of large quantities of wood to fire the melting process. The site had been chosen with great care, the abundant forests along the Randsfjord lake ensuring a plentiful supply of fuel. The years 1763 and 1764 saw the building of the works and in the summer of 1765 the melting furnaces were lit. Hadelands Glassverk began to produce bottles of all types for the domestic market of Denmark/Norway.

. . . and then quality glass

During the middle of the 19th century the manufacture of household glass and the peerless heavy-lead crystal was taken up and gradually superseded bottle-making. Nowadays the international renown enjoyed by Hadeland is based upon its domestic glassware and lead crystal. The unique character and style of its glass is due in no small measure

to the fact that Hadeland was among the first industrial concerns in Norway to employ people for their artistic talent, the forerunners of today's industrial designers.

In recent years considerable success has been achieved at international exhibitions of applied arts. At the Milano Triennale in 1954 Hadeland won a Diplom d'honneur, a gold and a silver medal, adding to these a gold medal in 1957 and a further silver medal 3 years later. In 1960 Hadeland was also awarded a gold medal at the German Arts and Crafts Exhibition in Munich.

The works employ some 400 people and make about 1,300 tons in finished products per year, of which 130 tons are heavy-lead crystal, 900 tons are blown and pressed flint glass and the remaining 320 tons consist of glass for lighting purposes. Altogether more than 6 million articles in flint glass and crystal are produced annually in the Hadeland works — quite an impressive amount when one considers the strong element of craftsmanship which still dominates in glass-making.

Today 10 % of Hadeland's output is exported to England, Australia, Denmark, U.S.A., West Germany, Sweden, Canada, Holland, France and New Zealand. There are indications that the particular characteristics of Hadeland glass have made a favourable impact in export markets and that the works may therefore look to the future with optimism.

Raw materials and types of glass

The most important raw material in the making of glass is silica sand which constitutes 70 % of the total content. In view of this it is essential that the silica sand used should be as free as possible of the iron oxide which is detrimental to the production of bright, colourless glass. The silica sand we use contains 99.97 % pure silica, 0.01 % iron oxide and 0.02 % other substances, such as titanium, calcium carbonate and aluminium oxide.

The other two most important raw materials are limestone and soda ash. The latter, a product of Norsk Hydro, contains sodium oxide and carbon dioxide.

In addition to these three main ingredients various other substances are added in order to improve the quality of the glass. Feltspar, for example, by reason of its aluminium oxide content serves to increase the finished product's resistance to chipping and sudden changes of temperature. Borax has a somewhat similar effect and furthermore enhances the brilliance of the glass.

There remains, however, an irreducible amount of iron oxide which gives the glass a blue-green tint. To counteract this a reddish colouring agent is added which, when the glass is molten, neutralises the bluish-green element so as to produce a colourless glass. Hadelands Glassverk makes 3 main types of glass, namely soda-lime or flint glass, crystal and opal glass.

Soda-lime glass

This is used in the production of tableware, both hand-made and pressed, such as stemware, tumblers, jugs, bowls, dishes, etc.

Lead crystal

Crystal glass is obtained by substituting red-lead in the place of limestone and potash instead of soda ash. This gives a heavier glass with a higher refractive index and a finer ring. Crystal is used for articles of superior quality.

Opal glass

Opal glass is obtained by adding fluor-spar and cryolite, two minerals containing fluorine which reacts with sodium to form small, flat crystals. These crystals refract the light and,

given sufficient of them, the result is a white, opaque glass, widely used by the lighting industry.

Coloured glass

By adding metal oxides various colours can be produced in soda-lime glass. This can be quite a complicated process, requiring a combination of different oxides in order to create the desired shade of colour. Briefly it can be said that the four main colours of the spectrum are produced in the following way: Blue glass — cobalt oxide and copper oxide. Green glass — chrome oxide and iron oxide. Yellow glass — sulphur and metal sulphides. Red glass — gold, copper and selenium.

