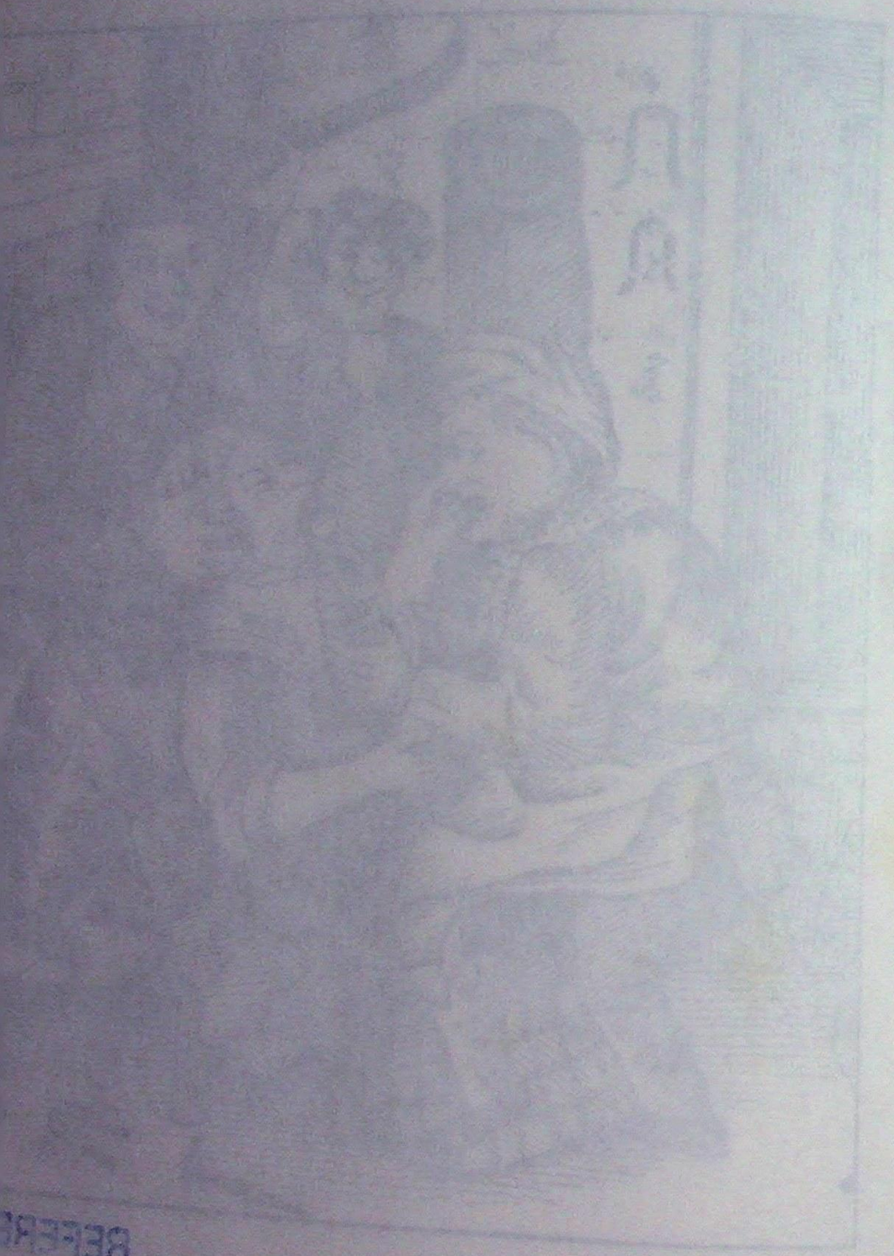
THE HISTORY OF DENTISTRY PORTRAYED BY THE HISTORY OF DENTAL PRODUCTS

A Dissertation submitted by Bozena Harmen to the Faculty of History of Art and Design and Complementary studies and in candidacy for the Degree B. Des. in Industrial Design 1987.



"Whoever profoundly understands
a superficial part of life
necessarily gains metaphysical
insight along with it"

Keyserling

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Introduction

Dentistry or rather the lack of dentistry as a factor in political and social history is only allowed due weight by dentists. History books make nothing of the fact that Louis XIV signed the Revocation of the Edicts of Nantes while distraught with tooth infection; that the wild judgements of Gustavius Vasa coincided with appaling mouth condition; that George Washington suffered from severe indigestion, short temper and could not make public speeches due to inadequate false teeth. Only in the limited dental world is it appreciated that the Victorians developed the habit of eating before meals because they were unable to chew with contemporary dentures; that Augustan wits of the eighteenth century avoided smiling altogether, cultivating the dry and ironic manner which flavours their writings, and that the use of the fan came about from the need to hide hidious teeth and deflect bad breath.

Toothache is as old as history yet almost at once (we learn for our comfort) men began to look for a remedy. The obvious solution was to remove the tooth, however this being a painful process as well as being a bad omen, was only performed as a last resort, when all the magic and obscure remedies had, not surprisingly, failed.

Naturally, along with the removal of teeth there was an effort to replace them - vanity rather than desire to chew better being the dominant motive. Both extraction and false teeth, which seem to go hand in hand, dominated dentistry

right through history.

There is an immense amount of dental products that could be covered while writing a dissertation such as this, ranging from small hand instruments such as dental mirrors, probes, files and tongue scrapers to the large and extremely large objects such as mouth gags and dental chairs. With the rapid advancement of dentistry in the last sixty years a wide range of electronic products, with which we are familiar with today, have also evolved.

It was therefore necessary to be very selective of the topics to be covered. It was found that by selecting the afore mentioned topics, extraction and false teeth, along with dental drills (that so occupied the minds of many dentists from the eighteenth century onwards) and putting them into context by a brief introduction to the history of dentistry, a clear overall picture of dentistry could be impressed. The realisation of the physical and mental miseries endured by the people of the past making us thankful to be living in the age of modern denistry.

The emergence of a profession

In the earliest times the tooth was seen as immortal and the loss of teeth meant certain death to the ancient man. Toothache - an affliction from the Gods - was cured with prayers and incantations. Cures involving mice were particularly favoured as they were considered to be under the direct protection of the sun and an antidote to death. The Egyptians used to split the living body of a mouse and lay it, warm along the gums of the patient. The Romans eat a mouse twice a month to prevent toothache. Cures involving mice still appeared in the early part of this century.

This fog of superstition and charlatanism was only dispelled with the advent of scientific thought. The Greek hippocrates (460 - 370 BC) (Fig. 1), known as the father of medicine is credited with this change. He based the practice of medicine on the concept that disease was a process which was governed by natural laws that could be known by observation. His work was continued by his pupils at the Medical Academy of Alexandria which produced a school of celebrated doctors who eventually brought their knowledge of dentistry to the Romans.

Figure 1: A Marble Statue of Hippocrates from Cos.

Unfortunately the medical tradition of the ancients was extinguished during the Dark Ages. Dentistry passed into the hands of quacks and fell into total obscurity. The toothworm - a tormentor from hell (Fig. 2) was then commonly believed to be the cause of toothache. This belief existed for a long time, even in the eighteenth century there were reports of worms swimming away from extracted teeth that were placed in a glass of water. The explanation for this might be that a split tooth could expose the nerve in a worm like pose.

Figure 2: French Ivory Carving Showing the Toothworm C 1750

Obscure superstitions and preparations flourished again to fight toothache. People would nail pain to a tree or transfer pain by spitting into a frogs mouth, messages were written on doors to the toothache telling it to go away - no one was home.

Nevertheless in spite of all these magic and quasi-religious beliefs, on going pain had to be dealt with in a more realistic manner. In western Europe the clergy undertook medicinal work until 1163 when the Pope prohibited priests from performing any operations that drew blood. The monks however had played a vitally important part in keeping alive the tradition of Greek medicine through the Dark Ages.

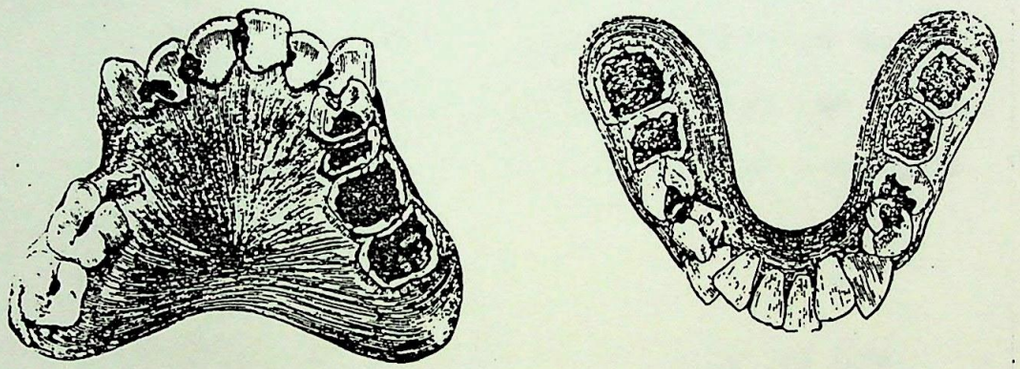
They passed their knowledge on to the barbers, who were

naturally used to handling knives. By the fourteenth century guilds of barber - surgeons had evolved with rules governing the conduct of their members. However, there were insufficient numbers of barbers and extractions were also undertaken by itinerant tooth drawers (Fig. 3).These appeared, garishly dressed, at fairs and markets throughout Europe, till the end of the nineteenth century, drowning the cries of the sufferers with raucous music. This group are of historic interest only, they did nothing to advance dentistry, if anything their effect was detrimental.

Figure 3: Wooden panel showing the itinerant dentist and his family C 1840.

Despite the obvious recognition that dentistry of some form was required, extraction was the only operation performed, even that was a last resort. This was due to a number of reasons; the scarcity of people courageous enough to extract teeth, the excruciating pain involved (no anaesthetic), the high risk of infection or getting ones jaw broken and the resulting difficulty with eating. Teeth were only pulled when pain became unbearable, instead people lived with poisoned breath and teeth that had rotted into stumps.

Figure 3 A not uncommon representation of the teeth of a 23 year old girl in 17th Century.



Progress in dentistry was negligible till the sixteenth and seventeenth centuries when literature on the subject began to be published and the term for dentist was changed to 'operator for the teeth', which by its definition suggested slightly more respectable aspects.

The most important person in the history of dentistry was Pierre Fauchard (1678 - 1761) - The Father of Dentistry. He wrote "Le Chirurgien Dentiste" in which he described all the

procedures of dentistry and every type of instrument known at that time. This was highly irregular as comtemporary dentists kept their methods of practise secret. He inspired French dentists, making french dentistry far in advance of any other country for the following 100 years.

At this stage there was no organized course of study available or qualification for practice. An apprenticeship was the only way to learn the trade. The terms of apprenticeship were harsh; a solemn oath had to be taken by the boys to keep all they learnt secret, they could not marry, play at cards or visit playhouses and taverns. The apprenticeship lasted between five and seven years and cost £500. The result was that only a few who practiced were 'qualified' dentists, the majority were uneducated and disreputable people who jumped on what was then seen as a highly lucerative bandwagon.

