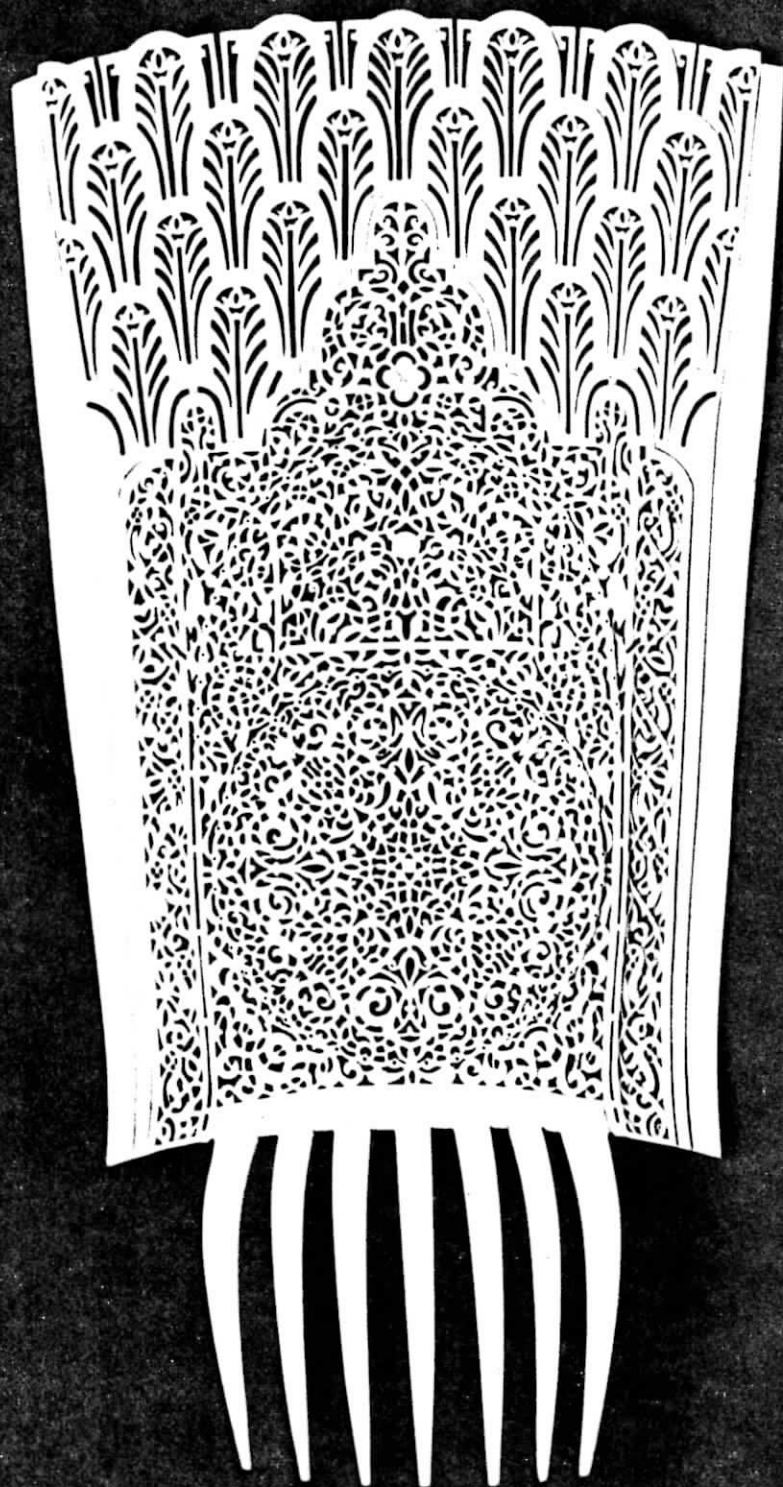


2. In the early 1900s, the craftsmen of Oyonnax produced true works of art in the plastics then available. This mantilla comb, cut from a sheet of cellulose acetate, pierced, formed and finally polished, is a superb example.