Batch mixing

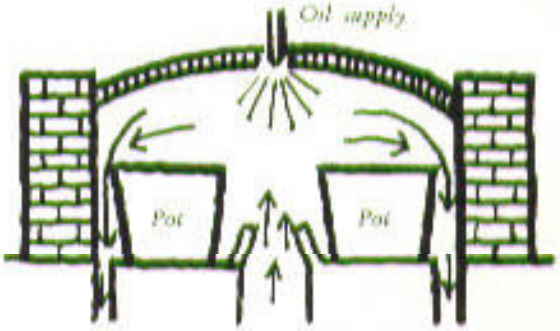
The mixture of raw materials is called a batch. Great care is exercised in weighing the different materials to the correct proportions before they are emptied into the batch mixer. The weights of the different raw materials in a single batch vary greatly — from 150 kg. silica sand to some 20 g. decolorizer.

Batch charging and melting

When the day's work is finished the batch is brought to the different furnaces. In the furnaces where melting takes place in fireclay pots, the batch is fed in by means of large shovels. In the tank furnaces, however, where the glass is melted in a bath made of refractory blocks, the batch is emptied from large containers which are transported by a hoist running on overhead rails. The furnaces are then closed and the oil supply increased to bring the temperature up to 1450° Centigrade. The workers on night shift follow the melting process carefully and ensure that the correct furnace temperature is maintained. After 10—12 hours the glass is molten.

Between the temperatures of 1200° C. and 600° C. glass can be moulded into shape. At 1200° it is quite soft but as the temperature falls it gradually sets, a relatively slow process which affords ample opportunity to work and fashion the glass. The normal working-temperature is 1200° C.

Hadeland was among the first glassworks in the world to install electric melting-furnaces. This was in 1962 when Hadeland celebrated its bicentenary. Thus the wheel had come full circle. At the outset it was Norway's vast forests which, as a rich source of fuel, provided the impulse for the foundation of the country's glass industry. Towards the end of the 19th century English coal had taken over, later to be itself replaced by imported oil. Today we rely once again on a Norwegian source of energy in the making of crystal and glass, products as bright and sparkling as the mountain waters harnessed to provide electricity for the melting-furnaces.

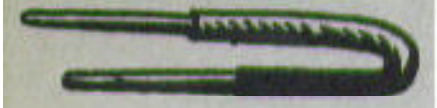


Glass-blower's chair

Iron rod with molten blank

Mould

Shaping-block



Pucella

How blown glassware is made

The glass is gathered

When the batch is molten, the workers gather round the furnace. They form teams or "shops", each consisting of a head workman, known as the "gaffer", with skilled hands and apprentices. The hands are called "servitors", "blowers" or "gatherers" according to their particular job. The apprentices carry out the first preparatory work for each article and assist their seniors in various ways. Each shop has also its "takers-in", boys who carry hot glassware to the lehr, an annealing oven.

The glass is blown

7 men to 1 glass

No. 1 "gathers", i.e. he collects molten glass, thick as syrup, on the end of a blowing-iron. He rolls this gather on a flat, metal plate (marvering) and blows into the glass a small amount of air.

No. 2 takes over and fashions the blank with a shaping-block.

No. 3 blows the blank in a mould and passes it on for the foot to be added.

No. 4 holds the blank on the blowing-iron with the stem pointing upwards. No. 5 places a new piece of molten glass on top of the stem. No. 4 clips off a suitable amount and shapes the foot with a tool known as a "battledore".

No. 6 places the glass in a machine where small gas-flames melt off the superfluous top, leaving a strong, smooth rim.

The glass is finished and No. 7 carries it out for annealing, a slow cooling process which ensures a glass free of stress.

The fitting of a jug-handle

After the jug has been blown in a mould, a punty is fixed to the base and the blowing-iron is knocked loose from the other end. The jug is re-heated until it is white-hot. The top is then opened with the pucella and cut into shape with scissors. The blank for the handle is joined to the jug near the base, cut to a suitable length, bent round and fixed to the upper part of the jug.