Progress in dentistry gathered momentum during the late eighteenth and nineteenth centuries. An increasing amount of literature was published on the anatomy of teeth, false teeth, extraction and fillings. The first dental school and society were founded in Baltimore, America in 1839 - it being much easier to institute schools in America. There was less prejudice to contend, and no established medical school claiming rights to a study they had previously neglected. Despite all these advances at the end of the century only one out of ten dentists were graduates of a school and dentistry was seen largely as a trade.

In 1921 the Dentist's Act was passed which succeeded in eleminating all the unqualified dentists from practicing dentistry. Under this act the Dental Board of the United Kingdom was established to promote research and public education, and to insure high standards of education and professional behaviour. Dentistry had become a closed profession.

Dentistry as a profession is young - 70 years or so - but is very progressive. This is largely due to improved equipment, materials, methods, a National Health Service and Public Dental Health Education, all of which combined offers us the high standard of dentistry we are familiar with today.

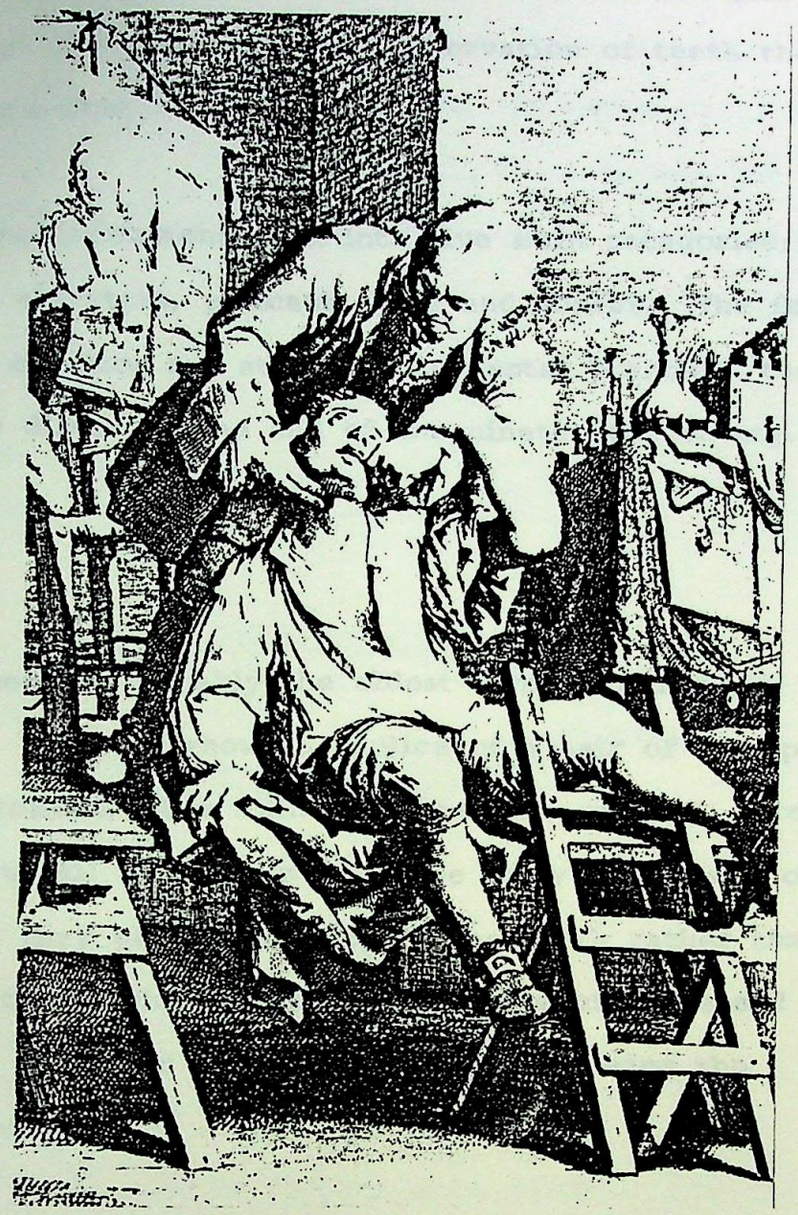
Extracting instruments

In the history of dentistry the most frequently performed operation was extraction. It was the only operation performed until dentists became interested in false teeth and fillings in the eighteenth and nineteenth centuries respectively. For the majority it was the only form of dentistry encountered till the early twentieth century.

In the acient world, indeed throughout the middle ages until the eighteenth century, extraction of teeth was seen as an extreme relief of pain, only to be attempted when all else failed. This is not surprising when one remembers that anaesthesia was not introduced till 1840's and that some of the methods of extraction were quite dangerous and a high risk of infection was involved.

With the introduction of anaesthesia people flocked to the dentist, in incredible numbers, to have their teeth extracted, hearing that a whiff of gas would make the operation painless. It was then it became popular to perform extractions in a chair - previously it had been customary to place the patients head between the operators knees (Fig. 4).

Figure 4: Extraction in the eighteenth century.



After the wholescale extraction the beginning of the twentieth century saw a period of saving teeth at all costs, but it was quickly superceded by the 'focal infection' theory of the 1920's. This meant that no matter what a persons ailment, tooth infection was blamed for it. Once more, teeth were extracted on mass. Sanity was eventually brought to the situation in the middle of this century when improved

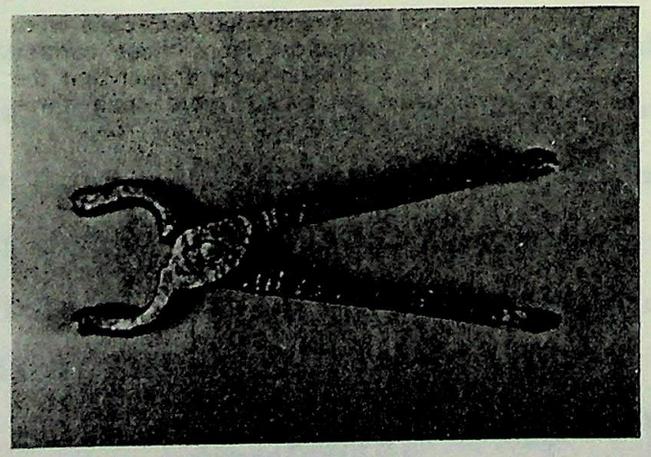
diseased pulp treatment aided by x-rays, improved equipment, and public dental education halted the wholesale loss of teeth and brought about the conservation of teeth that we experience today.

Extracting instruments fall into five main catagories; forceps, elevators, pelicans, keys and screws. The forceps and the elevator are still used in dental practice, the rest fell into disuse at the end of the nineteenth century.

Forceps

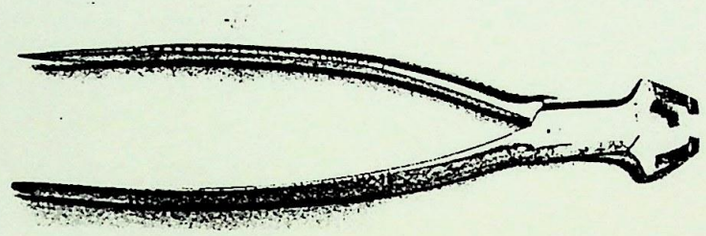
The forceps is probably the oldest dental instrument, after fingers. Figure 5 shows a replica of a pair of forceps used by the Romans. The main characteristic of these forceps, common to all forceps up until the early nineteenth century was that they gripped the top of the tooth rather than the neck of the tooth, this meant that they often caused the tooth to crack, or slipped off the tooth during the extraction.

Figure 5: A replica of forceps used in the Hellenistic era.



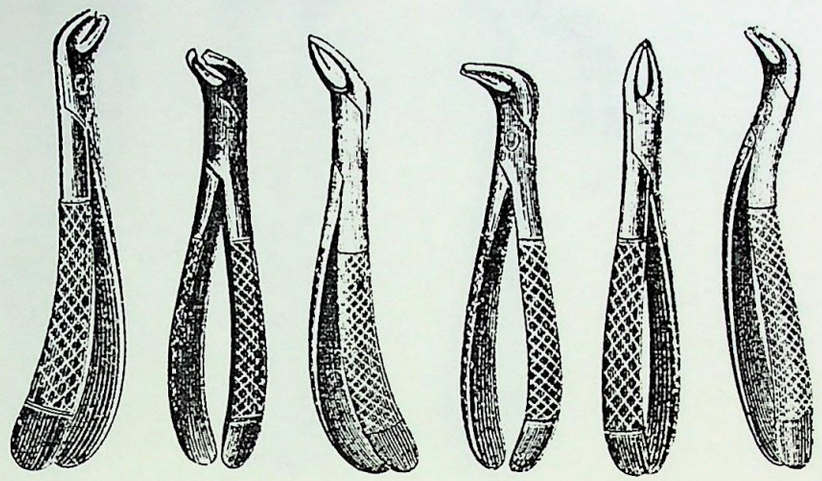
By the twelfth century several types of forceps had evolved because of the variety in shape of teeth. Each was designated by its resemblance to the beak of a bird or the jaw of a dog (i.e. the parrots bill, the crows bill and the storks bill). However the first big breakthrough did not come until 1826 when Gynes Fay designed forceps (Fig. 6) that could be accurately applied to the necks of several classes of teeth without any danger of breaking the tooth.

Figure 6: Forceps designed by Gynes Fay.



Whole sets of up to 30 forceps were designed and manufactured by the middle of the century, each differently shaped to suit each type of tooth. Only in the last decade have two 'universal' forceps been introduced. These are the forceps of the future, but if one were to take a look into the drawers of a modern dentist large numbers of forceps with ergonomically curved handles with crosshatching or a herringbone pattern (Fig. 7), quite similar to those produced in 1840 would be discovered.

Figure 7: Forceps from the nineteenth century , similar to those used today.

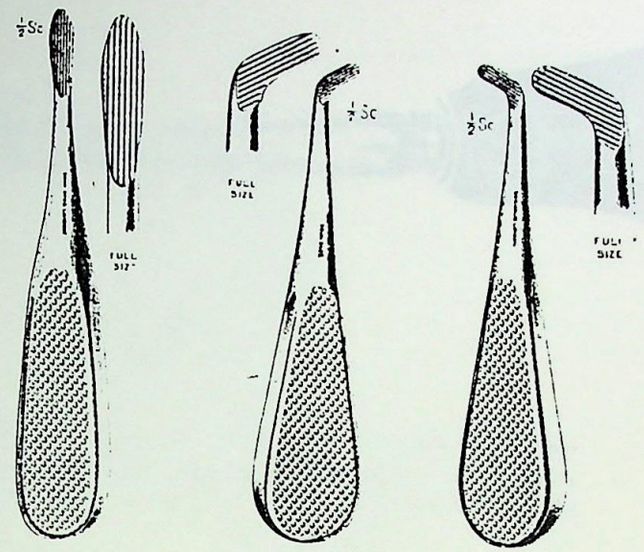


Elevators

The other extracting instrument used today is the elevator. This also originated in ancient times. They are used to prise parts of teeth from their sockets though in the past they were used also for entire extractions or as a punch to loosen teeth (a pound of lead was struck against the handle). The latter sometimes resulting in cerebral concussion.

Figure 8 illustrates the type of elevators currently available. Each of them have pear shaped handles. One of them has a straight shaft and straight elevating section, the other two are mirror images of each other, each having the elevating section at right angles to the shaft. They are all metal so that they can be sterilized.

Figure 8: Modern elevators.