Isolated among the mountains of the French Jura, with no major resources and away from main communication highways, Oyonnax produces a range of about 10,000 different articles in plastics of all kinds, articles that find their way into homes and industries throughout the world. They range from precision components for all branches of engineering to camping equipment; from spectacle frames to artificial flowers; from teaching aids to household equipment. A busy, largely modern, town set rather improbably amidst starkly beautiful mountains, Oyonnax is undisputed 'capital of plastics' in France; indeed, in Europe as a whole. The nature of the claim is not unique in the region because three other nearby towns have similar distinction in other industries—Dortan, 8 km away, claims to be the capital for manufacture of chess sets; Saint-Claude, 32 km away, for manufacture of tobacco pipes and for diamond cutting; Morez, 55 km, for spectacle frames. There is obviously something special about the valleys of the Jura that has encouraged the people there to exploit local conditions and provided proof over the centuries of a lasting professional and creative skill in the mastery of extremely specialised techniques and the ability to compete successfully in a highly competitive world.

But why Oyonnax for plastics? Curiously, the origins date back a long, long way, a mixture of legend and fact.

In this area of the Jura, the soil is arid and poor, but the mountain slopes have for centuries supported huge forests mostly of fir and box. The winters are long and harsh and the local people built a reputation for wood carving; in particular, for making combs. According to the legend, in 630 AD, Léodogarius, ambassador to Dagobert King of the Franks, was passing through Oyonnax on his return from Geneva, when his litter broke. The local inhabitants used their skills to repair it, and to nurse an aide who had been injured. When Léodogarius later became a minister to Childeric II, he remembered the services rendered by the Oyonnaxiens and granted them a monopoly for the manufacture of combs which the Frankish warriors used to comb their long hair. When canonised as Saint Léger, he became the patron saint of Oyonnax.

Historical documents of 1176 make the first factual mention of Oyonnax, although destruction of records leaves a gap until 1667, when not only is the village mentioned but also its industry. The town itself is built on a large filled-in bog, on which sheep were reared, and later commemorated in the arms of the town. Life remained difficult and, even in the 18th and 19th centuries, the population continued to farm during the summer and make combs during the winter;

leaving in the spring as travelling salesmen for the products of their craft and in the autumn again leaving home to comb hemp in the north-east. However, from about 1710, some factories employed workers throughout the year.

Box-wood has a yellow colour that is not particularly attractive and attempts were made to dye it by steeping it in vats along with well-moistened cowdung. After several months the wood acquired a reddish-brown hue and, after shaping and cleaning, articles could be fashioned revealing the wood grain most clearly. In the early days one worker made each comb entirely by himself—one man could make 12 to 18 combs per day. They could more properly be called scourers; very large combs with double sets of teeth.

It was not until the end of the 18th century that the fashion-comb industry began. In 1800 (Revolutionary Year IX) Oyonnax had 12 comb manufacturers and 20 workers, and 22 manufacturers in 1809, although some of these had begun to make buttons, snuff boxes and inkstands.

Change to horn

A major change came in 1820 when experiments began with horn, the first natural plastics material. At first, horns from local cattle were used but soon the supply became insufficient and horn had to be imported from Switzerland, Brazil, Paraguay, Ireland and Madagascar. The foundations of the association of Oyonnax with plastics had begun.

Horns consist of three main parts. The first is the point, used in making such articles as knife handles or pipe stems. The second is the roller which, being hollow, can be used for such items as napkin rings, or brush handles. The third and broadest part, also hollow, is the forerunner of plastics and is used for larger articles. It is first heated in wood furnaces and, when sufficiently soft, is split with a pruning knife and opened out. The next stage is to steep the horn in water for about a fortnight and then to scrape it free of cartilage. The horns are then greased with either oil or tallow and compressed in hot presses to flatten them. As knowledge progressed a craft known as the 'horn flatteners' (*aplatisseurs de corne*) grew up, and this led later, during the hard times of the 1870s, to the formation of the first friendly society in Oyonnax—the *Caisse des Aplatisseurs*, or 'Flatteners' Friendly Society.