Shaping in a block

Shaping with wet asbestos

They may sometimes act as "mould-boy", holding the mould while the glass is mouth-blown. A shop may contain from 3 to 9 men according to the type of article being made and it is difficult to define the work of the gaffer and other individual members of the team as their roles can vary from product

Blowing in a mould

Adding the stem

Adding the foot

to product and from workshop to workshop. The gaffer, the servitor and some of the other workmen have each a chair which is in fact a simple, wooden bench about 3 ft. wide. The "arms" of the chair are fitted with an iron rail on which the blowpipe is rotated back and forth to keep the glass from running before it sets.

Each shop has its blowing-irons which pass from man to man. Apparently for some reason or other this is not a danger to health. Workers are seldom ill and infectious diseases do not spread any more easily in a glassworks than elsewhere. What is more, the average life-span of glassworkers is very high. In addition to blowing-irons a workshop has many other tools peculiar to the trade of glass-making. Marvers are flat, metal plates on which a gather of glass is rolled and shaped. Moulds are made of beech, iron or graphite and cover a whole range of shapes and sizes. They are split vertically into two halves and can thus be opened and closed around the blowing-iron. Between each blowing they are dipped in water or sprayed, as are also the shaping-blocks, pieces of wood in varying sizes with which the glass is shaped on the blowing-iron before being blown in the mould. The pucella is a tool, rather like a large hair-pin, which is used to open out the top of a wine glass. Various types of scissors are available for cutting and trimming. Finally we must mention the punty, an iron rod used to hold the base of hand-made ware during re-heating and shaping or for gathering gobs of glass for pressed ware.

Cutting and shaping with simple tools

Hadeland's glass guaranteed against stress breakage

Many housewives have been annoyed to have the rim of a glass break off in the washing-up. With good reason they complain, "How did that happen? I was as careful as could be". The cause is stress in the glass arising from out-of-date production methods.

Burning-off — old method

The old method was to burn off the top of the glass after it had cooled down. Under polarised light the stress appears as a ring beneath the rim of the glass and this is where it fractures.

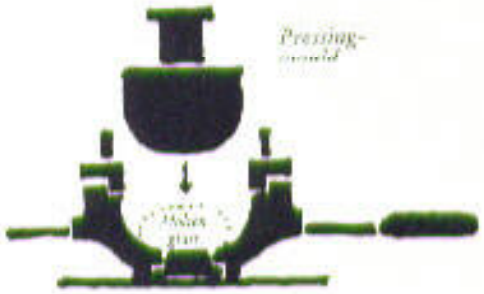
Burning-off — modern method

The modern technique used by Hadeland is to melt off the top of the glass while it is still hot. The finished glass is carefully cooled in electric annealing lehrs, thus ensuring a product free of tension and the danger of stress breakage.

Making pressed glassware

Inexpensive and strong glassware can be manufactured by the pressing process. A gob or gather of molten glass is dropped into an iron mould. A plunger driven by compressed air is lowered into the mould, pressing the glass into shape. After a few seconds the mould is inverted so that the finished article falls out, base upwards.

A red-hot punty is fixed to the base of the glass which is then re-heated for a few seconds until it becomes soft without losing its form. This treatment removes small irregularities left by the mould surface and gives the glass a bright finish. A wooden stick is used to obtain the final shape desired, the punty is knocked loose and the glass carried to the annealing lehr. Bowls and plates with the same diameter base are pressed in the same mould, acquiring their individual shapes after the re-heating process.