Though the principle has remained the same they did change in design. In the past popular types heads were the clefted head (Fig. 9), the branched head (Fig. 10) and the arrow head (Fig. 11). Handle shapes also varied greatly from flat to round shaped and square to T shaped. The biggest difference however between the elevators of the past and those today is the delicacy and care that with which the dentist now uses these instruments.

Figure 9: Clefted head elevator C1820.

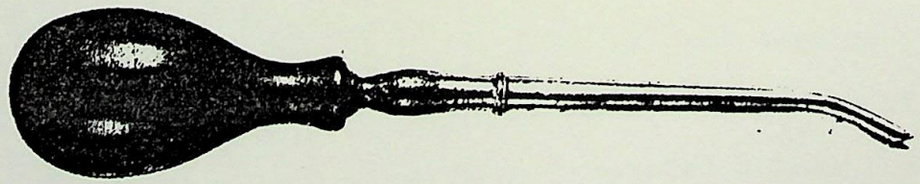


Figure 10: Branched head elevator C 1725.

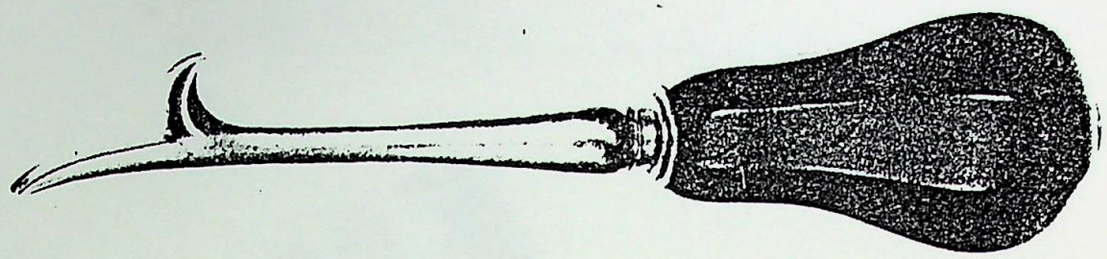
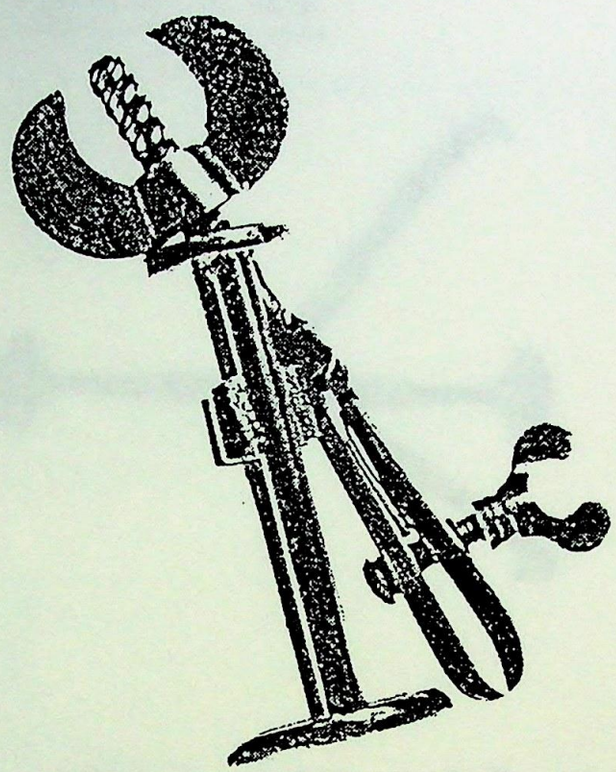


Figure 11: The arrow head elevator C 1829.

Other instruments

The other instruments used for extraction were pelicans, toothkeys and screws and some rather obscure instruments such as that in Figure 12 designed by those with an inventive turn of mind.

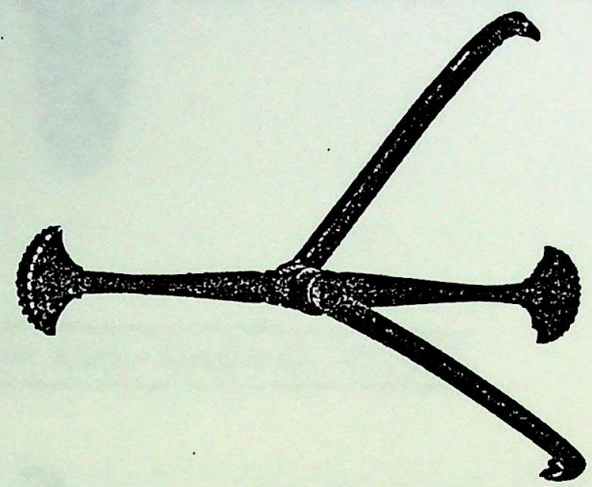
Figure 12: Instrument for perpendicular extraction C1790. The action is very similar to that of a double action corkscrew.



The pelican (Fig. 13) was based on a coopers tool used to force the last hoop on the cask. Essentially it consisted of a shaft with one or both ends forming a serrated bolster. At some point two metal shafts, with claws at either end were riveted on, the direction of the claws opposing one another to allow access to both sides of the mouth. In use the claw

was placed around the tooth and the bolster against the tooth on the other side, acting as a fulcrum when force was applied either in an upwards or downwards direction.

Figure 13: The pelican C 1570.



The toothkey consisted of a handle, a shaft and a fulcrum (bolster). The fundamental difference between the toothkey (Fig. 14) and the pelican was that in the key the claw was directly fixed onto a shaft or bolster. In use the bolster was pressed against the base of the tooth and the claw engaged over the crown, the key was then turned, as in a lock, the action dislocating the tooth. Original examples looked exactly like a doorkey (Fig. 15).

Figure 14: A toothkey C 1790.

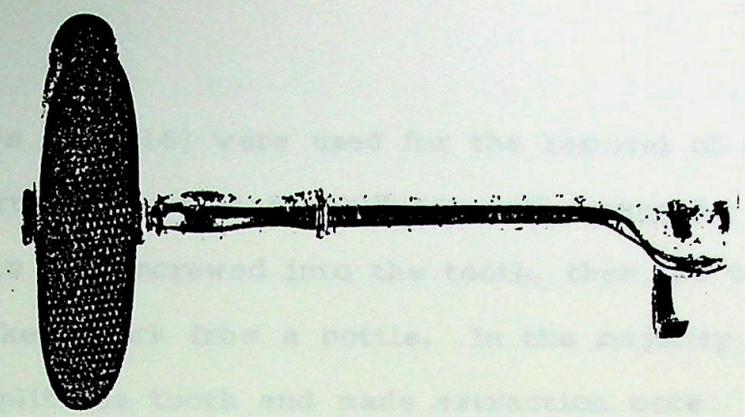
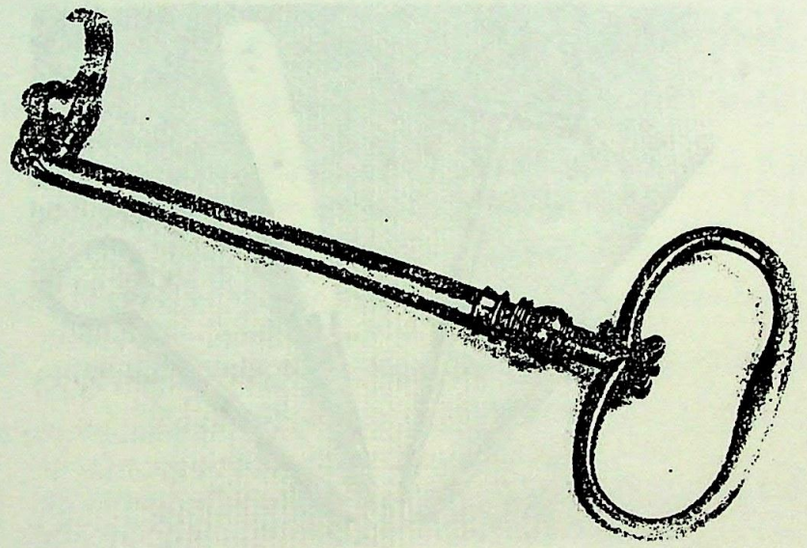


Figure 15: An Early toothkey C 1750.

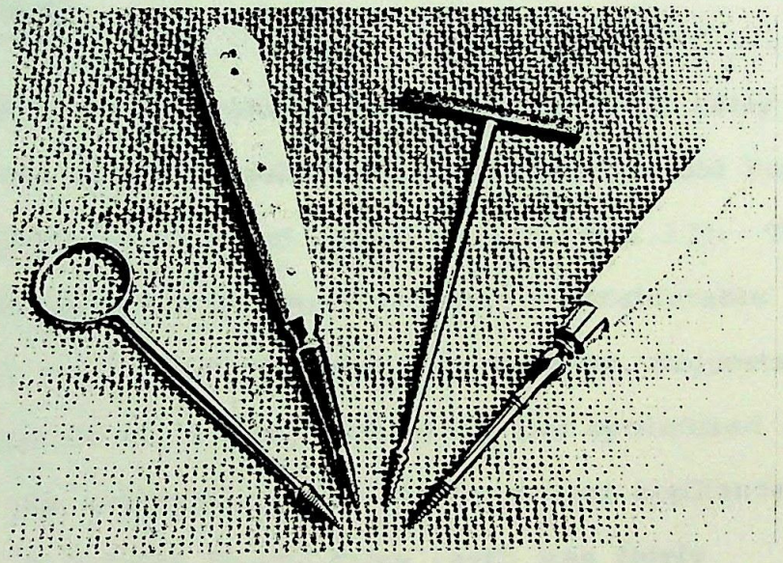


Both the pelican and the key had the major disadvantages of drawing the tooth in an oblique direction and occasioning severe bruising of the gum, these were probably the main reasons for their decline. However they were very rapid

methods of extraction - a main consideration before anaesthesia was introduced.

Dental screws (Fig. 16) were used for the removal of stumps where no part remained that could be easily grasped. As the name suggests they screwed into the tooth, then the tooth was pulled out like a cork from a bottle. In the majority of cases they split the tooth and made extraction more difficult. For this reason they fell into disuse.

Figure 16: Dental screws C 1867.



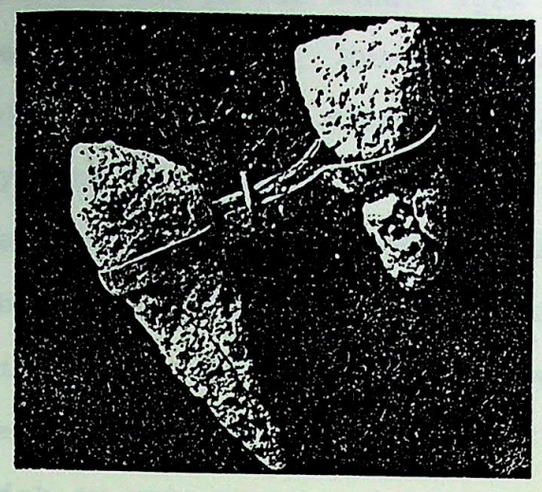
False teeth

Up till the end of the nineteenth century the large quantity of grit and dust in food and poor dental care resulted in the inevitable loss of teeth at an early age. This presented immediate difficulties with mastication, articulation and disfigurement, it also, in the long term, caused bad health (indigestion and deafness for example). Despite these obvious difficulties it was vanity and superstition that resulted in the first steps to false teeth.