The change to horn brought rapid increases in production. By 1860 there were 120 flattening presses in Oyonnax, many of them mechanical, but some hydraulic, and at that time 240 gross of combs were produced each day. Gradually, machines were introduced to reduce handwork: in 1845 the

first groove milling machine, in 1850 the first handsaws and jigsaws, in 1860 the 'intersecting' machine, in 1871 the trimming machine. These last two could be described as the earliest machines with specific relevance to the work of the district. Originally, comb teeth were cut one by one and then, with circular saws, the teeth of several combs could be cut in one operation, a mechanical system advancing the comb one tooth at a time. The intersecting machine cut two combs from each blank form, the teeth intersecting, or meshing, with each other as the cutter zigzagged from one end of the combs to the other. Later modifications enabled fine and coarse teeth to be cut in the same comb. The trimming machine operated with punches that cut out the external shape of the article to be made, and thus greatly reduced hand work.

The period 1820 to 1918 could well be described in the history of Oyonnax as 'the reign of the comb' and, as demand built up, so the artisan/cultivator increasingly became transformed into the factory worker. Quite large establishments were founded, some of them still surviving, notably Marie-Philippe Convert, founded in 1830 and still in business as *Ets G Convert*.

Moments of crisis affected life, however. About 1860 the Empress Eugénie introduced, from her native Spain, the fashion of decorated hennets. No more combs—and near catastrophe for Oyonnax! Not for the first time, diversification into other products such as snuffboxes, bracelets and brooches brought salvation, and this was supplemented by new sources of energy.

Until 1865, by which time the population of the town was 3500, water power from two streams drove the machinery. Then steam arrived, in the shape of the *Grande Vapeur* power company, and progress became very rapid. With it came the first measures of specialisation, some doing trimming, some tooth cutting, others finishing.

Celluloid, cellulose acetate and polyethylene

In 1878, nine years after its discovery, celluloid was introduced to Oyonnax industry. A delegation had been sent from the town to the International Exposition in Paris, had seen there the first products made from celluloid and, on their return, recommended its adoption. Because the material was at first very expensive, local industrialists decided to form a co-operative to make it themselves. Called *l'Oyonnaxienne* and formed in 1889, it survived until 1935–6. New possibilities for creative use of the new material were exploited fully, and specialised machine tools invented to make the most of a growing market. Electric power—supplied through the first high voltage

feeder line in France, in 1889—and two railway lines gave added impetus to the development. By 1900, when products and machines from Oyonnax appeared at the International Exhibition in Paris and won three silver medals and one bronze, it had become clear where the future lay. Two years later, Oyonnax exported over 80 per cent of its output—to Germany, Italy and the Middle East, among other places—and fashion goods such as hair slides and fancy combs of all kinds began to appear to supplement the more traditional range. Greater artistry became apparent in design, too, and one man in particular, Arbez-Carme, created articles in celluloid, as well as in ivory, that have survived as true works of art. The period 1914–18 saw production of tens of millions of knitting needles and, after the war the revival of the fashion for hair combs. It was said that 'each woman wore between 100 and 200g of celluloid in her hair'.

Casein and Bakelite became common after 1918 and then, six years later, cellulose acetate was first used at Oyonnax, and led to an industry that has flourished ever since—the moulding of spectacle frames. As already mentioned, the town of Morez, 55 km away, had established a pre-eminent position in making such frames and they now wished to make them in plastics. However, they lacked the knowledge to do so, and asked their neighbours to do the moulding of the components, which were then assembled at Morez.

As with all other forms of industry, the 1920s dealt harshly with Oyonnax. Although, by 1925, the range of products produced in the town was described as 'prodigious', the fashion for short hair was already causing doubts about the future and, when the worldwide troubles at the end of the decade reached Oyonnax the results were severe. Once again, resilience and adaptability won—supported by the craze of the yoyo which brought much-needed work to the plastics processors!