Pressing-mould

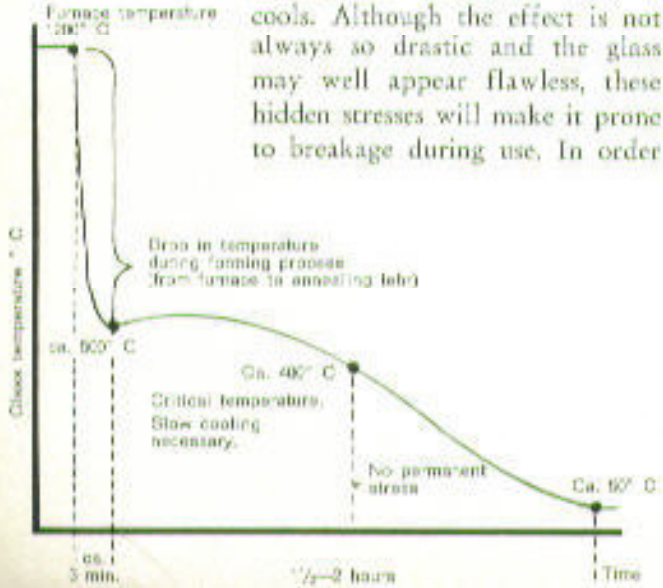
Pressing glass

Sorting

Annealing

The cooling of the hot, finished glassware is a problem demanding special attention. When the temperature of glass falls below 540° C, stress develops if the glass is cooled too quickly. If this stress is very great the glass will shatter into fragments when it cools. Although the effect is not always so drastic and the glass may well appear flawless, these hidden stresses will make it prone to breakage during use. In order to prevent stress developing, the hot glassware is placed in annealing lehrs or furnaces where the cooling process can be carefully controlled. At one time these furnaces were coal-fired and the glasses transported by trolley. This was a lengthy procedure, not always very efficient, and the glass became so dirty that it had to be washed before packing and despatching. Nowadays Hadelands Glassverk uses electrically-heated furnaces with conveyor-belts, an automatic process which gives a cooling period of 1½ hours and a product free of stress.

The annealing lehrs lead direct to the warehouse where the glass is examined for defects. Plain glassware is packed on the spot, while articles to be decorated are passed on to the appropriate departments.



Decorating glass

Cutting

Cut glass is produced by grinding patterns or figures on the surface over an abrasive wheel made of iron, carborundum or cork, and varying in size from 3 cm. to 70 cm. For deep cutting the craftsman presses the exterior surface of the glass firmly against the edge of the wheel, following his work through the interior of the glass. The cutters form teams of three. The first man rough-grinds the pattern on an iron wheel, using guide lines previously marked in red. The second adds the finer details of the pattern with a carborundum wheel and the final stage consists of polishing smooth on a large wheel made of cork. In the case of cut lead crystal, however, polishing is replaced by immersion in an acid bath.

Engraving

Engraving is based upon much the same principles as cutting, although smaller wheels are used. A far wider range of tools and accessories is required to create the desired shades and contrasts. Grinding wheels of iron, carborundum, copper, lead, stone, wood and cork, diamond tools, various abrasive powders, — all have a place in this artistic and delicate craft.

Engraved work is in steadily-growing demand and Hadelands Glassverk offers a wide range both in crystal and in glass. Special commissions are undertaken for articles of superior quality intended as gifts for anniversaries or official occasions.

Acid Etching

A distinction is drawn between matt etching and deep etching. The former technique is used to mark glassware with a name or emblem, such articles usually being made for a hotel or restaurant. A transfer of the design required is affixed to the glass and the surrounding area covered by a lacquer. When this is dry, an etching-paste of fluoric acid and crystalline soda is applied to the transfer. After a few seconds the paste is washed off, leaving a matt-etched design. Deep etching involves immersion of the article in an acid bath. The complete glass apart from the areas to be etched is protected by an acid-resistant lacquer or, in the case of pattern etching, by a wax.

Painted glassware

Patterns can be painted on all types of glass from domestic ware to electric light fittings. The work is done largely by hand, either with a brush or with a paint-spraying pistol. Litho and silk-screen processes are also employed. Glass ornamented in this way is heated to a high temperature in electric ovens, the paint fusing with the glass to form a permanent decoration.

Sand-blasting

The sand-blasting of sheet glass, light fittings and decorative articles is nothing new. It has been practised at Hadeland for many years. This harsh technique gives the glass a fine, soft texture, and sand-blasted sheet glass is often employed as an architectural medium in buildings of outstanding importance.

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