Early false teeth

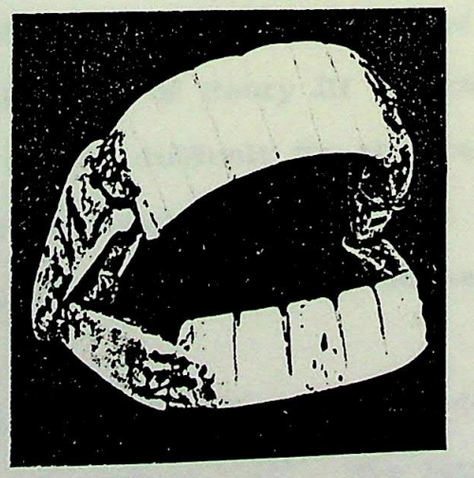
People of the ancient world acheived dentures as early as 700 BC. Gold bands or gold wire were used to hold human or carved ox teeth to adjacent natural teeth (Fig. 17). The undisguisable use of gold which covered a considerable part of the tooth well above the level of the gums, suggests that dental appliances were worn with pride and symbolised wealth. In spite of the aesthetic nature of the dental appliances, the method of holding in the false teeth was fairly sophisticated, they were capable of mastication and some were even removable. Nothing as proficient was made again till the nineteenth century.

Figure 17: Etruscan bridgework C 700 BC.



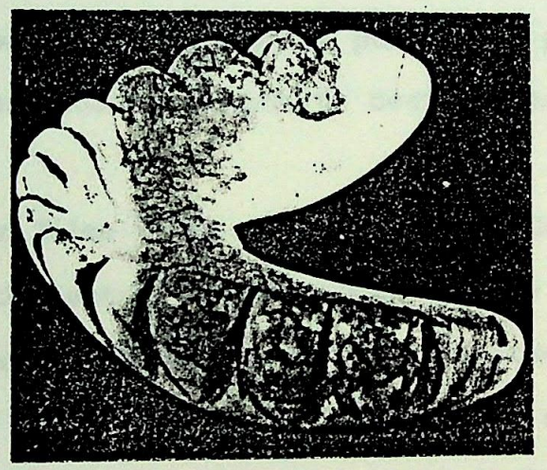
If Romans ever made a full set of dentures they probably resembled those in Figure 18. This half hearted mouth decoration was occasionally worn by continental women around 1500. They resembled the real thing no more than periwigs real hair, and like periwigs were often removed. They would be pulled out at the beginning of a meal and were slipped in again with great dexterity whenever there was a pause in eating. Absolutely no embarassment was attached to having false teeth.

Figure 18: 16th century false teeth.



A number of methods existed for providing people with false teeth between the end of the middle ages - late 14th century and the seventeenth century. Human teeth or teeth made of bone were wired together and tied into ones mouth. Alternatively sets of artificial teeth (Fig. 19) were carved from a piece of bone or ivory, sometimes human incisors were inset into the piece rather than carving teeth. The method of transplanting teeth also existed. However false teeth in general were not taken seriously and were only worn by the occasional rich or vain person.

Figure 9: Dentures carved from one piece of ivory C 1650.



Curious accounts survive of the morning ritual of tying on the bone false teeth of Henry III of France in the late 16th century. As it was difficult for the wearer to tie in the teeth himself, dentures were often left in situ for considerable periods of time and became prone to tartar.

Transplantation was mentioned by Guy de Chauliac (1300 - 68) and Ambrose Pare (1510 - 90). The latter recounting the

removal of the tooth of a princess and immediately replacing it with one from her lady in waiting. The indignant poor were always available to sell a suitable tooth or perhaps someone unable to refuse extraction was used. Charles Allen (1687) suggested animal teeth as surrogates - finding the use of human teeth distasteful.

Queen Elizabeth - like the majority of people at the time did not wear artificial teeth. She did, however make occasional use, for appearance sake, of a device that can have been effective only when she did not open her mouth. The description in Costume and Fashion in 1602 was as follows:

> "... when she cometh in public she putteth many fine cloths into her mouth to bear out her cheeks ..."

Progress in false teeth was negligable till the end of the seventeenth century. It was then people began to realise that the highest rewards could come from supplying the rich with false teeth, it was this realisation along with resulting competition that inspired the dental operators, the barber surgeons, the goldsmiths and the ivory turners to advance the design of false teeth.

Eighteenth century false teeth

The second decade of the eighteenth century saw the reintroduction of transplanting on a large scale the writings of the dentist John Hunter is partly responsible for this. He advised operators to have several people in attendance in

case the tooth did not suit.

Pierre Fauchard - father of dentistry also described transplantation: The process was expensive and was not always successful. Normally successfully transplanted teeth would last only five years. Conscientious dentists would boil the tooth prior to transplantation (disinfectant was not invented), others did not which meant the receiver was placed in immediate danger if the tooth came from an infected mouth.

Replanting teeth became more popular as the success rates of transplanted teeth were observed and noted. Bad teeth were extracted, boiled and repaired before being placed back in the mouth again. Replanting of teeth still exists but only in the form of replanting teeth dislodged by accident.

As for the transplanting method it quickly died out as the nineteenth century wore on and false teeth improved. Although the craze was over, some rich people, especially women, continued to insist on the operation. As late as 1919 this operation was recorded to have been performed.

There were a number of developments in the design of sets of teeth in the eighteenth century. Lorenz Heister (1683 - 1758) designed partial sets in ivory which were kept in position in the gap between standing teeth simply by their form. Later the dentures were weighted to help gravity to keep them in position. Where expense was no object teeth of silver, mother of pearl or enamelled copper could be obtained. Top dentures were never attempted and bottom

dentures were almost useless for eating. They were mere ornaments and comment causing luxuries of the idle rich.

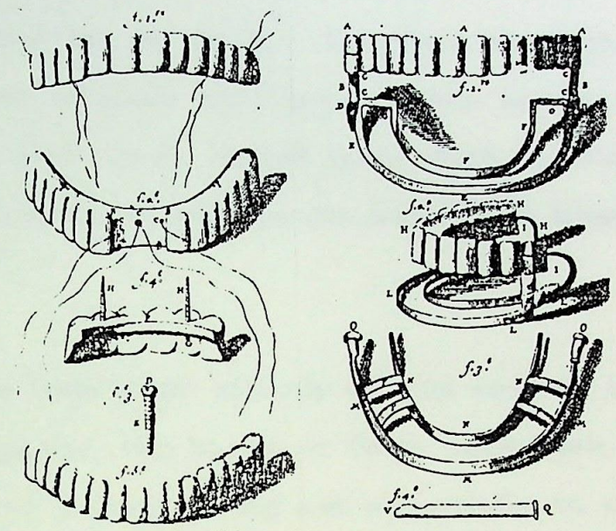
Pierre Fauchard in his remarkable book 'Le Chirurgien Dentiste' discribed how he made full lower dentures. He turned them on a lathe from one piece of oxan bone. He then bleached them by boiling them in quicklime, and exposing them to dew. These were better than ivory dentures in that they did not discolour as easily. Having pierced the canals in the remaining roots of the jaw to take posts, he placed quills filled with ink in the holes. The denture was lowered on to them thus marking the position of the hole to be made in the denture. The posts often of wood, swelled on contact with saliva and kept the denture in position.

Fauchard also worked on artificial teeth for the upper jaw, a problem not previously tackled. He produced two solutions. The first involved piercing the gums and suspending the teeth from the jaw, or attaching the upper set to a framework which fitted over the lower gums.

His best known invention however was the attachment of the upper set to the lower by steel springs (Fig. 20). These were very strong and needed considerable force to close the mouth. He did try springs of whale bone as an alternative but they were not found to be much good. Strips of gold or silver were placed around the base of the teeth, natural or not, inside and outside and attached to the springs. This type of denture was still used into this century. However, inevitably all false teeth of Fauchards day slipped sideways,

as there was no covering of the palate. He admitted that a full set was "only for ornament and pronounciation" but was more confident of his lower sets.

Figure 20: Fauchards illustration of his denture design.



Lacking reliable wax for the job, operators could not take a full impression. They got to work often observing the mouth and measuring it with compasses. Fitting was done by painting the gums with colour, then repeatedly letting down the set of teeth in trial and scraping the parts of the ivory base that picked up the colour. Later that century P. Pfaff devised an efficient method of taking impressions using sealing wax and plaster of paris, similar to that used today.

Interesting observations at the time were the fact that the odd set of upper dentures did stay in place without the use

of springs. This phenomena could not be rationalized in any other way then except that a few people had learnt the trick of balancing their false teeth with their tongues.

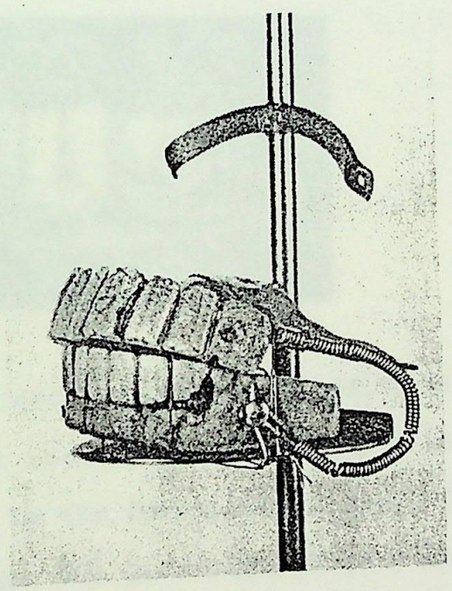
The most commonly used material for false teeth was ivory and bone which unfortunately decayed and fermented with time. The excessive use of the fan throughout the eighteenth century was certainly encouraged by the need to deflect bad breath. Calves teeth, carved ivory teeth and human teeth from graveyards and poor people were often inset into the ivory base.

Some bases were made entirely of gold covered in flesh coloured enamel, the human or ivory teeth were riveted to the plate. Gold, though strong and not subject to errosion was not easily worked. It also must have been heavy, some dentures weighing up to 3lbs.

In America dentures were not as popular as in Europe. George Washington in letters and records highlights this fact. He had the sort of teeth that decay fast and by the age of 28 his teeth were in incredibly poor condition. Throughout his lifetime he constantly searched for satisfactory dentures. Chewing must have become impossible contributing to the indigestion and short temper he later suffered. The effect of uncouth false teeth on Washington's appearance is still to be seen all over the world on American paper money and stamps (Fig. 21).

Figure 21a The portrait of Washington on the American dollar bill showing disfigurement due to his dentures.

Figure 21b Teeth worn by George Washington.

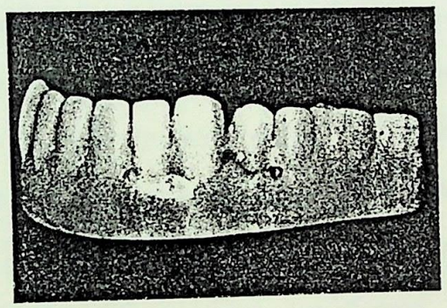


Meanwhile back in France an important discovery was being made. Alexis Duchateau, a French apothecary, had grown especially disagreeable to his hippopotamus ivory teeth which tainted all he ate and had become extremely discoloured. He eventually conceived the idea of reproducing his denture in

porcelain. Numerous trials of different processes and compositions of the porcelain resulted in near misses. After seeking the help of a dentist, Du Chemant, a satisfactory denture was produced. Porcelain dentures were not liked at first and were reported to sound in use 'like cracked bells'.