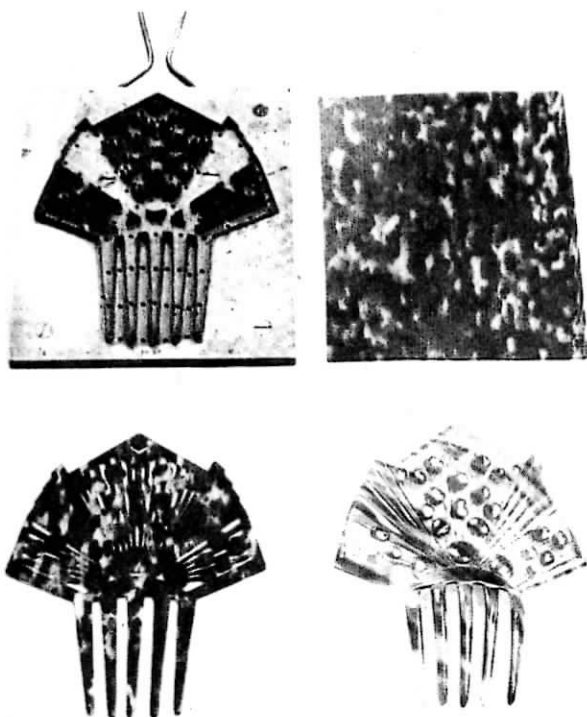
The end of the 1930s saw the introduction of polystyrene from Germany and then, just over ten years later, the material that was to transform the fortunes of Oyonnax became available there. This was, of course, polyethylene, discovered by ICI in 1933 and the forerunner of the versatile family of polyolefines. It proved to be a major incentive to diversification, away from combs and into what has become a vast range of industrial applications. Since then, and notably following the introduction of polypropylene, that diversification has continued, until now virtually the whole range of thermoplastics is used at Oyonnax.

Machinery developments

Injection presses appeared in Oyonnax

3 Stages in manufacture of a traditional head-comb. At the top, the punch (left) and a flat sheet of cellulose acetate are shown. The material is heated and the punch used to cut out the basic shape of the comb (bottom left) and to form the principal features of the pierced decoration. Skilled thermo-forming and polishing produces the finished comb shown at the right.

4 Part of the moulding shop at the State College of Technology at Oyonnax. An extensive range of equipment is available.



5 A corner of the materials laboratories at the college. The training includes work on the nature of plastics materials, plastics processing and laboratory work, as well as projects in basic design, choice of materials, and design and manufacture of tools.

about 1930, the work of several local men—M. Cretin, then MM Goujon and Guignot. All these early experiments were with that highly dangerous material, nitro-cellulose and one or two fires each week became commonplace. In the words of one who remembers those days, 'a mixture of nitro-cellulose and camphor burns well—it explodes very well!'

Six years later, injection presses from the German firm of Eckert and Ziegler arrived, followed by others from the Société Viennoise of Vienna. Cretin and Goujon developed their own, which were made under licence by Cotte-Emard-Rouleau (CER) of Oyonnax from about 1940. These, known as 'little Gretins', were manually controlled and very successful, even if they would seem somewhat strange to us today.

The earliest 'little Gretins' had capacities of 25 to 30 cm³; one attained 60 to 70 cm³, although it had a servo-system to assist the operator. It incorporated an enormous drum, driven by a motor and a pinion-gear assembly. Inside the drum there were brake shoes, functioning as in a motorcar, and this enabled presses to be controlled both during closure and injection. Heating came from electrically operated steam boilers. The first

hydraulically-operated injection moulding machines appeared in 1945, and some remained in use for almost fifteen years.

By then, of course, rapid progress had begun in machinery design in many countries, and now machines of the most modern kind are to be found in the factories of Oyonnax. In addition, the French Billion company set up their own works in 1947.

In parallel with machinery advances have come improvements in the techniques of mould making and several firms specialise in that work.

Famous school for technicians

The change in the fortunes of Oyonnax demonstrated the need for change in its education policy, particularly in the closing years of the 19th century. Business prospered and the need for better education became apparent: virtually all employees came from farms in the area. The first secondary school was founded in 1890, although the education it offered was general, not particularly related to plastics. Within about another twenty years, the need for training in machine operation and in the technology of materials was recognised; a workshop wing was added to the