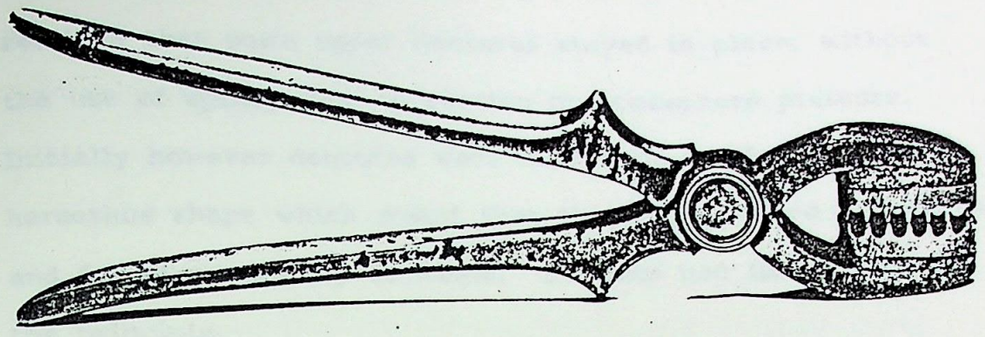
Du Chemant emigrated to England where he manufactured 12,000 dentures. He wrote literature on the advantages of procelain teeth as opposed to existing false teeth. For extra strength the teeth were not separated but merely shaded, they and their pink procelain gums looked shiny and fresh (Fig. 22).

Figure 22: Early porcelain dentures.



Due to the inefficient performance of dentures in masticating food an instrument known as a masticator seen in Figure 23, was used to chew up the food prior to swallowing. It took the form of forceps, the jaws being shaped like two or three pairs of molars. These were recommended to be dipped from time to time in hot water. They were used up till the end of the nineteenth century.

Figure 23: Masticator C 1800.



Nineteenth and twentieth century false teeth

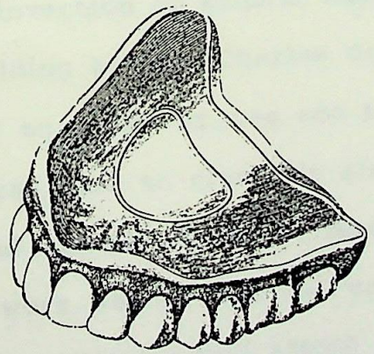
As dentures became more natural in appearance they brought false teeth into the category of the modern male toupee. However blatently artificial, and loose, they had to be passed off as the work of nature. However inconvenient for eating they stayed in at meals. The consequence was the tight lipped Victorian smile and the habit of eating before meals. As for laughter, it was no more than the sound it made. A dry ironic manner developed and often flavoured discussions and writings. The wearing of artificial teeth brought embarassment which would still seem to exist today despite modern perfections.

The charletans of the nineteenth century took advantage of the embarrassment, operating in dark alleys and obscure squares and plunging the reputation of the profession into hitherto unknown depths with their shoddy work and ridiculous prices.

A number of interesting developments in denture design occured in the nineteenth century. In 1800 James Gardette realized that some upper dentures stayed in place, without the use of springs due to suction or atmosphere pressure. Initially however dentures were still made in the traditional horseshoe shape which meant that they only worked sometimes and failed completely at meals. Dentists had little faith in the principle.

Later in the 1860's this type of denture developed from its horseshoe form to the form in Figure 24. It now featured a roof plate with either air chambers or rubber suction rings. Though reasonably effective, they often injured the mouth sometimes seriously, by creating intense suction at one point. Also often patients neglected or could not afford to go back for adjustments following the normal shrinking of the mouth tissues, thus began, around 1890, the long era of the dancing top set. This design was abandoned entirely in the mid 20th century.

Figure 24: Upper set with suction chamber C 1880.



The spring appliances introduced by Fauchard were extremely popular up till the end of the 19th century when they were supplied with reluctance by dentists who saw them as a reflection on their ability to do close fitting work. The same materials were used for dentures until the middle of the century except that human teeth, known as Waterloo teeth, came from the young men killed in battle in America. These were shipped to England by the barrel, and worn by many unknowingly in their dentures.

Porcelain teeth were not popular in the first half of the century, mainly due to the inability of Du Chemants imitators to make them fit properly. He had many imitators, all anxious to be up to date, but some so unskilled in porcelain work that patients were made grotesque by their appliances.

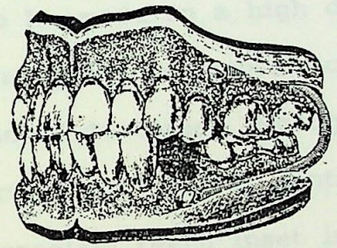
The introduction of anaesthesia in 1844 had a tremendous effect on dentistry in general. People flocked to have their troublesome teeth removed painlessly. This caused unprecedented demand for false teeth.

The era of false teeth for the masses began in the 1850's with the American invention of sulphur hardened rubber (vulcanite) for moulding bases. Charles Goodyear's vulcanite was cheap and easy to work. It was not in fact ideal, being slightly porous it was hard to clean, it also held the taste of certain foods and sometimes caused soreness. Also the colour of the gum work was so flat and unnatural that it became usual, if the patient could afford it, to attach porcelain gum to the front of the bases.

One good result of the vulcanite was that dentists were encouraged to try out new cheap materials (gold still remained the best and most expensive). Celluloid was hailed with enthusiasm even though it was brittle, tended to warp and discoloured from pink to green. Celluloid is also inflammable, hardly a major disadvantage but a disaster for those unfortunates who dozed off with a cigar in their mouth.

Vulcanite continued in use far into the twentieth century, long after celluloid and various metals had been found wanting.

Figure 25: Late nineteenth century full set - vulcanite.

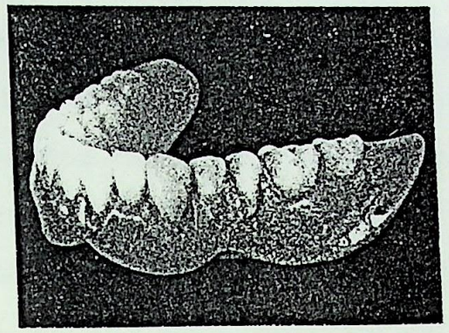


Methods for making false teeth improved throughout the nineteenth century. Machines for their special construction were developed to the point where they measured, shaped and moulded dentures. Artificial teeth had become big business.

The mid twentieth century acrylic resins superceded vulcanite. These plastic teeth were made to look extremely pleasant, at last realising the eighteenth century boast 'not

to be distinguished form the natural'. They had, however, the single disadvantage of being too soft.

Figure 26: Lower denture with acrylic resin teeth.



The manufacturing methods used today are basically the same as those used forty years ago. It involves investment casting which allows the denture to be made to a high degree of accuracy allowing suction or 'atmospheric pressure' to be used satisfactorily for the retention of dentures. Mostly acrylic resins with improved properties are used in dentures. Some people still prefer to have porcelain teeth inset into the resin, which are also available. The real future however will see dentures as history.

Crowns and bridges

Efficient procelain crowns and bridges only date from the last quarter of the nineteenth century after the grinding machine and a satisfactory cement had been developed. Fauchard had introudced impermanent crowns that were attached to pegs of hickory wood, these were pushed into the root canal and held there till the moisture of the mouth caused

them to swell and become tight. The developments of the latter nineteenth century meant that crowns and bridges could be securely pinned into roots and jacket crowns became a worthwhile restoration.

What rarely took place however was the aseptic filling of these roots - this was detrimental to the process. Doctors were soon discovering that crowns and bridges were causing ailments that disappeared on the removal of such appliances. The method of securing false teeth was deemed dirty and the ingeniously made bridges were described as 'mausoleums of gold over a mass of sepsis'.

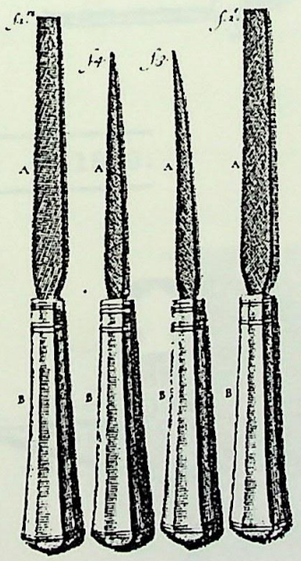
As a consequence people started to blame teeth for almost any illness. The early twentieth century saw faces of the young and old disfigured in attempts to cure a variety of illnesses. Sanity was brought to the situation in the middle of the century with the introduction of the x-ray, dentists could now see which roots were diseased or healthy. Crowning and bridging once more became accepted methods. Moreover indescriminate extraction of teeth became a thing of the past.

Excavating instruments

Hand powered drills

It is difficult to imagine denistry without the use of high speed drills yet up until the eighteenth century were dentists still using the same type of finger drills used by the Greeks in 3AD. The rotation of this drill depended on the nimbleness of the dentists fingers, the task was tedious and the pain endured by the patient immense - especially considering that anaesthesia was not used. Slightly faster methods of excavation involved using small files, chisels and knives (Fig. 27). It is no wonder extraction was a much preferred method of curing toothache.

Figure 27: Illustration from Fauchards 'Le Chirurgien Dentiste' showing four dental files.



The first person to describe excavation in detail was Pierre Fauchard (1678 - 1761). He outlined a process which involved the use of a half round file, an awl and a sewing needle - carefully threaded so as not to escape the grip of the dentist and be swallowed by the patient. Apart from this gruesome proces he recommended the use of a bow drill (Fig. 28) if the positioning of the tooth so allowed.

Figure 28a: The bow drill recommended by Fauchard for excavation.

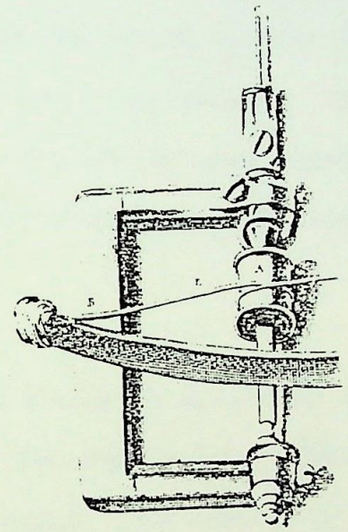
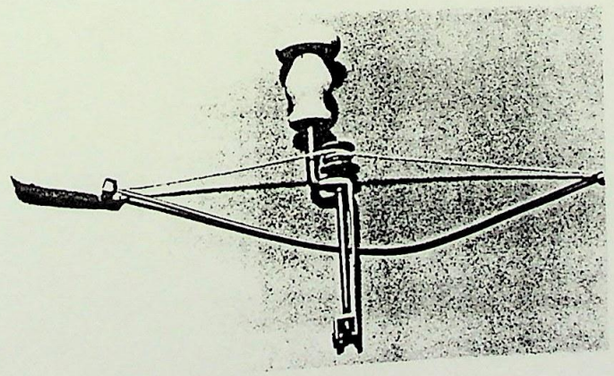


Figure 28b: Bow drill C 1800.

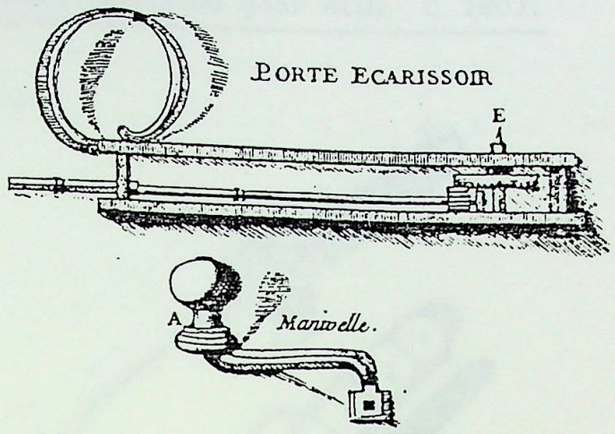


Fundamentally the bow drill consists of a drill with a string twisted around it, rotated by the means of a bow. The drill Fauchard descirbed was mounted on a trestle to be held in the left hand driven by the bow in the right hand, the 'bur' consisted of a sewing needle which was frequently dipped in water to be kept cool.

This drill was still used eighty years on, a few developments being made i.e. using cat gut instead of string, angling the head of the drill for easier access and making the bow smaller, thus enabling prescise craftsmanship to be undertaken by dentists and those making dentures i.e. jewellers, lapedaries and ivory turners. The drill was especially popular in the 1840's when dentists were very prone to adapt, for their own use, the tools of different trades.

Another type of drill Fauchard described was one invented by Jourdain (Fig. 29). This mechanical drillng device was turned with a hand crank. The history of the dental engine began with these drills, even though they caused a lot of controversy - many dentists believing the use of faster drills caused more pain to the patient.

Figure 29: Drill invented by Jourdain and described by Fauchard.



Up to the sixth and seventh decades of the nineteenth century a great variety of drills were invented and developed, mostly by the dental operators themselves. Even though they were all rather superflous, the efforts of the dentists showed a great need for such instruments.

Among the more noted designs were the crank operated gear drill (Fig. 30) of 1803 which could be seen as a modification of Jourdain's drill by a system of gears to increase the speed. This drill also featured adjustable drill heads, allowing greater accessability. Another popular design was the 'egg beater' drill (Fig. 31) so termed because of its working mechanism, it was the first dental drill to be patented in 1838. This drill also necessitated the use of two hands and featured again the adjustable head. Later a similar drill was patented as an "egg beater come drill" - the different end attachments allowing the dentist's wife to

beat her eggs at home and the dentist himself to drill peoples teeth at work (Fig. 32).

Figure 30: Crank operated gear drill C 1803.

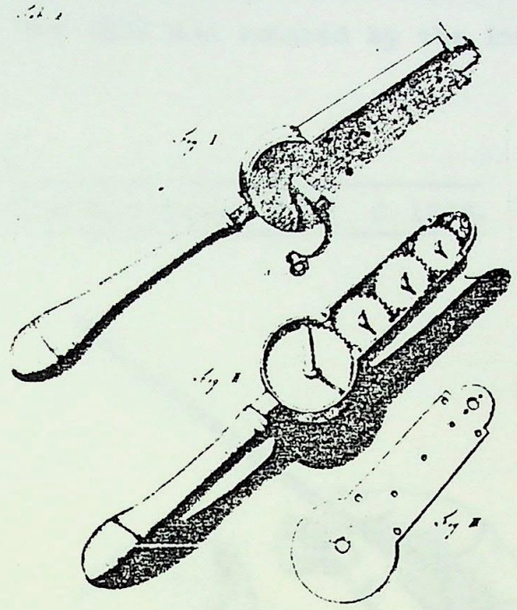


Figure 31: The egg beater drill C 1838.

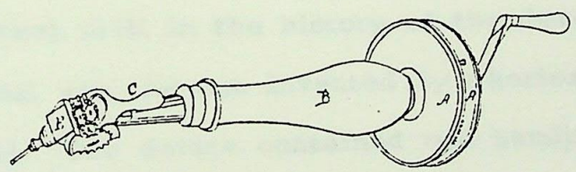
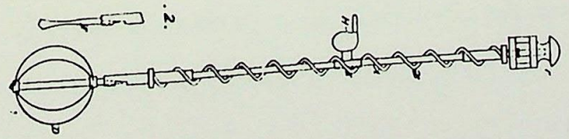
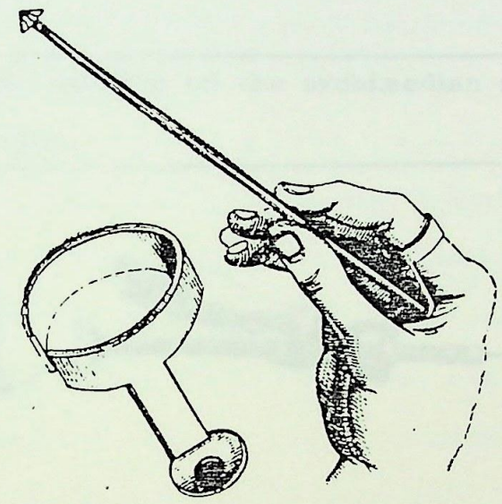


Figure 32: The egg beater come drill C 1850.



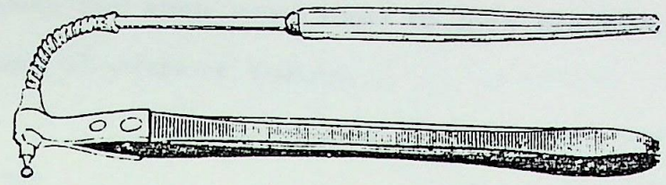
Wescotts finger driven drills (Fig. 33) of 1846 gave the dentist the new facility of operating the drill with one hand only. It consisted of a finger ring, a socket ring and a long-handled drill. The free end of the drill fitted into a shallow sockett (thimble) which was attached to the steel finger ring. The drill was rotated by the index finger and the thumb.

Figure 33: Wescotts finger drill C 1846.



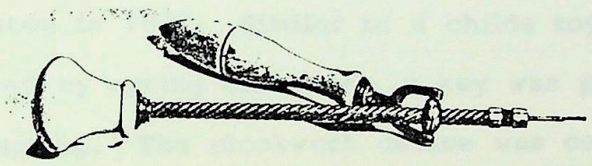
A very important drill in the history of the development of the dental drill was the one invented by Charles Merry in 1858 (Fig. 34). The device contained two handpieces: one retained the rotating drill in position, the other propelled it. The handpieces were connected by a flexible coupling later used in Morrisons foot engine.

Figure 34: Charles Merry's Drill C 1858.



In the 1860's a drill working on yet another principle - the archimedian spiral principle - was commonly used (Fig. 35). Some of them only required the use of one hand for operation. These drills superceded the bow drills.

Figure 35: Drill working on the archimedian spiral principle C 1840.



All these drills exhibited exquisite craftsmanship. They were normally made by instrument makers under the direction of the dentists. This meant that the drills were extremely personal products, the great care undertaken to make and design them is not hard to understand. Handles were normally bulbous in shape, improving grasp and manual comfort. They were made in various woods, horn silver, tortoise shell, ivory and mother of pearl. Due to the extremely functional nature of the drills, excessive decoration, as was wont particularly in the mid nineteenth century, was not often employed.

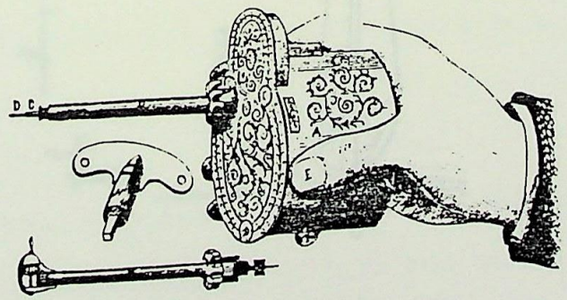
The skill of the instrument makers can be appeciated in the overall appearance of the drills, their basic principles were extremely clumsy but they were made to look graceful and delicate objects of extreme beauty.

Mechanical drills

Mechanical drills, energized with clock springs, reducing gears and pulleys were the next stage in the development of the dental drill. The designs persued the concepts of high speed and the reduction of the effort required of the dentist.

The first motor driven dental engine was patented in England by G. Harrington in 1864. Similar to a childs toy of today it was operated by spring clockwork, a key was provided to wind up the spring. The clockwork device was contained in a superbly designed and engraved silver container with straight and right angled holders for drills (Fig. 36). The whole apparatus was supplied in a velvet lined, walnut veneered case for 6 guineas.

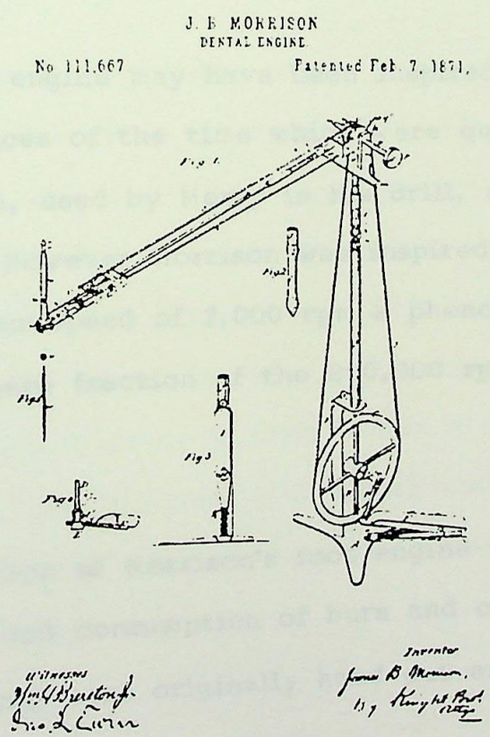
Figure 36: G. Harringtons clockwork drill.



The drill ran for two minutes and the device could be easily held in one hand as shown in the drawing, its only problem was the noise factor which was reduced in the revised design. In spite of the ingenuity of the product its visual appearance was not one of delicacy and precision featured up till then in hand drills. The whole nature of the drill was being based on its mechanism.

Morrison is credited for the introduction of the first foot treadle dental engine (Fig. 37) in 1871. This concept had been used previously by George Washingtons dentist J. Greenwood in 1790 when he modified his grandmothers spinning wheel. However the design was not widely publicised and only used within the family.

Figure 37a: Morrison's patent specification for the dental foot engine.



J. B. MORRISON.
DENTAL ENGINE.

No. 111,667. Patented Feb. 7, 1871.

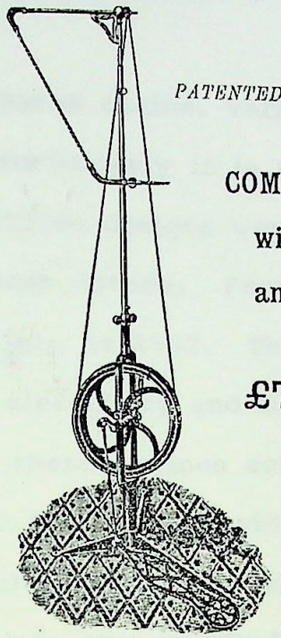
Witnesses
Wm. G. Breckenridge
Geo. L. Curtis

Inventor
James B. Morrison.
by Knight Bros
Attys

Figure 37b: Similar engine advertised in 1896.

SHAW'S

DENTAL ENGINE.



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LONDON, W.

The Morrison engine may have been inspired by the sheep shearing devices of the time which were quite similar. The flexible cable, used by Merry in his drill, also featured in the design. However Morrison was inspired, his design produced a bur speed of 2,000 rpm a phenominal speed at that time but a mere fraction of the 800,000 rpm we experience today.

The introduction of Morrison's foot engine stimulated the manufacture and consumption of burs and other rotary cutting devices. These were originally hand cut and therefore

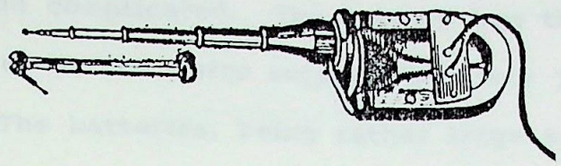
costly. Mass production saw the use of carbon steel as the bur material, but they did not perform well at high speed. Cutting tools went through immediate improvements in design and high speed drills became a truly realistic concept.

Following Morrisons engine, variants were introduced in profusion. Unfortunately it is not possible to cover these in detail. Modified designs were introduced almost every year for the next decade. Foot engines were seen in dental catalogues as late as 1952. They proved extremely useful in areas without electricity and indispensable in both world wars. Few of these engines achieved the success which was hoped for them but they provided a spring board for invention which has resulted in the relative calm with which we can today contemplate this particularly unpopular piece of dental equipment.

Electrical drills

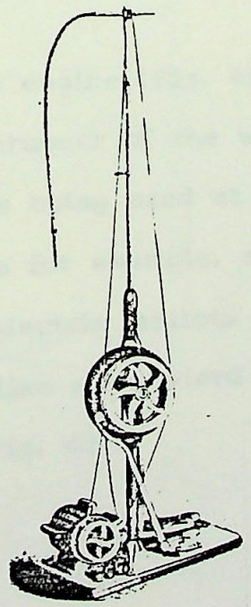
Early trials with electricity began in the mid nineteenth century with G. Greens invention (Fig. 38). The whole machine was held in the hand and connected to a battery with a wire. The product however was unsuccessful; it was too large, clumsy, heavy, costly, had little torque and the batteries at the time were poor. The most interesting thing about this drill however is that it was a concept which only recently has been realised in a satisfactory manner with the modern micromotor which now presents itself as the dental drill of the future.

Figure 38: Green's electric drill.



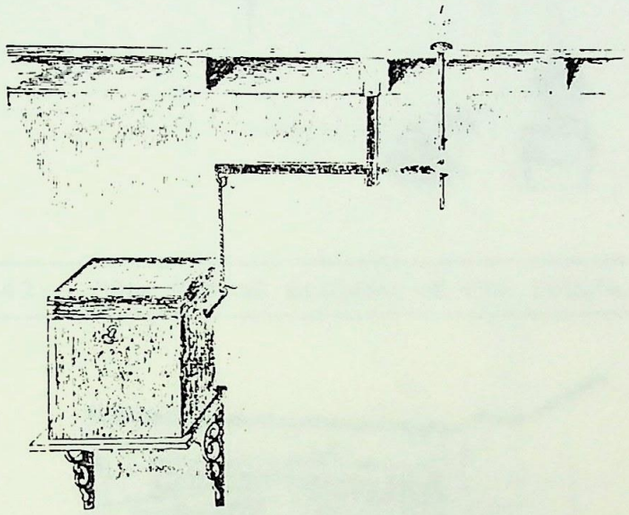
So Green's engines were put on the shelf and it was not until the 1880's that real progress in the design of electric engines began and it was Morrisons foot engine with its cable and cord transmission which permitted the construction of a practical electrically driven dental engine. The electric motor was separated from the handpiece and the engine's rotary power transmitted to the handpiece by cable or cord. A further improvement was the enclosure of the motor which eliminated frightening sparks and diminished noise. In the first decades of this century both the foot and electric engines went through many improvements and became excellent precicison machines.

Figure 39. Dental engine powered by electricity.



The 1880's saw the dental engine suspended, as part of a floor unit or attached to the dental chair. The overall form was spindly and complicated. The battery was the normal source of power as the mains supplies had only just become established. The batteries, being rather large were kept out of sight usually in an adjoining room or in the room below (Fig. 40).

Figure 40: Battery stored in the room below.



The counterpoise dental engine (Fig. 41) was introuced in 1890's and was the forerunner of the wall-bracket dental engine. Electricity was being used at this stage to power a number of other objects for example, mouth lamps, hot air syringes, cautery and electric mallets and the dental surgery was beginning to look like some wierd and wonderful scientific laboratory (Fig. 42).

Figure 41: The counterpoise dental engine.

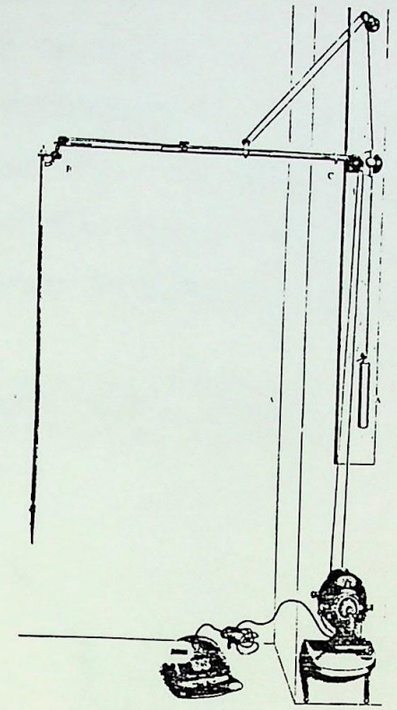
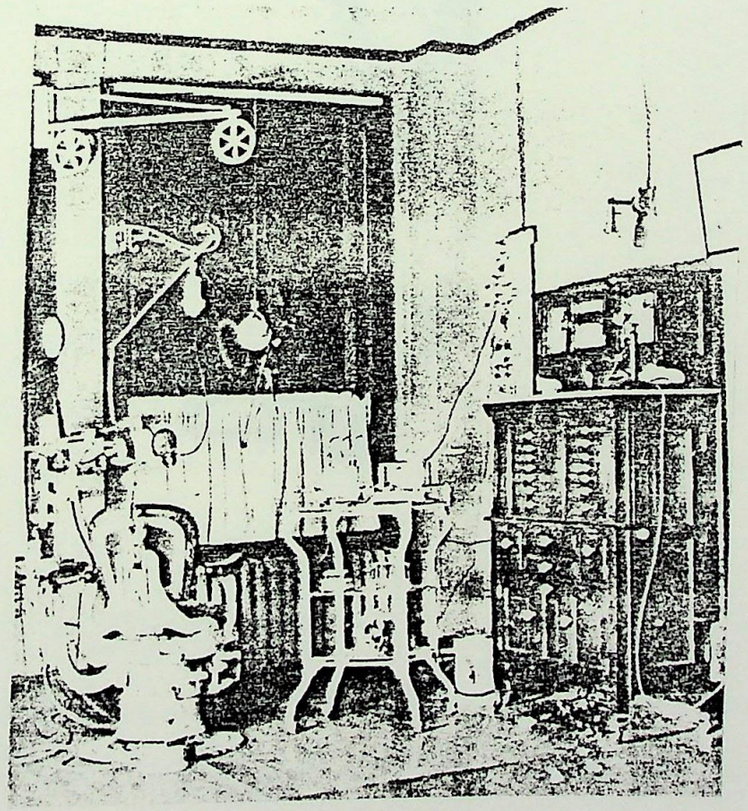


Figure 42: The dental surgery of the 1890's.



In the beginning of the 19th Century most engines were suspended or attached to the wall. They were beginning to look neater and they could also fold up after use (Fig. 43). These were shortly superseded by the dental unit introduced by Riter in 1915 (Fig. 44). The speed obtained by the Morrisons (2,000 rpm) foot engine had been increased to 5,000 rpm in 40 years, rather unsatisfactory progress.

Figure 43: The dental engine of 1900.

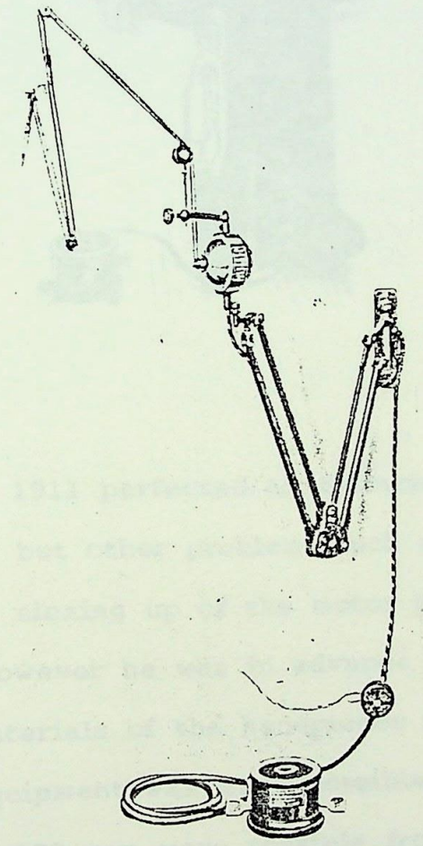
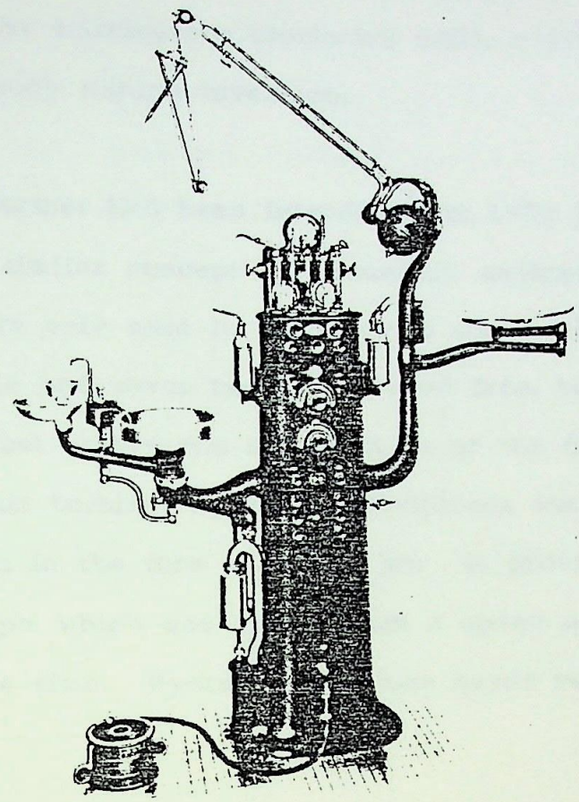


Figure 44: The Ritter Unit.



Emile Huet in 1911 perfected an electric engine yielding up to 10,000 rpm but other problems such as the heating up and sometimes the siezing up of the motor prevented their use at that time. However he was in advance of his time. As the design and materials of the handpieces improved acceleration of existing equipment was made possible and by the 1960's speeds of 100,000 rpm were possible from electric drills.

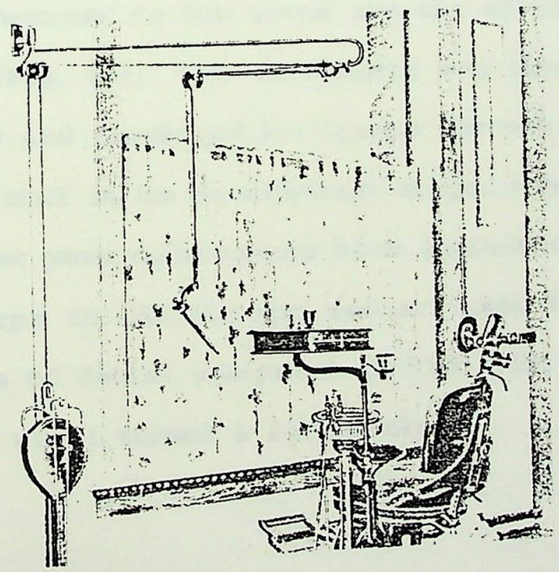
Hydraulic and pneumatic drills

Early trials with pneumatic drils also began with G. Green in 1850. The drill he invented was attached with a rubber tube

to a foot bellows. The pneumatic engine is of interest as a forerunner of the modern air motors and turbines but at the time was, like Harringtons clockwork drill, overtaken by Morrisons epoch making invention.

Hydraulic engines had been introduced in 1900 (Fig. 45) - basically a similar concept to pneumatic engines. These however were only used in the country where electricity was not available and never really advanced from that lowly position. Just before the introduction of the first successful air turbine, hydraulic handpieces were reintroduced in the form of turbo jet. It provided a speed of 60,000 rpm which was not as high a speed as the electrical drills of the time. Hydraulic turbines never really were used again.

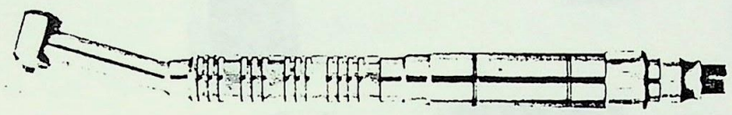
Figure 45: Simms Hydraulic Engine. C 1900.



The pneumatic turbine was introduced in 1957 - a century after Green's invention. One can only suppose that electricity must have held the imagination of the inventors

for a considerable amount of time. This air turbine (Fig. 46) provided a speed of 300,000 rpm, the future of pneumatic drills was established, and electric drills began to fade into the background. The drill has changed little in form since then, technical advances have provided speeds up to 800,000 rpm. Almost every dentist uses air powered drills at present.

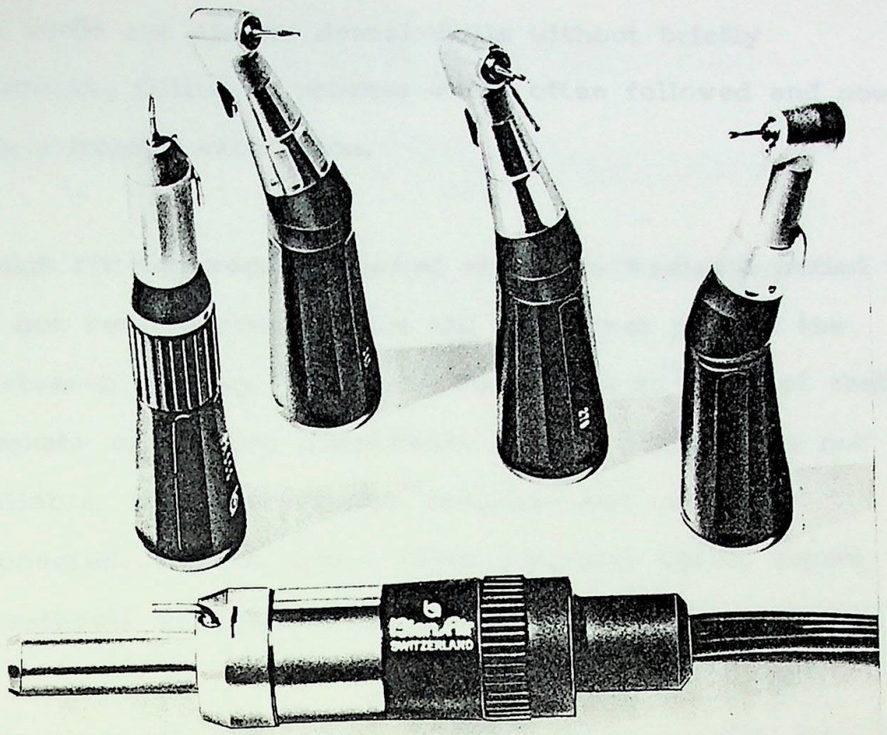
Figure 46: The air driven turbine handpiece.



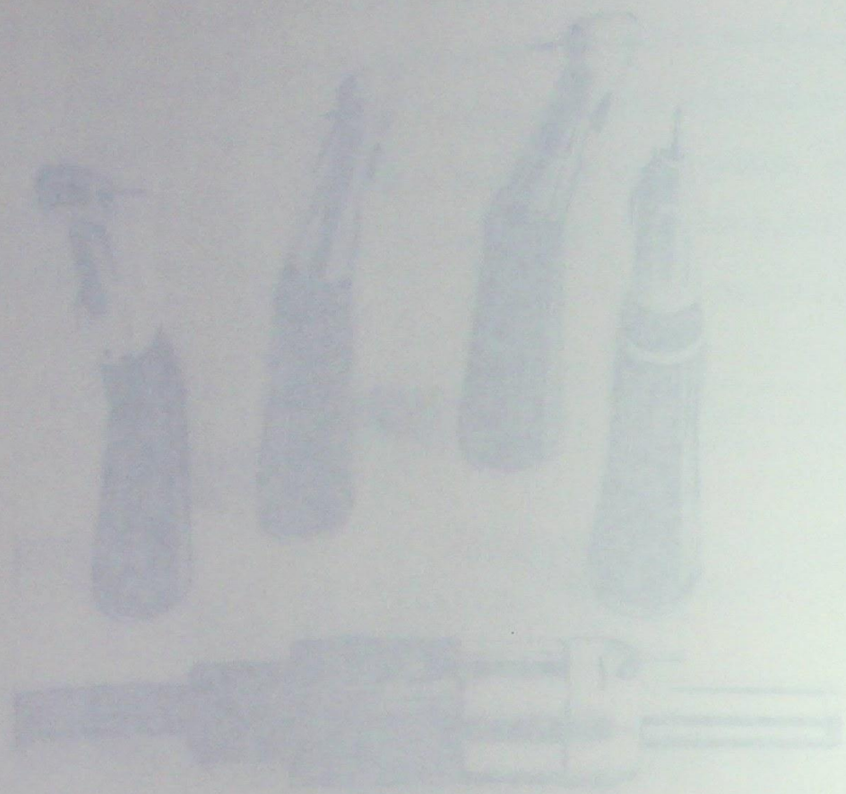
Drills of today and tomorrow

The latest newcomer on the scene are the electrically driven micromotors (Fig. 47). The micromotor was first used in space rockets and developed by Garrier for use in dental drills. It is still in its development stage, however, only within the last year micromotors have increased their speed from 60,000 rpm to 160,000 rpm and are seen by the manufacturers of dental equipment as the drill of the future. Thus has the wheel turned a full circle.

Figure 47: The micromotor.



In just over 250 years from Fauchards bow drill there is a long line of continuous progress. Most of it has been achieved by the inventiveness of practicing dentists, helped by the resources of dental industry. None of the principles used in the past have been discarded. Today finger rotated reamers, hand driven drills, conventional foot and electric dental engines, high speed air turbines, electic micromotors are all used. At the start dentists borrowed from other trades the primative rotary instruments that existed at the time. In the hands of the profession they became the varied precision cutting and grinding tools which are used today.



Filling materials and instruments

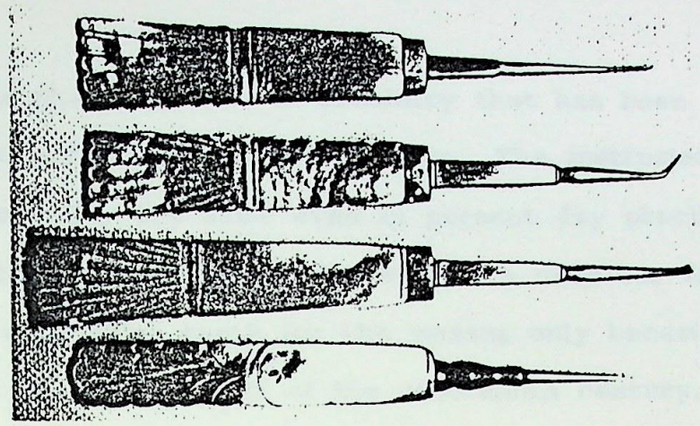
One could not discuss dental drills without briefly mentioning filling, a process which often followed and now always follows excavation.

Though fillings were performed since the medieval period they did not become commonplace till the latter part of the nineteenth century. This was mostly due to the fact that adequate excavating instruments (mainly drills) were not available, and that suitable amalgams had not been discovered. It was also a tedious process which, before anaesthesia was introduced, was quite painful.

Early medieval fillings for dental cavities included wax, gum and resin, ravens dung and stale bread and mastic. Lead or gold were the first metal fillings, lead in the form of pellets and gold in the form of foil both pressed in gradually. This procedure was capable of good repair providing there was no leakage and that there was a minimum decay remaining below. Another satisfactory filling material was white wax mixed with gum, a little mastic, white coralle and prepared pearls. Pitch and bees wax was also popular.

Fauchard was the first to describe filling instruments. He mentioned three, one was cylindrical and pyramidical with a curved sharp point. The second was similar except the end was more curved and blunt. The last had a round end bent at right angles. Filling instruments today are very similar to those used in the past.

Figure 48 A set of Gold Foil pluggers. C 1840.



All kinds of mixtures were being experimented with even the dangerous mix of mercury and silver, which expanded and cracked the tooth, found takers who were soon sorry. Bismuth, lead, tin and mercury were melted and poured into the cavity. The mixture of Gutta-percha, lime, quartz and feldspar came on the market in 1849 and is still used for temporary fillings. Gold at this stage was heated and pushed into shape, a process like this might take three hours.

A balanced amalgam of the kind used today did not appear until 1895.

Conclusion

Extraction is the only form of dentistry that has been performed frequently throughout history. The instruments remaining basically the same even in present day practice. The extraction of teeth naturally created a need for false teeth. However false teeth for the masses only became available in the second half of the nineteenth century. These were crude and only developed into satisfactory designs in the 1950's. The design of drills, which were initially used to manufacture false teeth rather than for excavation, concerned dentists a great deal. Only when these achieved acceptable speeds and design were they used, prior to filling, in the latter part of the nineteenth century.

The seeds of the profession that were sown in the nineteenth century found a soil so barren and unpromising it was a miracle they took root. The initial development of dentistry was slow, the high standard of dentistry that we experience today only coming about in the second half of this century.

The most important point, which has resulted from the history of dentistry is the respect for teeth which both dentist and patient have developed. Herein lies the future of dentistry where excellant dental care and dental hygiene will make dentures antiques and extraction a rare occurence. Technology also holds a fascinating future for us in that any dental opertation that may have to be performed will be completed in seconds with no feeling at all.

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